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SCIENCE, TECHNOLOGY, AND INNOVATION PUBLIC EXPENDITURE ANALYSIS

UKRAINE

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List of Acronyms

EHEA	European Higher Education Area
EIB	European Investment Bank
EBRD	European Bank for Reconstruction and Development
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GERD	Gross Domestic Expenditure on Research and Development
GCI	Global Competitive Index
GVC	Global Value Chains
IFC	International Finance Corporation
MESU	Ministry of Education and Science
MEDT	Ministry of Economic Development and Trade
NASU	National Academy of Science of Ukraine
NIS	National Innovation System
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
PRI	Public Research Institution
R&D	Research and Development
SCD	Systematic Country Diagnostic
SME	Small and Medium Enterprise
SOE	State-Owned Enterprise
STI	Science, Technology, and Innovation
TFP	Total Factor Productivity
UN COMTRADE	United Nations International Trade Statistics Database
VC	Venture Capital
WGI	Worldwide Governance Indicator

Executive Summary

This report is one of several analytical pieces developed by the World Bank's Ukraine Technical Assistance on Innovation Support project, supported by the Swedish Ukraine Financial and Enterprise Sector Recovery and Growth Trust Fund. This report attempts to evaluate the quality mix of public support programs for science, technology, and innovation (STI) and provide recommendations for the improvement of the support programs' effectiveness. The three supporting analytical pieces performed by the Ukraine Innovation Support project team are as follows:

- **Ukraine Innovation and Entrepreneurship Ecosystem Diagnostic**, which attempts to (a) identify the gaps that impede enterprise innovation in Ukraine and (b) develop recommendations for policy reforms and support instruments

- **Fiscal Incentives for Science, Technology, and Innovation Best Practice Review,** which reviews different international good practices in introducing fiscal incentives for supporting STI and provides policy recommendations relevant to the implementation of such incentives in Ukraine

- **Ukraine Intellectual Property and Technology Transfer Regulatory Review,** which attempts to identify regulatory and framework impediments for the commercialization of publicly funded research and recommends reforms and policies that could improve the framework conditions for intellectual property (IP) and technology transfer (TT)

The Ukrainian economy has been facing significant challenges in recent years. The volatile macroeconomic environment has translated into a significant deterioration of living standards and a major need to seek new sources of growth in the economy. The private sector, however, remains locked into a low-productivity/low-diversification regime, partly explained by existing distortions in the economy and by a lack of innovation investments in the economy.

Against this background, the World Bank team was requested to evaluate the quality and composition of public investments in science, technology, and innovation (STI) in the context of an important process of fiscal consolidation that resulted in a reduction in public expenditure on STI. The evaluation aims to determine the coherence in the allocation of innovation expenditure in addressing the main innovation challenges in the country, as well as the main gaps and redundancies. The objective of the review is to increase the efficiency and effectiveness of STI public expenditure and maximize impact.

The methodology used builds upon the Public Expenditure Reviews (PER) for STI (Correa 2014)[1] and compares the demand for innovation policies arising from an innovation ecosystem diagnostic with the actual expenditure on STI. Several challenges arose while implementing the methodology. First, given the lack of budget programming, STI expenditure sourced from the BOOST database only approximates actual expenditure due to the lack of budget codes for all STI-related expenditure. Second, the fact that most expenditure is disbursed as block funding reduced the granularity of the analysis. Finally, an additional limitation of the analysis was the lack of access to existing programs to evaluate the quality of design, implementation, and coordination of policies. Despite these caveats, the analysis uncovered significant gaps related to STI policies and revealed general trends in STI expenditure.

[1] Correa, P. (2014) Public Expenditure Reviews in Science, Technology, and Innovation: A Guidance Note. World Bank Group, Washington, DC.

General Findings

Despite the difficult fiscal position, the Government of Ukraine has recently renewed its commitment to STI policies and launched two strategies that target innovation in the Ministry of Economic Development and Trade (MEDT) and the Ministry of Education and Science (MESU). These are important and necessary efforts to improve the governance of the National Innovation System (NIS). However, the NIS remains fragmented and with little alignment across strategies.

Ukraine's innovation underperformance is reducing economic competitiveness and compromising growth in firm productivity. Lagging innovation signals are consistent with low research and development (R&D) commercialization and the overall decrease in the number of national patent applications in recent years. In addition, the decreasing economic share of technology-intensive sectors and the low incidence of successful start-ups compared to the Western European average provide additional indication that conditions for innovation are not fertile.

The existing innovation policy mix and relevant public funding do not respond to the critical needs of the Ukrainian NIS. The STI expenditure allocation and innovation policy instruments available are misaligned with the challenges observed and are ill-suited to foster innovation and competitiveness in the private sector. The gap is not limited to more radical types of innovation or R&D-intensive firms, but it also includes imitation and technology adoption among small and medium enterprises (SMEs). Existing expenditure on STI has decreased in recent years primarily at the expense of support to business innovation. Existing funding concentrates almost entirely on the national academies in the form of block funding and with little competitive grants. In addition, while public expenditure on STI remains low and has been decreasing in relative terms in recent years, there are significant concerns related to the governance of these funds and the relevant policy implementation.

Difficult framework conditions represent a significant constraint to innovation and competitiveness. Conflict and macroeconomic volatility have imposed significant uncertainty for long-term investments in innovative activities. In addition, bribes and corruption are known to increase the cost of doing business, affecting potential collaboration partnerships and innovation financing. Distortions in the economy are known to divert resources from the most productive firms, constraining their growth (Hsieh and Klenow, 2013)[2]. Improving these unfavorable framework conditions is a much-needed complementary policy for supporting the innovation policy. In this context, a pragmatic innovation agenda could be delivered by creating 'spaces of novelty' that could circumvent impeding framework conditions.

Industry-university collaboration is weak and prevents firms from acquiring the latest industrial advances. Universities perform weak R&D and innovation activities, featuring low positions in international rankings. The NIS lacks agencies specialized in technology adoption that can drive commercialization of research. Technology commercialization has been marginalized, at least in terms of public resource allocation. In terms of knowledge supply, the decline of R&D expenditures is leaving research infrastructure obsolete. In addition, the drain of leading research skills represents a threat to the local innovation ecosystem, particularly for the scarcity of specialized skills. Evidence of this is the decrease in the volume and quality of research output. Moreover, the system of innovation support infrastructure and intermediaries remains weak, preventing effective coordination between the public R&D sector and private companies such as technology platforms and clusters. The strong existing capacity in science and technology, particularly in engineering and research, is not exploited, suggesting a missed

[2] Hsieh, C., and Klenow, P. (2009) "Misallocation and Manufacturing TFP in China and India". The Quarterly Journal of Economics, November 2009, 124 (4): 1403-1448.

opportunity. Difficulties of innovative companies and SMEs with access to finance are known to be a major constraint in Ukraine. The undeveloped venture capital (VC) system and lack of financial intermediaries and suppliers of quality business services make the ecosystem thin and unable to service new ventures.

The current governance arrangements with large transfers of block funding to the national academies do not provide strong incentives to business innovation. NASU consumes the largest share of state budget allocated for R&D (53%) followed by other specialized Academies (25%). These funds awarded through block grants rather than competitive funding prevent efficient allocation of research resource to innovation or R&D needs. Furthermore, the limited applied research that NASU and the other Academies conduct for government bodies or corporates is still tied to old areas of economy—former state-owned companies, defense, and resource industries—rather than emerging areas of economy. Only half of the around 350 universities perform any kind of R&D and many of these do only limited R&D, with Ukrainian universities featuring low positions in international rankings. The problems identified pertain to the poor articulation of priorities aligned with the private sector and the low impact efficiency of state support for R&D and innovation. Absence of mechanisms to promote competitive allocation of public resources for innovation support is reducing the effectiveness of public funds.

Finally, the Ukrainian NIS remains deeply fragmented, lacking an effective integration platform that can articulate a national STI strategy. In the current system, the different ministries work in silos and the newly developed strategies are unlikely to break this fragmentation, unless efforts are unified under an innovation policy strategy for the country. The governance in STI is fragmented across several institutions. The country presents no clear and unified research and innovation strategy but instead has several sector strategies, lacking coordination, especially between the research policy and business needs for innovation. The lack of strategic foresight is compounded by excessive fragmentation and paucity of funds. Therefore, Ukrainian policy makers should consider unifying the national STI policy into one cross-cutting strategy that spans ministries and innovation-related agencies. Innovation in the business sector and industry should receive increased focus.

Recommendations

The report's recommendations belong to three major categories of measures.

- **First, Ukrainian policy practitioners should strengthen governance, planning, and learning mechanisms for better innovation policy efficiency**. Before reallocating existing resources, addressing design and implementation capacity of Ukrainian innovation agencies will increase the likelihood of deployment of effective instruments. In this regard, practitioners need to introduce good and transparent policy practices that create incentives to collaboration and commercial research. Instituting competitive selection processes should improve the quality of research, turning reviews, evaluations, and revisions into a regular practice to enable agencies to learn about what works in policy instruments. Introducing systematic diagnostics, deliberate identification of issues, and cost-benefit analyses as de facto measures should improve the design of innovation policy interventions.

- **Second, Ukrainian policy practitioners should shift budget allocation to induce enterprise innovation**. Public support to the research sector is currently directed to the national academies on a minimally competitive basis and with little incentives to generate research that can be commercialized and to incentivize collaboration with industry. Reforming the academies with focus on introducing transparent and competitive funding should allow for competent knowledge

producers (research institutes and universities) to produce impactful and relevant research results. Introduce good and transparent policy practices to maximize impact of STI expenditure and enable public expenditure expansion. Additionally, public support for private sector R&D and innovation is almost nonexistent. State budget support remains biased toward state-owned organizations at the expense of commercial innovation and the competitive allocation of grants for research projects. Rebalancing the budget to introduce demand-side measures will provide space for a comprehensive and mutually reinforcing set of business support measures that can revert the lagging trends of competitiveness in Ukraine. The governance of STI policies and institutions suggests large skewing and strong legacy problems in Ukraine. STI remains largely dominated by science and research institutions with a strong linear view of innovation, from science to innovation. National- and regional-level policies are not aligned either. The regions do not have comprehensive governance systems for STI. Only a few regions have created special departments responsible for R&D, and there are no data on the performance and effectiveness of the regional support policies in this area. A commensurate portion of business support should be decentralized and implemented at the regional level once effective governance systems, competent teams, and anti-capture provisions are established.

- **Third, Ukrainian policy practitioners should invest resources in instruments that build firm capability, induce industry-specific research collaboration for business innovation, and improve the enabling environment of innovative firms**. A set of measures aiming at increasing the absorptive capacity of firms include upgraded management systems, enhanced quality standards, expanded staff skills, and the ability of firms to participate in global value chains (GVCs). Instruments promoting effective interactions between firms and knowledge providers generally and in specific sectors, such as the technology transfer system and strengthened collaboration between local and foreign knowledge providers, will support accelerated knowledge diffusion. Moreover, measures aimed at improving the entrepreneurial environment, especially through venture early-stage support, will increase the formation rates for new ventures and increase survival of young enterprises.

Introduction

Ukraine is undergoing a challenging period of macroeconomic volatility that has resulted in severe fiscal consolidation. Income per capita has decreased to levels of a decade ago and firms are stuck in low productivity, unable to export to international markets and generate the much-needed high-quality jobs. Several factors constrain firms' productivity growth, but critical among them are distortions in the economy that constrain firm growth and investments in innovation. Addressing these distortions and increasing innovation activities in the business sector is key for the growth prospects of the country.

The World Bank was tasked with profiling and assessing the composition and the quality of public investments in science, technology, and innovation (STI) against the background of fiscal consolidation. Thus, this note evaluates the contribution of STI policies to business innovation by assessing the coherence between the country's needs for business innovation policies and the allocation of innovation expenditure. The analysis considers several factors affecting innovation performance of businesses such as the local country conditions, external factors, and institutional arrangements. The results from the demand analysis is measured against the portfolio of policy instruments and current public expenditure on STI. The analysis yields a review of the strategic context of innovation policies, a comparison of the country's National Innovation System (NIS) with peers, a profile of the STI institutional framework, the existing set of policies and programs, and a description of the program portfolio and policy mix for business innovation.

The objective of this note is to inform the decisions of policy practitioners embarking on the process of design and review of innovation policies with the aim of maximizing the effectiveness of innovation policies. This exercise is an important and necessary step toward building a good set of instruments—the policy mix that effectively supports business innovation. The Analytical Framework and Approach section presents the analytical framework employed in this exercise. The Demand for STI Policies section creates a demand profile for innovation policies considering the evidence of business innovation outcomes, firm investment patterns, and capability traits, such as skills and assets. The analysis is complemented by an assessment of the enabling environment, external to the firm, which includes the local framework conditions and other external factors affecting innovation. The Policy Framework for STI Business Innovation section describes the current policy framework for business innovation policies. The Resource Allocation and STI Expenditure section discusses the pattern of allocation of public resources for innovation. The Internal Consistency and External Coherence Analysis for Policy section presents the results of the gap analysis between the needs of the country and the supply of innovation policy support, looking at internal consistency of the policy portfolio and its coherence with the needs for country support. The last section offers recommendations and suggests various ways to support business innovation policies in Ukraine.

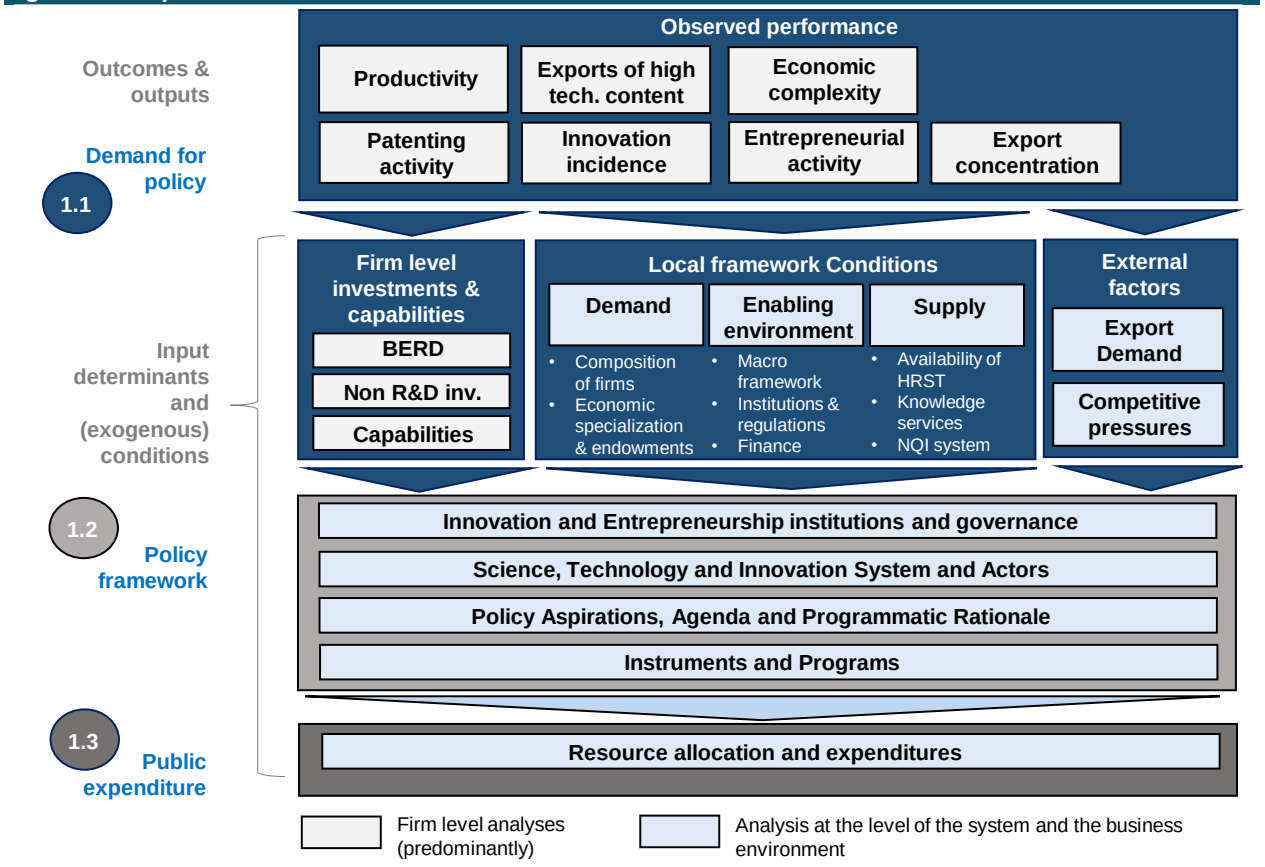
Analytical Framework and Approach

The proposed framework aims to answer two simple questions: (a) how well is the policy framework for promoting business innovation addressing market and system failures that constrain knowledge and innovation activities? and (b) is the allocation of public resources for STI consistent with its policy priorities? The importance of obtaining answers to these questions is not trivial. Given that public resources are scarce, policy makers should prioritize addressing those failures that are more critical for innovation and leverage complementarities across existing innovation policy instruments, making innovation policy programs increasingly cost-effective.

The country's needs analysis provides the foundational understanding of the importance of STI policies for policy practitioners and the characteristics of policy demand. The analysis sheds light on how consistently the country's existing policies and programs respond to that demand. The observed gaps will enable practitioners to identify possible action steps toward bridging them.

The approach for this analysis recognizes that not all the observed parameters remain under the control of policy makers, and as such, many determinants of demand represent exogenous variables, such as external competitive pressures and other contextual macroeconomic variables, such as interest rates. Figure 1 provides an overview of the analytical framework.

Figure 1. Analytical Framework to Assess Unmet Needs for STI Policies



Source: Authors.

This analysis relies on primary and secondary sources of data collection to produce information. The demand for innovation policy analysis relies on information found in databases that compare countries and ecosystems at the aggregate, such as the conference board for aggregate productivity metrics or the Organisation for Economic Co-operation and Development (OECD) innovation indicators. Trade-related performance data can be found in the World Bank Development Indicators or United Nations International Trade Statistics Database (UN COMTRADE). Information regarding local framework conditions resides usually in country-specialized publications and reports, such as the OECD reviews for innovation policies, and in country featured monitoring indicators, such as the global entrepreneurship monitor (GEM) consortium.

The STI expenditure information relies on the unified database of the central government spending that captures all relevant items for the sector expenditure and the overall budgets of selected entities involved in the financing of research and development (R&D), innovation, and entrepreneurship development in Ukraine (see appendix II for a description of the BOOST data set). The Ukraine BOOST database, based on the Treasury data, is a multidimensional multisectoral fiscal database that covers all national government expenditures. It can be decomposed by the level of government, budget entities, functional, economic, and program classification. By design, it also covers all crosscutting fiscal areas such as spending on R&D available at the program/project level, among others. However, the data set does now allow for a granular analysis embedded in the large transfers of block funding to the National Academies.

At the core, the framework implies a causal relationship between observed performance variables, such as firm-level productivity, and the existing policy framework, which includes public investment (or expenditure) in policies and programs to promote innovation and entrepreneurship. Hence, this framework relies on both descriptive and causal inference. The degree to which this causal relationship between the presence of policy instruments and observed outcomes can be established will depend on the quality of the information available. It is worth noting that demand determinants depend on a variety of factors, including existing framework conditions, which cannot always be influenced by innovation policies directly, at least not in the short term. The strength of the case will be established on a qualitative basis.

Table 1. The Framework Represented by Guiding Set of Questions

Analytical Step	Guiding Questions
1.1 Demand for innovation policies	• What is the case for innovation policies in this country? • Is there evidence of unmet demand for support to business innovation and entrepreneurship? How do we know? Is innovation performance lagging, and how is it affecting productivity and other impact metrics? • How do the framework conditions affect innovation performance of firms? • Which of these conditions can be susceptible to improvements? Which are not and can be considered as fixed parameters affecting our outcomes?

1.2 Policy framework	• What are the existing innovation policy priorities and identified challenges? • What are the most important ministerial bodies for innovation policies in the country? What is the institutional and legislative framework of STI in country? • Is the policy framework consistent with the innovation policy needs of the country? • What are the entry points for working with innovation-related institutions in the country? • What are the governance structures at geographical/regional or sectoral levels? • How conducive is the environment in which firms operate for innovation and entrepreneurial activity? • How consistent are the policy aspirations with the needs of the country? • Are the existing innovation policy instruments and programs addressing the main innovation issues in the country? • Is the quality of these programs commensurate with their stated goals?
1.3 Public expenditure for innovation	• Is the general allocation of resources consistent with the country's priorities for innovation policies? • How is the distribution of funds by instrument and policy program? • What are the sources of funding for these programs? • What trends in resource allocation can be discerned, in terms of both allocation and uses of funds?

The selection of structural and regional peers for the country can be a useful way to conduct the benchmarking analysis. Structural peers represent countries with similar economic characteristics to the one being analyzed, and the construct is normally ad hoc but based on important determinants, such as similarities in the economic composition of production and exports. The selection of regional peers is usually more straightforward; since these are bound by geography and proximity, understanding these is a strong determinant for economic performance.

Overall, the analysis of business innovation outcomes suggests a picture of decreasing productivity among Ukrainian firms, with a significant loss of competitiveness in recent years. Addressing this lagging competitiveness should be the paramount objective of STI policies, since innovation is the key element for productivity growth and diversification of the economy.

Business Innovation Outcomes

Aggregate levels of competitiveness metrics show consistent symptoms of continuing deterioration of innovation in Ukraine. Per the Global Competitive Index (GCI), the Ukrainian economy ranked 85th in 2016/17, and its position has been slipping from the 73rd place in 2012/13.

Table 2. GCI Ukraine Ranking

	Rank/138	Score (1-7)	Edition	2012-13	2013-14	2014-15	2015-16	2016-17
GCI	85	4.0	Rank	73/144	84/148	76/144	79/140	85/138
Subindex A: Basic requirements	102	4.0	Score	4.1	4.1	4.1	4.0	4.0

Source: International Monetary Fund; World Economic Outlook Database (April 2016).

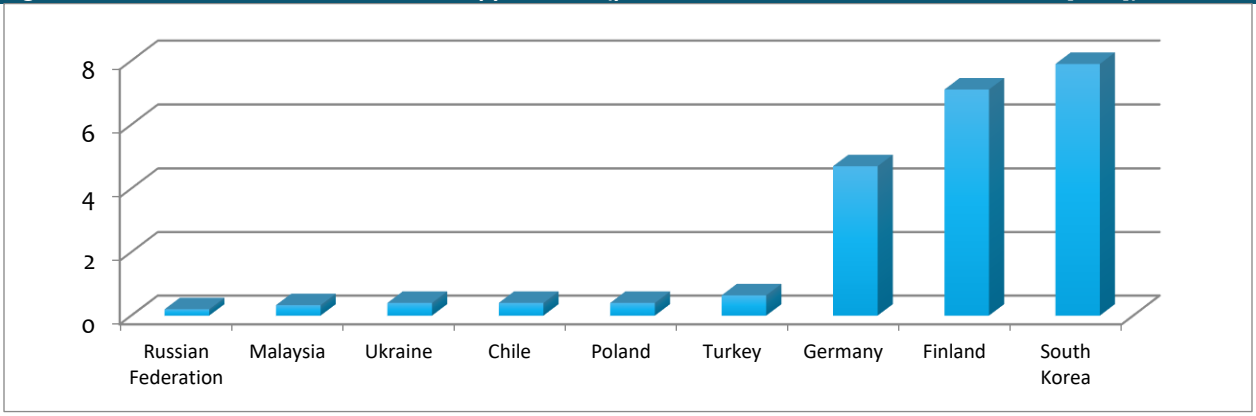
Table 3. Innovation Performance Indicators (GCI)

ranking and grade (1- 7)	2012- 2013	2013- 2014	2014- 2015	2015- 2016	2016- 2017
General innovation performance (overall)	71 / 3.2	93 / 3.0	81 / 3.2	54 / 3.4	52 / 3.4
Capacity for innovation	58 / 3.3	100 / 3.2	82 / 3.6	52 / 4.2	49 / 4.4
Quality of scientific research institutions	64 / 3.7	69 / 3.6	67 / 3.8	43 / 4.2	50 / 4.2
Company spending on R&D	104 / 2.7	112 / 2.7	66 / 3.1	54 / 3.4	68 / 3.3
University-industry collaboration in R&D	69 / 3.6	77 / 3.4	74 / 3.5	74 / 3.5	57 / 3.5
Governmental procurement of advanced products	97 / 3.2	118 / 3.0	123 / 2.9	98 / 3.0	82 / 3.1
Availability of scientists and engineers	25 / 4.8	46 / 4.5	48 / 4.3	29 / 4.7	29 / 4.7
PCT patent applications per mln. inhabitants	51 / 2.1	52 / 2.9	52 / 3.2	50 / 3.6	49 / 3.9

Source: European Commission. 2016. *Peer Review of the Ukrainian Research and Innovation system: Horizon 2020 Policy Support Facility.*

The mediocre ranking seems to be driven by deteriorating quality of institutions, poor infrastructure, a difficult macroeconomic environment, and lagging quality of primary education, all of which ranked much worse than the average. It is worth noting that Ukraine is still strong in higher education and skills, putting the country in the 39th place and revealing an untapped opportunity to capitalize on its human resources. Ukraine also ranked low in technological readiness, although it improved in the sub-ranking of 'availability of latest technologies' (climbing from 113th to 96th position).

Figure 2. Number of International Patent Applications (per billion PPP$ Gross Domestic Product [GDP]) in 2015



Source: Author's elaboration.

Ukraine compares poorly to peer countries by the number of international patent applications (figure 2). While the number of patent applications has remained stable in recent years, the number of patents granted has decreased significantly. Table 4 shows the number of total patent applications in Ukraine.[3]

Table 4. Applications for Inventions Filed and Patents Granted

	2009	2010	2011	2012	2013	2014	2015
Applications filed	4,812	5,310	5,247	4,944	5,418	4,813	4,497
Under the national procedure	2,678	2,810	2,926	2,834	3,132	2,676	—
by residents	2,429	2,551	2,640	2,483	2,855	2,456	—
by nonresidents	249	259	286	351	277	220	—
Under the Patent Cooperation Treaty (PCT) procedure	2,134	2,500	2,321	2,110	2,286	2,137	—
including resident applications	—	2	1	1	3	1	—
Patents granted	4,002	3,874	4,061	3,405	3,635	3,319	3,014
to residents	2,395	2,034	1,902	1,557	1,743	1,701	—
to nonresidents	1,607	1,840	2,159	1,848	1,892	1,618	—
Patents in force by year-end	24,651	24,617	24,773	25,276	26,033	26,183	—

Source: Website of the patent service of Ukraine (http://sips.gov.ua).

From 2003 to 2013, Ukraine had 1,125 PCT-filed patent applications in the technological sector (less than the Russian Federation and Turkey). Most PCT-filed applications from Ukraine were made in the mechanical engineering sector (320 or 28.4 percent of the total national share of PCT-filed applications). However, Ukrainian firms have very few patents recognized in the European Union (EU) or in the United States compared to neighboring countries due to weak integration of domestic enterprises in global value chains (GVCs) and high costs of foreign patenting (this also explains why most PCT-filed applications were

[3] The numbers cover only those patent applications that were made to the Ukrainian patent registration offices. Thus, they do not give any information on those Ukrainian patent applications that were filed in a foreign patent office. Most PCT patent applications submitted by the Ukrainian inventors are aimed at the home country. Both for national (under a national patent office) and international protection (under PCT), most of the patent applications were made to the Ukrainian patent authorities.

filed only in Ukraine).

Figure 3. Labor Productivity in Selected Countries

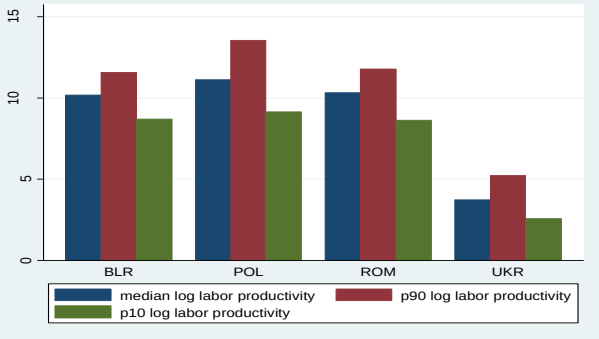
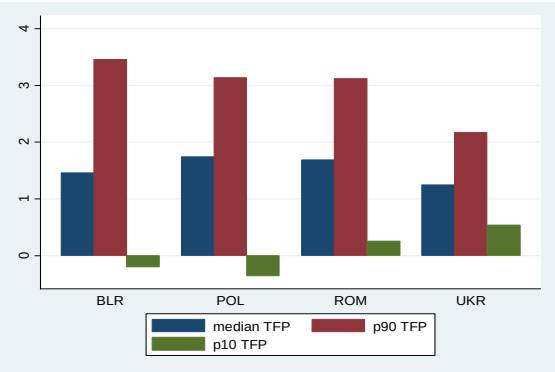


Figure 4. TFP in Selected Countries



Source: Author's elaboration from enterprise survey data.

At the level of the firm, Ukrainian firms are half productive in terms of labor productivity than firms in Belarus, Poland, or Romania (figure 3). While this is just a proxy for efficiency, recent estimations for Total Factor Productivity (TFP) by the enterprise survey suggests a similar picture (figure 4). In this case, the median Ukrainian firm is the least productive from this set of countries, although closer to Belarus and on average to Poland, and with less dispersion between the most and least productive firms. In any case, productivity in Ukraine is lower than its peers, especially on its lead firms that by any account are least productive than lead firms in peer countries.

Table 5. Introduction of Innovations at Industrial Enterprises

Year	Share of Enterprises That Were Introducing Innovations, %	Introduction of New Technology Processes, Number of Processes	Including Resource-Saving and Low-Waste Technologies	Launched Production of New Innovative Products[a], Number of Products	Including New Types of Techniques	Share of Innovation Production in the Total Volume of Industrial Production, %
2000	14.8	1,403	430	15,323	631	9.4
2001	14.3	1,421	469	19,484	610	6.8
2002	14.6	1,142	430	22,847	520	7.0
2003	11.5	1,482	606	7,416	710	5.6
2004	10.0	1,727	645	3,978	769	5.8
2005	8.2	1,808	690	3,152	657	6.5
2006	10.0	1,145	424	2,408	786	6.7
2007	11.5	1,419	634	2,526	881	6.7
2008	10.8	1,647	680	2,446	758	5.9
2009	10.7	1,893	753	2,685	641	4.8
2010	11.5	2,043	479	2,408	663	3.8
2011	12.8	2,510	517	3,238	897	3.8
2012	13.6	2,188	554	3,403	942	3.3

Year	Share of Enterprises That Were Introducing Innovations, %	Introduction of New Technology Processes, Number of Processes	Including Resource-Saving and Low-Waste Technologies	Launched Production of New Innovative Products[a], Number of Products	Including New Types of Techniques	Share of Innovation Production in the Total Volume of Industrial Production, %
2013	13.6	1,576	502	3,138	809	3.3
2014[b]	12.1	1,743	447	3,661	1314	2.5
2015[b]	15, 2	1,217	458	3,136	966	1, 4

Source: Website of the state statistics service of Ukraine (http://www.ukrstat.gov.ua).
Note: a. Until 2003—new kinds of products.
b. Data without the territories of Crimea, Sevastopol, and some territories of Donetsk and Luhansk regions.

In addition, the share of the innovative output within the industrial output has decreased from 9.4 percent in 2000 to 1.4 percent in 2015 (table 5). However, the proportion of firms that have introduced either a product or a process in the previous three-year period has remained relatively stable at around 15 percent. A sectoral cross-sectional analysis reveals that food production stands as the most innovative in 2014, accounting for 17.1 percent of all innovative enterprises. Machinery and equipment production showed a lower proportion of innovative companies, ranging from 4.7 percent to 9.6 percent.

Figure 5. Innovation Incidence in Ukraine in Relation to Peer Countries

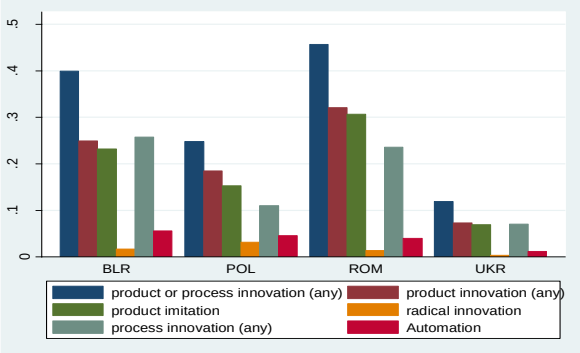
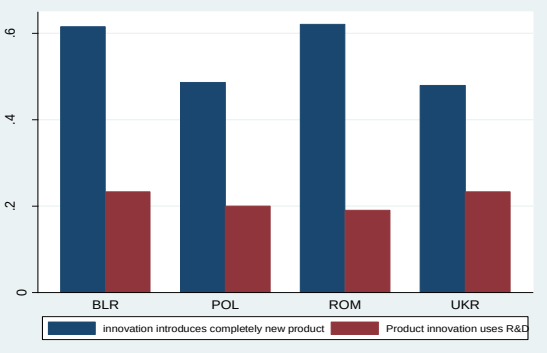


Figure 6. Share of Product Innovators Introducing New Products and Using R&D



Source: Author's elaboration from enterprise survey data.

The innovation level of Ukrainian firms ranks lower than the rates of peer neighboring countries. Figure 5 shows a comparison of different innovation incidence measures.[4] In all metrics, Ukraine ranks significantly lower than its peers, even when considering simple innovation through purely imitations, which manifests in lower productivity and competitiveness of its business sector.

The problem of low innovation incidence is compounded by low innovation quality. One could argue that despite having low innovation rates, innovations introduced in Ukraine are of better quality than that of peer countries. Around half of the innovations in Ukraine rely on the introduction of a new product instead of an upgraded product, which is similar to Poland but lower than that of either Belarus or Romania (figure 6). In addition, only 20 percent of product innovators engage in any R&D, which is similar to Belarus and

[4] Includes product or process innovation, product innovation, and process innovation. We also decompose product innovation into imitation—when new to the firms or the national market—vs radical innovation—when new to the international market; and process innovation into those process innovations that involve some degree of automation of the production processes.

slightly more than Poland and Romania. This suggests low innovation and low sophistication of innovations introduced in Ukraine.

Firm-Level Investment and Capabilities

Innovation activities in the last decade have shadowed patterns from the business cycle, becoming increasingly volatile (table 6). While private R&D activities have increased significantly in nominal terms, overall private investments in innovation activities have decreased in the last three years, driven by reduced investments in knowledge, machinery, and equipment. The decrease in investments in knowledge is particularly alarming as it will likely carry negative impacts in the medium and long-term quality and quantity of upgraded products and processes and productivity.

Table 6. Innovation Activities of Ukrainian Firms

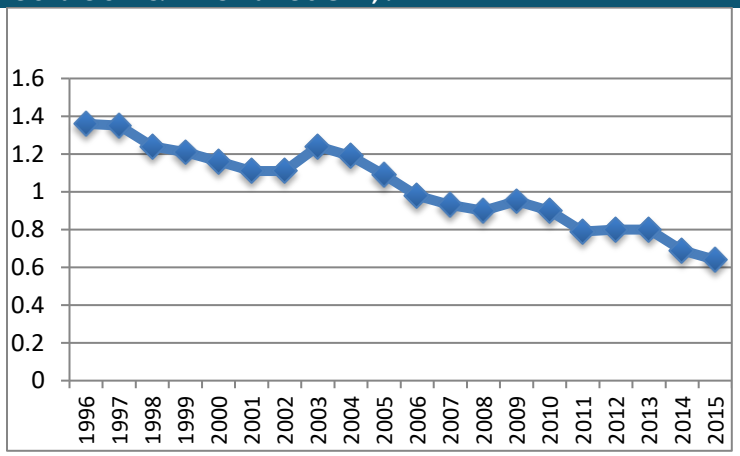
Year	Share of Enterprises Conducting Innovative Activity	Total Expenses	R&D[a]	Internal R&D	External R&D	Acquisition of External Knowledge[b]	Preparation of Production for Introducing Innovations[c]	Acquisition of Machines, Equipment, and Software[d]	Other Expenses
	%	UAH, millions							
2000	18.0	1,760.1	266.2	—	—	72.8	163.9	1,074.5	182.7
2001	16.5	1,979.4	1,71.4	—	—	125.0	183.8	1,249.4	249.8
2002	18.0	3,018.3	270.1	—	—	149.7	325.2	1,865.6	407.7
2003	15.1	3,059.8	312.9	—	—	95.9	527.3	1,873.7	250.0
2004	13.7	4,534.6	445.3	—	—	143.5	808.5	2,717.5	419.8
2005	11.9	5,751.6	612.3	—	—	243.4	991.7	3,149.6	754.6
2006	11.2	6,160.0	992.9	—	—	159.5	954.7	3,489.2	563.7
2007	14.2	10,821.0	986.4	793.5	192.9	328.4	—	7,441.3	2,064.9
2008	13.0	11,994.2	1,243.6	958.8	284.8	421.8	—	7,664.8	2,664.0
2009	12.8	7,949.9	846.7	633.3	213.4	115.9	—	4,974.7	2,012.6
2010	13.8	8,045.5	996.4	818.5	177.9	141.6	—	5,051.7	1,855.8
2011	16.2	14,333.9	1,079.9	833.3	246.6	324.7	—	10,489.1	2,440.2
2012	17.4	11,480.6	1,196.3	965.2	231.1	47.0	—	8,051.8	2,185.5
2013	16.8	9,562.6	1,638.5	1,312.1	326.4	87.0	—	5,546.3	2,290.9
2014[e]	16.1	7,695.9	1,754.6	1,221.5	533.1	47.2	—	5,115.3	778.8

Source: Website of the state statistics service of Ukraine (http://www.ukrstat.gov.ua).
Notes: a. Starting from 2007—sum of internal and external R&D.
b. Until 2007—acquisition of new technologies.
c. Starting from 2007 the indicator is included to 'other expenses'.
d. Until 2007—acquisition of machines and equipment related to the introduction of innovations.
e. Data without the territories of Crimea, Sevastopol, and some territories of Donetsk and Luhansk regions.

The volume of funding for R&D and innovation in Ukraine is not sufficient. The share of R&D in the GDP

has been decreasing, and it is lower than in most comparable countries (figure 7). Ukraine underperforms in R&D expenditure per worker in relation to its peers (figure 8). Low R&D intensity is driven by not only the large number of firms that do not perform any formal R&D but also by low intensity among those that do conduct R&D. This relative underperformance is driven by the low use of foreign technology licenses by Ukrainian firms.

Figure 7. Dynamics of the Share of R&D in Ukraine's GDP, %[5]



Source: Author's elaboration.

The share of foreign investments in R&D in Ukraine peaked at about 25 percent of gross domestic expenditure on research and development (GERD) in 2010–2013 but has dropped due to the political and economic instability since 2011 and the recent military conflict in the occupied eastern regions. In 2005, this share was 24.8 percent, and in 2014, 19.8 percent. However, this share of foreign investments in Ukrainian R&D is still relatively high compared to the other Eastern Partnership (EaP) countries (figure 9).

Figure 8. R&D Intensity in Ukraine and Peer Countries

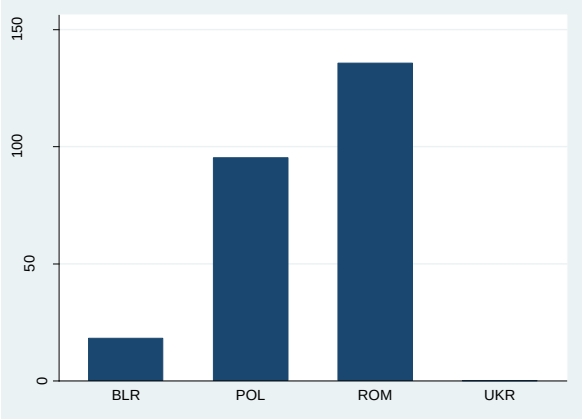
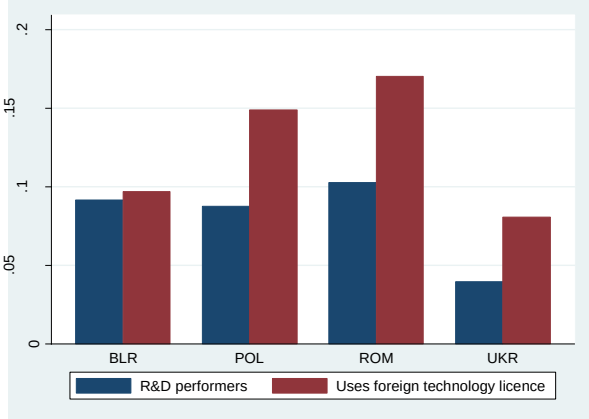


Figure 9. R&D Activity and Use of Foreign Technology Licenses



Source: Author's elaboration from enterprise survey data.

Low innovation capacity of research organizations and poor incentives to collaboration hinder potential cooperation between science and industry. The interaction between the research sector and industries and within the research sector (between universities and academic institutes) is weak. Lack of information

[5] Website of the state statistics service of Ukraine (http://www.ukrstat.gov.ua).

on opportunities of such cooperation, high costs faced by organizations in search for partnerships, lack of commercial orientation among research institutes and universities, and inefficient technology transfer infrastructure are all hindering collaboration opportunities. Ukraine's state policies aim at closing this gap through different strategies: creation of research infrastructures for joint use by different research organizations, creation of organizations facilitating technology transfer, provision of grants to promote R&D cooperation between universities and research organizations, and establishment of technology parks.

The next section offers a description of the existing conditions in the country that are likely affecting the way the firms weigh opportunities behind innovation and its costs, including the risks and uncertainties.

Local Framework Conditions

Structure of Demand

The demand for business innovation among a significant population of large firms is low and presents limited scope for increasing R&D intensity. Heavy industry and agriculture, host to large companies and public enterprises, represent a disproportionate share of economic output, making Ukraine an industrial and agrarian country. The prevailing economic specialization owes to a legacy from th,e Soviet era, featuring heavy industries with large conglomerates and dominant public enterprises in heavy engineering, ferrous and nonferrous metallurgy, shipbuilding, the automotive industry, the aerospace industry, manufacturing and supply for power plants, oil, gas, and the chemical industry.

Domestic demand for R&D and innovation has dropped substantially since the independence of the country. The change in the relative composition of economic sectors has reduced the aggregate value added for the country. The participation of Ukraine's high-tech sectors has decreased threefold since the beginning of the 1990s, while the share of energy and ferrous metallurgy, sectors with considerable lower value added, grew substantially during this period. These lower value added sectors present low technological deepening, not requiring meaningful R&D and innovation. Moreover, many companies operating in these sectors buy ready-made solutions embedded in equipment.

According to Yegorov (2012), enterprises operating in the equipment-building, ferrous metallurgy, and chemicals sectors represent the lowest value segments in the world markets[6]. Competition in such markets is particularly fierce and Ukrainian companies are persistently under pressure to retain their existing positions against price-driven competitors from developing countries.

Enabling Environment

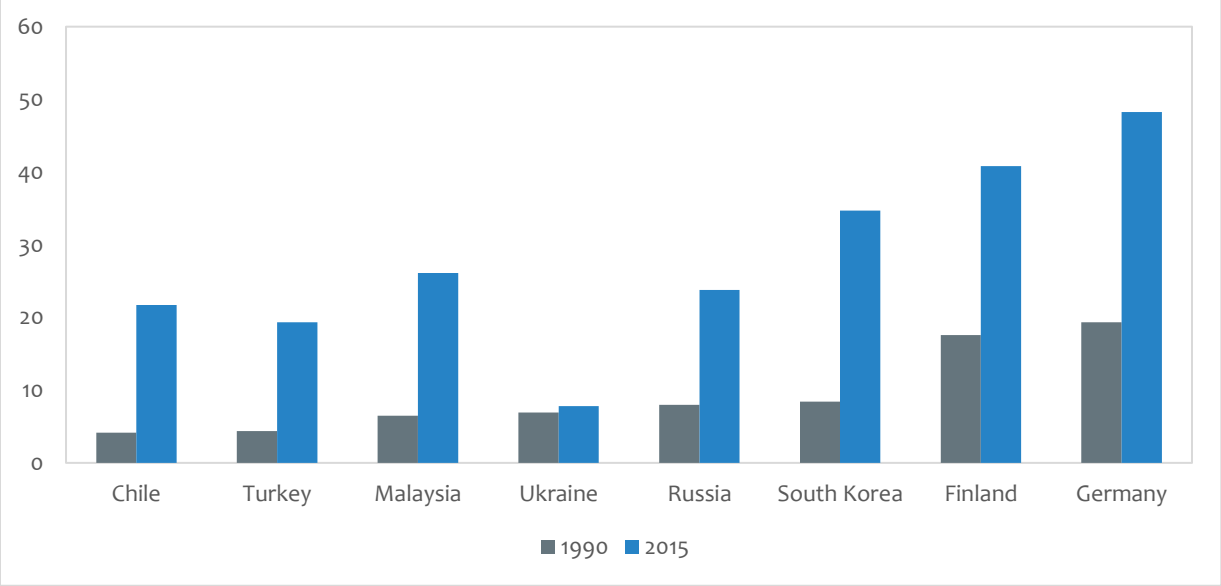
The enabling environment for innovation in Ukraine has been hardly conducive for innovation activities.

The economic situation in the country has deteriorated in the last several years due to various external and internal factors, particularly the conflict in the east, which has led to a significant drop of GDP, exports and imports, and foreign direct investment (FDI). Ukraine's GDP dropped by 50 percent between 2014 and 2015, and GDP per capita decreased from US$3,986.2 in 2013 to US$2,114.9 in 2015, regressing to the 2008 level, revealing a pattern of growth divergence compared to peer countries. By comparison, Chile, Turkey, and Malaysia, which had lower income per capita in 1990 than Ukraine, presented much

[6] Yegorov, I. (2012): ERAWATCH Country Reports 2012: Ukraine.

higher income per capita in 2015 (figure 10).

Figure 10. Income Per Capita in 1990 and 2015, Selected Countries



Source: Author's elaboration.

Weak financial services constrain local firms that depend on the domestic financial system. Innovative companies, and small and medium enterprises (SMEs) in general, face additional difficulties when trying to raise finance, which remains a critical obstacle for starting a business. Around 40 percent of entrepreneurs in a Ukrainian study reported difficulties in obtaining financing in general, but this problem seems of especial importance for R&D performing companies, of which 80 percent stated limitations in their innovation activities due to inadequate financing position. Financial resources are usually provided to Ukrainian banks for onlending to SMEs under different programs (sponsored by International Finance Corporation [IFC], European Investment Bank [EIB], European Bank for Reconstruction and Development [EBRD]) in the areas of priority for the country economic catchup program.

Financial difficulties remain more acute for early-stage ventures than for mature firms, particularly in the absence of risk capital financing. Limited state support targeting start-ups and weak presence of business angel and venture financing compound the problem. At face value, the number of venture funds seems large in Ukraine. At the rime of writing this note, Ukraine featured about 700 venture funds (Ukrainian Association of Investment Business - UAIB), totaling €2 billion in 2009. However, these venture capitals (VCs) are mainly domestic vehicles targeting speculative real estate and equity stakes in mature companies, representing brokers, consultancies, construction, and trade outfits. The modest early-stage investments channeled through VCs are mostly of foreign origin. A more detailed analysis is not possible at this point due to lack of data on investment volumes and information on deals.

Further development of the early-stage financing system remains hampered by incomplete legislation, particularly the legal framework dealing with minority stakeholding in businesses and the availability of option schemes. Consequently, most funds are registered abroad (although tax avoidance may also be a motivating factor for foreign registration).

The unfavorable business environment, driven by bureaucracy, bribery, corruption, and crony capitalism, represents an important constraint to private investment. In 2014, Ukraine ranked at the 15th percentile

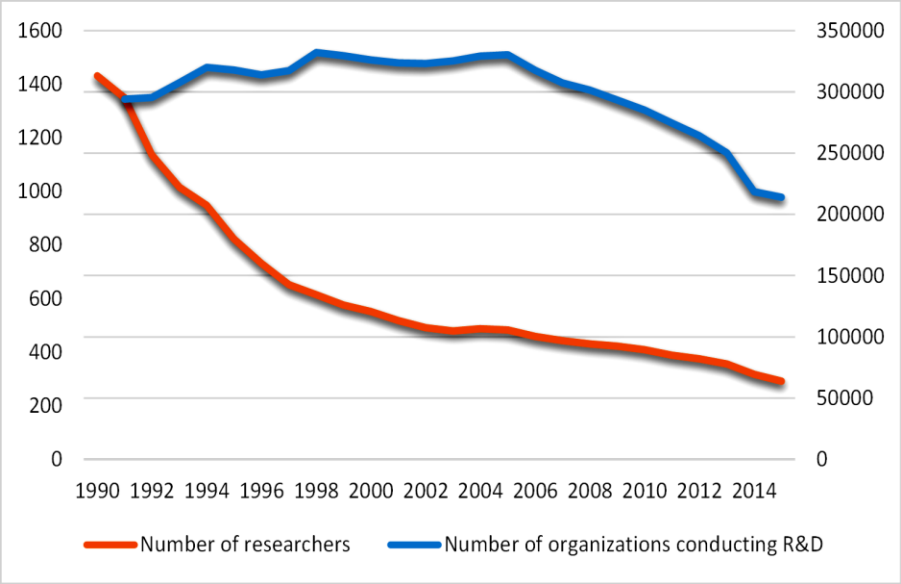
in terms of control of corruption as part of the Worldwide Governance Indicator (WGI), well below comparable peers, such as Poland and Romania. In a similar fashion to countries in the region, privatization of state assets ended up under the control of a few groups, with vested interests and political connections. Patterns of oligarchy have affected access to investment opportunities, normally open to the private sector, and competition in several service sectors in the economy.

Knowledge Supply

Brain drain of innovation skills remains a problem, and investment in inventiveness is decreasing. Ukraine has a well-developed education system. University enrolment and higher education attainment in Ukraine are high. Ukraine developed a good primary education system during the Soviet era, which features outstanding skills in mathematics and sciences at the school level. However, serious concerns have been raised related to the quality of science and technology education since the early 1990s. In addition, concerns have risen regarding the efficiency of the education system. Elementary schools feature around 600 teaching hours taught per school year, which is between 100 and 200 teaching hours less than in most European countries.

R&D infrastructure remains large but with some exceptions is considered outdated. The number of researchers in Ukraine has decreased five times since 1990, while the number of R&D performing organizations has dropped from around 1,400 to around 1,000 (figure 11). Systematic business R&D beyond the operations of the industrial research institutes, engineering departments, and special engineering bureaus is hardly present in Ukraine.

Figure 11. Labor Productivity in Selected Countries



Source: Author's elaboration from enterprise survey data.

Many institutions perform R&D, but most of this R&D does not have a commercial focus, and when it does, it is linked with noncompetitive state-owned enterprises (SOEs). The number of researchers, however, highlights the strength of human capital in the Ukrainian economy. Some of these researchers had to migrate to western Europe and the United States to continue their research work, but they still constitute an untapped knowledge potential if the right incentives were to be in place.

The total number of research organizations in Ukraine is estimated to be about 1,000. Most of these academic and industrial research institutions are public, but there are also several private or semiprivate industrial research institutes, engineering departments, and special engineering bureaus. The majority of the research organizations are located in the city of Kyiv (26 percent of all organizations), Kharkiv (16 percent), Lviv (6 percent), and Dnipropretovsk (6 percent). Fundamental research is carried out at the institutes of the National Academy of Science of Ukraine (NASU) that includes around 120 institutions and 200 research establishments, employing about 37,000 people (academicians, corresponding members, foreign members, and researchers). NASU is an independent public institution that receives more than 50 percent of the state budget for STI.

The focus of Ukrainian universities is on teaching, and not on conducting R&D. In 2015, 664 universities, colleges, and technical schools were active in Ukraine. Per the latest ERAWATCH report on Ukraine (2011), only half of the slightly more than 350 universities performed any kind of R&D in 2011[7]. Around 25 percent of the universities were private universities. The total expenditure on R&D in higher education was less than 7 percent of GERD in 2011. Two-thirds of persons with degrees of candidates of sciences and doctors of sciences are working in the higher education sector. Per the national statistics, they produce almost 78 percent of research papers, but NASU has more publications in internationally recognized journals, which also receive most of the funding. The relatively low absolute financial allocation might not be sufficient to maintain the comprehensive system of education in a country as big as Ukraine.

In addition, university enrolment in Ukraine remains high, with 80 percent of 19- to 25-year-old Ukrainians enrolled in universities, making it a member of the group of five European countries that collectively represent 54 percent of the total tertiary student population in the European higher education area (EHEA). However, at 1.52 percent, only a fraction of students enrolled at advanced research qualification programs in Ukraine as against 2.7 percent in the EHEA, indicating a low interest of the population in pursuing scientific careers. Attainment levels for higher education qualification are steadily rising in the EHEA. The Bologna median value is 37.3 percent for the 25–34 age group, 29.4 percent for the 35–44 age group, and 22.9 percent for the 45–64 age group. This increasing tertiary education attainment per age is the dominating pattern in almost all Bologna countries. Ukraine has a high level of tertiary education attainment. In the youngest age group, higher education attainment has reached 50 percent in Ukraine (as well as in Cyprus, Ireland, and Lithuania).

External Factors Affecting Business Innovation Outcomes

The Ukrainian economy was shocked by the conflict in the eastern part of the country, and by weaker commodity prices, resulting in the economic crisis of 2014/15 (Ukraine Systematic Country Diagnostic [SCD], 2017). The conflict in Donetsk and Luhansk regions has contracted industrial output, bringing significant disruption in commercial networks, and income. In addition, the drop-in commodity prices of Ukrainian products have worsened dependence on imports and significantly reduced Ukraine income from exports.

[7] Yegorov, I. (2012): ERAWATCH Country Reports 2012: Ukraine.

Policy Aspirations and National Strategies

Though Ukraine does not possess a unified national strategy to define STI priorities, it has a series of laws that set overall direction and guidance on innovation policies. These laws set priorities for R&D to increase the country's national competitiveness, highlighting strategic economic sectors of focus, capabilities to develop, and thematic applications (annex I). These priorities also underpin additional national policies and the formulation of policy instruments.

As for innovation, the key legislative act is the Law on Priority Directions of Innovation Activity in Ukraine, but in general the law was not implemented. It envisaged the adoption of one-year action plans with measurable targets, but none of these plans have been designed. Innovation issues are also mentioned in the 'Strategy for Sustainable Development of Ukraine 2020' and the 'Concept of National Program on Small and Medium Entrepreneurship Development for 2014–2024', but without concrete action plans in this area.

The Ministry of Economic Development and Trade (MEDT) and the Ministry of Education and Science (MESU) have launched separate innovation strategies. The MESU launched the Law of Ukraine on Scientific and Technical Activities focusing on the R&D sector and establishing the National Council of Ukraine on Science and Technology Development chaired by the Prime Minister (see the following section). The MEDT launched the High-Tech Sector Strategy focusing on the digital sector primarily.

In addition, the Law on State Regulation of Technology Transfer envisages the development of a national network of technology transfer platforms. Thus, Ukraine has created a diversified innovation support infrastructure but its effectiveness remains quite low due to funding problems and lack of support.

Ukraine has recently joined Horizon 2020, the EU research and innovation program, which provides new opportunities to Ukrainian research institutions, universities, and businesses to access EU funding.

Many goals under the national programs in Research and Innovation were not achieved due to the political situation, lack of follow-up actions, and the decrease of state financial support. An evaluation of the Ukrainian funding programs was conducted in 2015, which revealed fragmentation of the innovation policy in Ukraine. The report indicated that while innovation policies should be treated as a cross-cutting issue across ministries, the strategies from each line ministry lacked specificity and integration. The findings suggest that Ukrainian policy makers should introduce a single STI policy strategy that includes different ministries with coordination mechanisms such as the National Council of Ukraine on Science and Technology Development but with innovation in the business sector and far more industry focus. A well-articulated innovation policy will be difficult to achieve under the current design.

STI Institutions and Governance

The STI governance system in Ukraine is complex and represented by many state bodies (Figure 12). A description of the most prominent bodies is as follows:

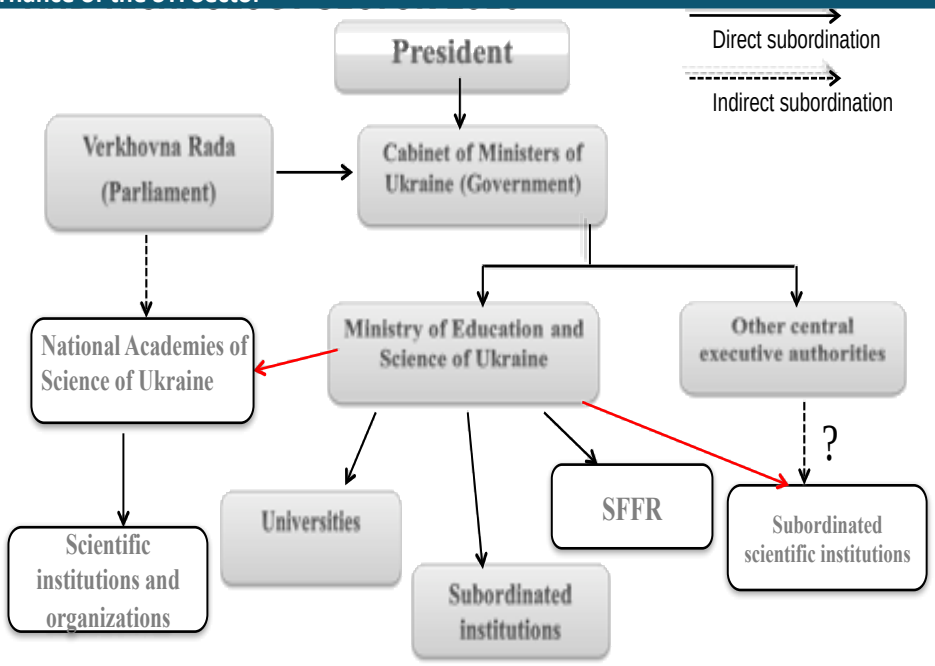
- **National Council of Ukraine on Science and Technology Development.** This council is chaired by the Prime Minister and represents a consulting and advisory body, aiming to advance R&D reform

in Ukraine. Its mandate includes leading policy proposals in R&D in Ukraine (priority directions and action plans), integrating Ukrainian science into international research areas, and drawing expertise of state-targeted scientific and R&D programs, scientific projects, and state attestation of scientific institutions.

- **Regional research and innovation agencies.** Ukrainian regions can also provide funds for R&I from their budgets. Some regional governments and administrations of large cities feature divisions responsible for R&I.

- **International partnerships for innovation.** In addition, the MESU affiliation makes Ukraine responsible for the implementation of Horizon 2020 and has helped the country establish the National and Regional Horizon 2020 Contact Points (the contact points are present in all regions).

Figure 12. Governance of the STI Sector



Source: PowerPoint presentation, December 09, 2016, Borys Grynyov (State Fund for Fundamental Research of Ukraine).

Ukraine has embarked on reforming the R&I governance system, due to the need for fiscal consolidation and improved performance. The change commenced with the establishment of the National Research Foundation of Ukraine under the Law of Ukraine on Scientific and Technical Activities. This foundation is responsible for grant making to improve Ukraine's attractiveness as a location for scientists and support projects according to key priorities. The thrust behind this reform is expected to improve research cooperation between academic institutes and universities, promote the participation of public research institutions (PRIs) and universities in start-up ventures, include property rights as part of the capitalization, improve provision of grants, support competitive selection of applications and their evaluation, increase administrative efficiency of NASU and branch academies,[8] reducing bureaucracy, retain skills through

[8] The academies such as the National Academy of Agricultural Science, National Academy of Medical Science, National Academy of Pedagogical Science, National Academy of Legal Science, and National Academy of Arts will be merged into the NASU after the evaluation of each branch academy.

measures to stop brain drain, and increase accountability by limiting the appointment to leading positions in research organizations to the maximum of two terms.

The national academies present significant opportunities for process improvement, as they still face strong legacy issues from the Soviet era. While there is a clear rationale for the activities they carry out, there is no clear definition and measurement of inputs, outputs, and outcomes for the projects of specific programs under their responsibility. As Link and Scott (2004) emphasize, clear expectations represent a key for the success of PRIs in leveraging investments and maximizing impact[9]. Moreover, the lack of competitive funding in their financing—primarily funded by block grant funding—prevents efficient allocation of research resources. Furthermore, substantial financing comes from SOEs (and financing from the private sector remains small), while it is known that public sector spending is deemed higher than necessary and misaligned with private sector priorities.

Instruments and Programs

A critical element when assessing the quality of the policy mix is the ability of the combination of innovation policy instruments to address the main market failures that constrain innovation activities in the country.

Block funding is the dominant form of business innovation support. Ukraine's bulk STI support consists of transfers to existing institutions to finance in-house R&D capabilities and research. This represents a very important difference between Ukraine and most middle- and higher-income countries in terms of STI expenditure and the type of instrument used to support STI. Most countries have moved away from block funding and use specific innovation policy instruments that induce demand and behavior change among firms. In Colombia, for example, the policy mix of STI instruments in 2014 included 130 different instruments that primarily allocate funding on a competitive basis. Research funding is allocated on a competitive basis through open calls for proposals; similar to direct support to businesses through matching grants or loan guarantees. This practice ensures a more efficient allocation of funding and alignment with private sector needs and priorities.

After the latest fiscal consolidation process, NASU has been tasked with administering a substantial portion of support programs. In the case of NASU, six umbrella programs were identified, with a total of 46 subprograms.[10] In total these instruments amounted to US$24.4 million, of which US$16.2 million funds R&D programs for NASU institutions, US$5.3 million finances heritage and infrastructure of NASU centers and units, US$2.6 million supports PhD and post-PhD programs, and US$0.3 million finances international cooperation. Interestingly, the R&D programs not only represent purely applied research but they also comprise basic research. It is worth emphasizing that all this funding is allocated through the network of NASU agencies and institutions, and it does not get channeled through other universities and research institutions.

The MESU is phasing out its role in deploying STI instruments—information provided by the ministry indicated that a variety of instruments have been deployed in the past five years (some of which do not

[9] Link, A., and J.T. Scott. (2004) The role of public research institutions in a national innovation system: An economic perspective. Final report, New York: The World Bank.

[10] These are as follows: support state target science and technology programs, support target NASU R&D programs (total number of subprograms 14), support target interdisciplinary R&D programs at NASU (total number of subprograms 25), support joint calls of scientific projects with international and foreign organizations (total number of subprograms 4), support maintaining NASU heritage (publishing, infrastructure, national heritage objects, and libraries), and support PhD and post-PhD courses in NASU.

exist any longer), totaling around €22 million. While NASU has retained some research capacity and PhD funding open for its units, the funding for research and scholarships from the MESU has been eliminated given the current fiscal situation of the country, which puts NASU and its staff as the only focus of government support for science and R&D.

The role of economic development agencies in delivering business innovation support has been diminished in recent years—the MEDT closed all existing programs, as well as private sector support agencies, that were dependent on the ministry. In addition to funding problems, some governance problems in the allocation of funding were identified in one of the Ministry of Economic Development and Trade of Ukraine (MEDT) agencies, which precipitated its closure.

A surge in early-stage infrastructure and science parks has extended support to firms in the middle of the rationalization push. During the last few years, Ukrainian policy makers have established several innovation infrastructure programs that includes 12 technology parks; 17 science parks; 28 business incubators; 25 innovation centers; 9 centers for science, innovation, and information; several units for intellectual property (IP) development at higher education institutions; and an institute of scientific and technical expertise and information (only few of these programs are functional today). Some higher educational institutions have their own technology transfer centers. However, these advancements do not seem to present much impact beyond the attraction of a few multinational enterprises (MNEs) for performing R&D contracts, and there is little evidence of effective transfer of technology.

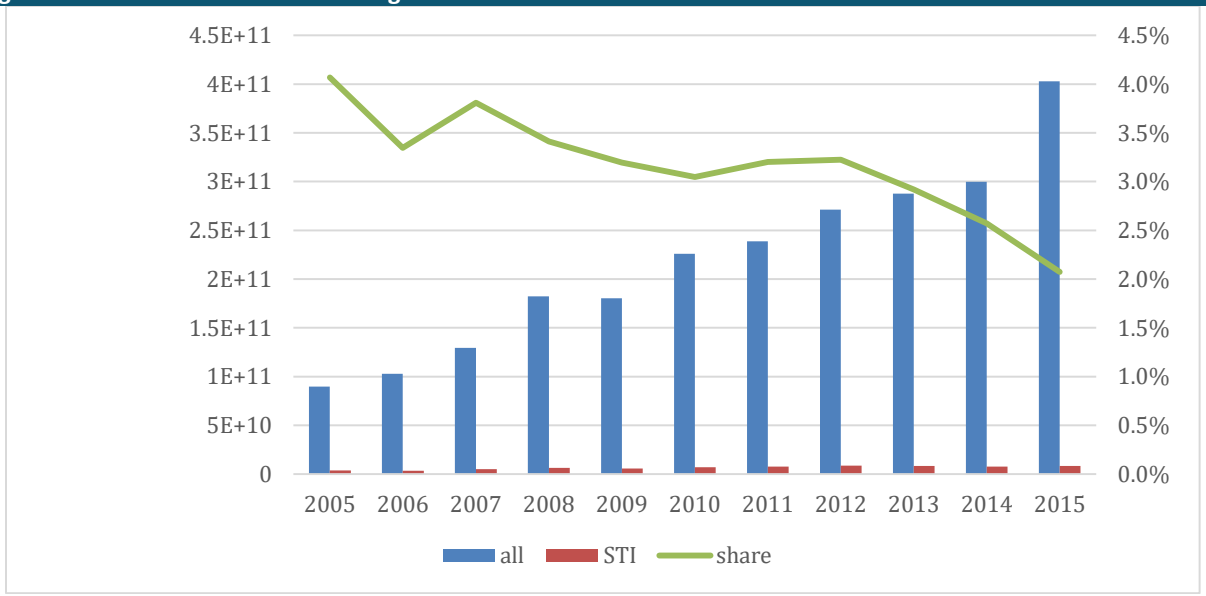
Implementation capacity will remain critical to revive the use of business innovations and expand the scope of their implementation. Even though the number of instruments available is very small, considering the quality of design and implementation is important. While it was not possible to provide an assessment of existing programs, the analysis raised a real concern about the quality of design and implementation of these programs and the installed capacities in different agencies to effectively implement innovation policies. This critical issue needs to be considered moving forward, especially given the increasing opportunities to access new external funding, such as Horizon 2020 and the smart specialization strategies, which could encourage the proliferation of innovation policy instruments. New instruments should be designed and implemented on solid grounds, and international good practices should be adopted in design and implementation to ensure effective deployment.

Resource Allocation and STI Expenditures

Expenditure is significantly biased toward a portion of the research sector, and there is hardly any support to the private sector. The strong bias to block funding for basic research does not provide incentives for firms to innovate. More specifically, it was found that the (shrinking) expenditures are imbalanced toward the supply side (with very little effectiveness/output) and very few (or none) functioning support instruments to the demand side, enterprise innovation, and entrepreneurship.

Fiscal consolidation has led to severe reductions in STI expenditure for innovation and entrepreneurship support. Most support programs for innovation have been cut, and its implementing agencies eliminated, due to general funding cuts and tightening in funds management. Figure 13 shows the evolution of expenditure on innovation and entrepreneurship programs and documents the sharp decline and elimination of programs and agencies after 2013. Although an EBRD program supports firm upgrading and finance, and some other donor-funded sector finance programs exist, there is effectively no program support to the private sector for innovation using government funding.

Figure 13. Evolution of STI in the Budget Identified in BOOST



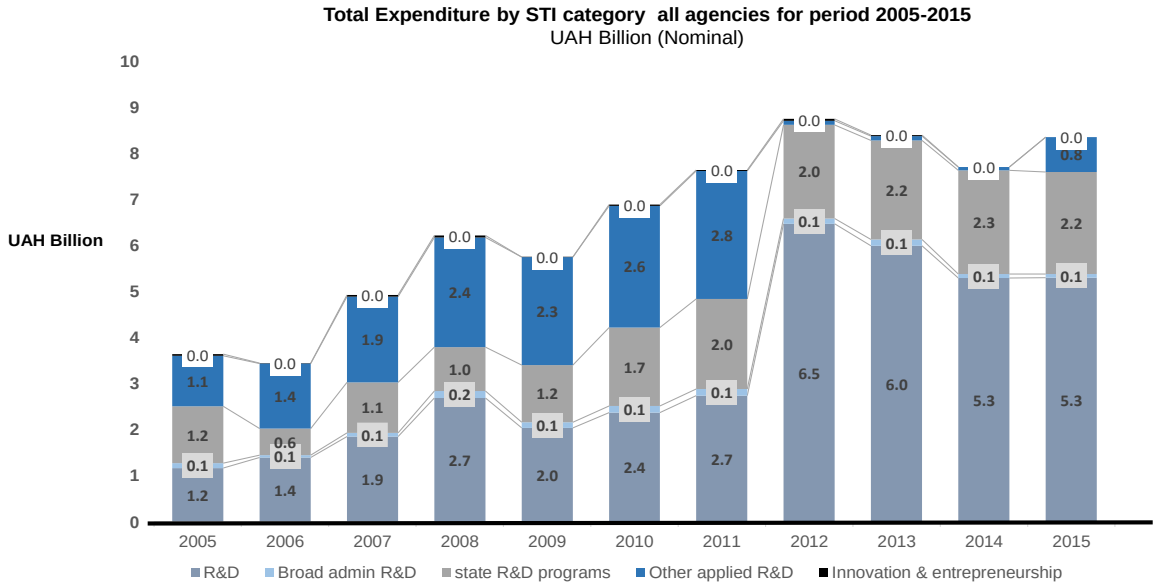
Source: BOOST.

The evolution of STI expenditure experienced a significant nominal increase from 2005 to 2012 (figure 13). However, after 2012, and during the period of crisis and consolidation, nominal STI expenditure decreased slightly. STI expenditure lost significance relative to total expenditure, shifting from 4 percent to 2 percent (figure 13).

All agencies have experienced funding cuts, yet the magnitude of these cuts has been unequal across agencies and across types of instruments. While the funding to the National Academies has been reduced, its adjustment was disproportional in magnitude to that of other agencies, reinforcing the sense of predilection of policy makers toward the National Academies for the allocation of STI resources. In addition, the reduction was more pronounced for investments in business innovation and entrepreneurship, exacerbating the concentration in R&D and research institutions (in other words, the general STI expenditure allocation has almost lost the 'I' in STI).

When looking at the disaggregation of STI budget items across categories, detailed in figure 14, most of the increase in expenditure is associated with an increase in R&D allocation for specific institutions, which more than doubled the level of expenditure. The latest fiscal consolidation affected two types of expenditures: fundamental research and other R&D programs and, more importantly, innovation and entrepreneurship programs. In the latter category, programs have disappeared completely, which implies a large concentration of the remaining STI budget on block funding and lack of competitive funding.

Figure 14. Evolution of STI Expenditure by Category

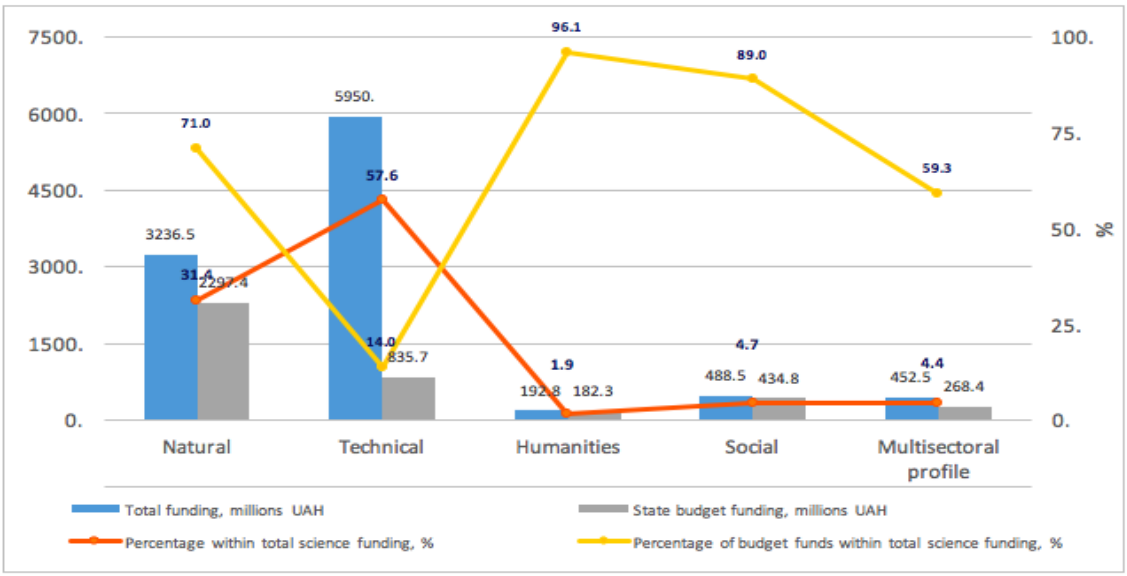


Source: BOOST.

The government directly funded 39.3 percent of the whole expenditure for R&D in 2014. The rest was funded by other national sources (20.9 percent), foreign investments in R&D (19.8 percent), and private funds (18.7 percent).

Figure 15 shows total funding in 2014 for different scientific/research fields in Ukraine from the state budget, revealing that most of the budget (57.6 percent) was allocated to technical sciences, followed by natural sciences (31.4 percent). However, only 14 percent of overall funding for technical sciences came from government sources, while humanities received 96.1 percent of their total funding from the state budget and social sciences 89 percent.

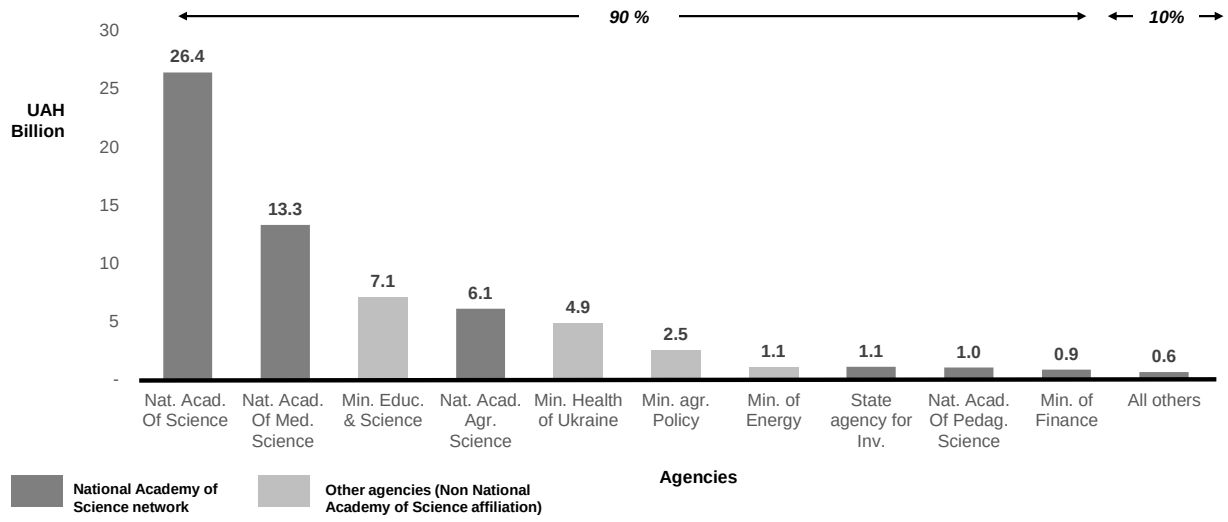
Figure 15. Funding Sources for Different Fields of Science in 2014



Source: MESU - Department of International Cooperation and European Integration (April 28, 2016).

The share of expenditure by agencies shows a heavy concentration of STI expenditure in the National Academies in 2015 (figure 16). The data suggest a staggering concentration of funding available in the National Academies, 53 percent of all resources, and when all the National Academies are considered, the share increases to 64 percent of all funding (annex III).

Figure 16. Overall STI Expenditure by Agency during 2005–2015

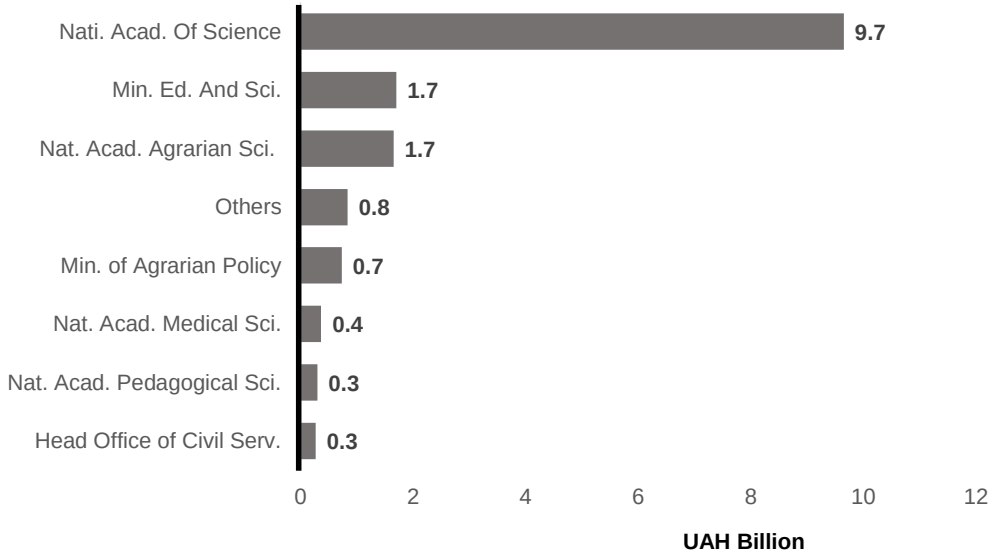


Source: BOOST.

The adjustment in STI expenditure has been implemented primarily in programs run by agencies other than the national academies. The national academies have received fewer resources than in the past, but they have retained a significant amount of core funding. This is the case for all the different types of STI expenditures, including other types of R&D programs, as shown in figure 17, where the national academies have retained most of the share of the budget during 2005–2015. A granular trend analysis

comparing the STI expenditure of the National Academy of Science Network with other agencies can be found in annex IV.

Figure 17. Expenditure for Other R&D Projects during 2005–2015



Source: BOOST.

Internal Consistency and External Coherence Analysis for Policy

The ecosystem diagnostic showed an underperforming private sector, with low productivity and competitiveness levels. Although this is explained largely by the volatile macroeconomic and political environment and the high costs of doing business, the current allocation of public expenditure for innovation does not prioritize the areas of need and the mechanisms to maximize impact.

Three elements emerge as key in hampering the potential impact of innovation policies: poor framework conditions, fragmented governance, and the misalignment between the innovation need and the existing policy mix.

Despite these clear problems identified in the ecosystem, the instruments available in 2016, which are reviewed in the previous section, did not tend to target these critical problems in Ukraine. The only direct instrument to support business innovation and upgrading at the national level is implemented through the EBRD program of SME upgrading.

Most of public STI budget is transferred through direct block grants to NASU, which received 64 percent of public STI expenditures in 2015, to finance in-house R&D capabilities and research. Expenditure to this sector is directed in a minimally competitive basis and with little incentives to generate research that can be commercialized, address the brain drain problem, and incentivize collaboration with industry. In fact, there are no specific instruments to facilitate collaboration between research and existing SMEs. One element that the current policy mix does focus on is international cooperation in research; however, the resources are so scarce that the potential for impact remains limited. Finally, there is hardly any early-stage infrastructure to support the generation of innovative start-ups.

Overall, the policy mix is inconsistent with the demands for innovation policies and biased toward the science part of STI, while leaving technology, especially regarding technology adoption, and innovation marginalized as de facto priorities for policy.

Key Recommendations

The lack of innovativeness of the Ukrainian business sector, which is underperforming in relation to its peers, needs to be a top priority for innovation policy reform. Firm upgrading and adoption of existing technologies are urgent, given the existing low productivity levels. This cannot be resolved only by increasing collaboration with local knowledge providers or increasing joint R&D projects. It is a much broader issue that should include upgrading firms with already existing technologies and broader participation in international activities, through importing inputs, links to FDI, and participation in exports markets of GVCs.

The necessary fiscal consolidation due to the fragile macroeconomic and political situation in the country has exacerbated an existing legacy bias on innovation policies toward the research part of STI. This bias left unattended the support to business upgrading and innovation that is key to competition in OECD economies. At the same time, existing policies and institutions are extremely fragmented, and there have been significant governance problems in the past in some of the private sector support agencies.

The report suggests some specific recommendations for improving the governance of the NIS and rebalancing the policy mix toward achieving these objectives. Along these reforms, the report also proposes a pragmatic innovation pilot related to creating 'spaces of novelty'.

Governance of the NIS

Priority: High (precondition to decentralization and rebalanced resource allocation)

While public expenditures remain low and have been decreasing in relative terms in recent years, there are significant concerns related to policy implementation. These should be addressed before any potential planned program expansion, as they are likely to increase the effectiveness in the use of public funds. In addition, the Government of Ukraine needs to undertake active steps to overcome the abovementioned problems through improving the governance system in STI, reforming the structure of national academies, improving the investment climate, strengthening academic and university research cooperation, and providing better incentives to qualified researchers and entrepreneurs to cooperate and establish innovative ventures. Some specific recommended measures are as follows (with indicative priority and feasibility for quick implementation):

- **Introduce good and transparent policy practices to maximize impact of STI expenditure and enable public expenditure expansion.** Public support to the research sector is currently directed to the national academies on a minimally competitive basis and with little incentives to generate research that can be commercialized and to incentivize collaboration with industry. Reforming the academies with focus on introducing transparent and competitive funding should allow for competent knowledge producers (research institutes and universities) to produce impactful and relevant research results. (priority: high; feasibility for quick implementation: medium)

- **Allocate funding for R&D based on competitive selection to improve research quality.** This is best practice in advanced countries. Programmatic funding for R&D based on competitive adjudication will likely attract stronger proposals than noncompetitive processes and will likely address research problems that are more relevant for the private sector. (priority: high; feasibility for quick implementation: high)

- **Decentralize and grant portions of the innovation support to the regional level.** Innovation happens at the regional rather than national level. A commensurate portion of business support should be decentralized and implemented at the regional level once effective governance systems, competent teams, and anti-capture provisions are established. Leverage private sector (financial) support to some of the industry-specific regional cluster programs (especially collaborative projects). (priority: medium; feasibility for quick implementation: low)

- **Conduct regular reviews to evaluate the extent to which funding allocation is achieving the intended goals and generating knowledge that is effectively contributing to productivity growth, competitiveness, and technological progress in Ukraine.** (priority: medium; feasibility for quick implementation: low)

- **Introduce systematic diagnostics and deliberate measures to identify issues to support the design of innovation policy interventions.** Justifications for funding public research should be based on its potential ability to generate knowledge that is applicable and can be commercialized to foster innovation and technological change. In the current model, proper justifications remain absent. Such justification is an important element when choosing the instruments of the policy mix and the mechanism of intervention. In the case of public research, it is important to establish the rationale for public intervention.[11] (priority: high; feasibility for quick implementation: medium)

More importantly, it is critical to have a change in the priority of STI policies to put business innovation and increase competitiveness of the private sector at the center of this agenda. This requires an alignment of existing innovation strategies that emphasize the role of the private sector in achieving the societal goals of innovation.

Accession to the Horizon 2020 framework program, the EU-supported smart specialization strategy, and other donor-funded programs opens new opportunities for international cooperation and additional financial support that offset the difficult fiscal situation of STI in the last few years. However, before increasing spending, the Government of Ukraine needs to have in place mechanisms to ensure sound use of public resources. It is, therefore, urgent to undertake an internal evaluation of existing programs that complement existing external evaluations, such as the 'Peer Review of the Ukrainian Research and Innovation System' and work in the adoption of good practices in funding allocation and design and implementation of innovation policies.

The Policy Mix

Priority: Medium to high (highly important measure and results driver)

Once some of the governance issues described earlier have been addressed, it is important to shift the composition of the policy mix to reflect these new priorities. The policy mix should include existing,

[11] Arrow (1962) suggests three sources of market failure related to innovation research—indivisibilities, inappropriability, and uncertainty (Link and Scott 2004). Some knowledge cannot be fragmented and commodified in the market, which implies that it cannot be sold in bundles and discourages private activity. There is large uncertainty in the generation of new knowledge and more importantly on its applicability, which discourages access to finance to fund research projects. More important for innovation activities is the issue of appropriability. Very often research application cannot be fully appropriated by the private innovator, since the social benefits far outweigh the private benefits.

reformed, and newly introduced instruments. The recommendations focus primarily on the innovation part of the system. Specifically:

- **Rebalance the budget to provide increased support to enterprise innovation.** Introducing demand incentives will be more effective to induce innovative behavior among firms. (priority: high; feasibility for quick implementation: medium)

- **On the supply side, increase support to university-based research due to its educational and collaborative impact.** Currently, Ukrainian universities are a minor player compared to the National Academies, which consume the majority of the national R&D budget. University-based research is more likely to allow young researchers to participate in research projects and provide private sector collaboration opportunities. (priority: medium; feasibility for quick implementation: medium)

- The rebalanced STI expenditure on enterprise support instruments and interventions should focus on the following key areas:

    - Upgrading of firms' management systems, qualification of staff, and adoption of existing technologies. This should be achieved not only with upgrading programs and a network of upgrading support to SMEs, but also through better cooperation with local knowledge producers, participation in international innovation processes, importing of knowledge and technologies, attraction of FDI, and promotion of exports and participation in GVCs. (priority: high; feasibility for quick implementation: medium)

    - Enhancement of the technology transfer systems that reach out to SMEs and that are implemented by industry specialists. There are several models ranging from technology extension programs to technology centers that can be considered. (priority: high; feasibility for quick implementation: medium)

    - Improvement of the entrepreneurial environment, especially the venture early-stage infrastructure to increase the rates of innovative start-ups' creation and survival. (priority: medium; feasibility for quick implementation: low)

    - Cooperation with local and foreign knowledge providers and between SMEs to develop join innovation projects. This can be achieved by providing some financial incentives for collaboration, for example, using vouchers for collaborative projects. (priority: high; feasibility for quick implementation: medium)

These proposed instruments could be introduced, coordinated, and implemented by an innovation agency or/and other ministries' and institutions' programs at central or regional levels. The World Bank team, through the innovation support project, has been providing technical support to the MEDT and the Reform Delivery Office in the context of designing and setting up an innovation agency (currently labeled as the Innovation Development Office) based on a request from the Prime Minister's Office. This innovation agency is intended to provide support to enterprise innovation in the real economy and is expected to administer and implement several support instruments such as innovation vouchers/grants and research collaboration grants (including several mentioned earlier). The mission, governance and institutional structure, areas of focus, pilot support programs, and budget are all currently under consideration by the main stakeholders. This report, in addition to other analytical work produced by the team, helps make the

case for such an agency and its missing role in supporting enterprise innovation but intentionally holds back from prescribing the details of the institution and its programs, which are addressed in a separate note.

Toward a Pragmatic Innovation Agenda[12]

In addition to the systemic governance and policy mix reforms discussed earlier, the report proposes a specific piloted program that could create an environment conducive for innovative practices. A pragmatic innovation agenda in Ukraine could be delivered by creating 'spaces of novelty'. Novelty in the sense of a proactive project generation procedure in contrast to mere project selection (more of the same). These can become an attractive proposition by reducing the grip of vested interests in policy support and by making sure that new agents of innovation participate in the process, preferably under collaborative schemes.

Spaces of novelty represent a focused procedure to generate collaborative projects in a specific problem domain, for example, agribusiness innovation. They rely on bootstrapping—introduction of diverse incremental changes in which a favorable balance of risks and returns encourages the first steps from a variety of entry points.

Current conditions can be particularly conducive to create spaces of novelty. First, the current conflict can act as a trigger to push local actors to depart from the rent-seeking state. This can also be described as a 'stick' type of incentive. Second, the promise of European integration for Ukraine represents a call to action, a business opportunity type of carrot incentive. Third, Ukraine presents agencies led by policy entrepreneurs that can use 'sticks' and 'carrots' and tap into opportunities to build a project portfolio.

The 'spaces of novelty' approach could be piloted in Ukraine by the envisioned innovation agency in either sectoral or regional settings. In a sectoral setting, the Ukrainian innovation agency could establish a two-stage competitive procedure to generate innovation consortia. Within this two-step selection procedure for large-scale innovation consortia, policy makers select collaborative projects per specified criteria embodied in the design of the call for proposals. Public space is first scanned for dynamic exceptions from the general rule—for better performing segments. In the second stage, an independent review board (which is at once competent and credible) can work with prequalified awardees to ensure the presence of synergy between participants and to assist them in the design of their projects. These dynamic segments of participants are then invited to collaborate under a framework program. Partnerships are thus created based on performance of existing programs and the functioning of the agencies housing them.

A shift from the present 'R&D project' culture to a sustained long-term collaborative effort of building applied research and technology consortia of a strategic nature is required. A consortium for industry-specific innovation (agribusiness as an example) could be selected through the competitive two-stage facilitated process following successful models (such as the Call for Proposals of Australian Ministry of Industry, Science, and Higher Education[13]). Details of the project generation procedure, selection criteria, overseeing bodies, and monitoring and evaluation could be fleshed out accordingly.

[12] Draws upon a policy proposal by Yevgeny Kuznetsov (2017), "Shaking Up 'Business as Usual': Towards Pragmatic Innovation Agenda in Ukraine."

[13] Australian Department of Industry Innovation and Science: https://industry.gov.au/Pages/default.aspx.

Long-term large-scale technology consortia, with an objective to build critical mass, can be described as a bundle of interlinked projects and services in R&D, human resource development, testing and metrology, and others to address specific problem. A diverse group of agents including international knowledge organizations and private sector users could participate in the process of the articulation and funding of the portfolio.

Appendix I. National Policy Aspirations for Business Innovation

National STI priorities are defined by two laws: (a) Law of Ukraine on the Priority Directions of Science and Technology (adopted in 2001) sets the S&T priorities for 2010–2020, focusing on efficient use of energy, power, and natural resources; development of life sciences; and creation of new substances and materials, and (bi) Law of Ukraine on Priority Directions of Innovation Activity in Ukraine (adopted in 2011) sets priorities in innovation for 2011–2021.

The priorities are aimed at the development and introduction of new technologies in the field of energy transportation, energy efficiency, resource saving, alternative sources of energy, transportation, spacecraft and aircraft manufacturing, shipbuilding, armament and military sector, production and processing of materials, nanomaterials and nanotechnologies, pharmaceutics, health care, environmentally friendly manufacturing, information and communication technology (ICT), robotics, and agriculture.

The main legal act on research in Ukraine is the Law of Ukraine on Scientific and Scientific-Technical Activities (last revision in December 2016).

The measures related to defining priorities for scientific activities, enhancing R&D quality according to the EU standards, and improving the governance in the area of research.

In March 2015, Ukraine joined Horizon 2020, the EU research and innovation program. This provides new opportunities to Ukrainian research institutions, universities, and businesses to access EU funding. To use these opportunities, the MESU is preparing a national strategy on cooperation of Ukrainian R&I organizations in the European Research Area. The state measures in this area may be aimed at mobilizing public and private resources, better policy coordination, facilitating technology transfer, and cooperation between science and business.

In 2016, the MESU focused on the increase of the state budget dedicated to R&D, in the following directions: basic funding of the institutions; grants for nationally funded projects; support for the development of research infrastructure; support for young researchers to increase their motivation to stay in or to return to the country; evaluation of state research institutes and universities, and support for access to databases of scientific journals (that is, Scopus, Web of Science, and so on).

Appendix II. Boost Data Identification

The objective of this task is to identify and quantify public spending on R&D, innovation, and entrepreneurship development in Ukraine. The resulting output is a unified database of the central government spending that captures all relevant sector expenditure items, as well as the overall budgets of selected entities involved in the financing of R&D, innovation, and entrepreneurship development in Ukraine.

Data Collection Efforts and Methodological Approach to Data Collection

There is little international guidance on how to collect and identify government expenditures on R&D, innovation, and entrepreneurship development. The attempts to collect such information were typically complicated by the fact that such expenditure items are usually reflected in the budgets of multiple government agencies (primarily central government ones), outlays (for example, education and agriculture), and cost types (for example, investments versus operational items). Fragmentation of the sector financing, on top of its cross-cutting fiscal nature, demands a unified source of information that ideally would be in line with the budgeting process of entities involved in the provision or/and financing of R&D, innovation, and entrepreneurship development activities.

The methodological approach to data collection envisaged by this note concerns primarily direct government expenditures on R&D, innovation, and entrepreneurship, which were directed through the formal government financing channels, mainly the Treasury Single Account. The approach to data collection therefore aims to be comprehensive in scope to account for all R&D, innovation, and entrepreneurship expenditure items, while ensuring that the information collected is consistent, credible, and verifiable.

The Ukraine BOOST database compiled based on the Treasury data is a multidimensional multisectoral fiscal database that covers all national government expenditures. It can be decomposed by the level of government, budget entities, functional, economic, and program classification. By design, it also covers all cross-cutting fiscal areas such as spending on R&D available at the program/project level, among others.

Assessment Framework and Identification Strategy

The expenditure identification stage follows compiling of the unified database that is ready to be used for the assessment. As mentioned earlier, some aspects of the data collection are the preconditions for the effective identification of government spending on R&D, innovation, and entrepreneurship development. These are the line-item structure of the compiled database and the sufficient level of disaggregation, ideally in line with the budgeting process.

The identification strategy follows a bottom-up approach, which implies a screening of the entire database of budget programs for their relevance to R&D, innovation, and entrepreneurship development. Simultaneously, the identified budget programs are reviewed and mapped to one of the categories of a topology. The typology, as presented in Table 2.1, comprises five categories that define the R&D, innovation, and entrepreneurship sector budget in Ukraine. The aim of the mapping was to strike a reasonable balance between the national practices of accounting and reporting of science, innovation, and entrepreneurship development expenditure items and internationally recognized broader categories.

Category 1 identifies sector-specific R&D expenses based on the functional budget classification. The functional classification in the case of Ukraine is COFOG-compatible and therefore includes sector-specific R&D expenditure items explicitly labeled. For instance, in the case of transport, the respective expenditure line item will be '0485 Research and development in transport sector'. The rest of the programs were inspected more closely on their attribution to science, innovation, and entrepreneurship. Activities/programs related to entrepreneurship were mapped to **Category 5**. The expenditure items classified under this rubric include 'Activities related to the creation of a positive investment climate in Ukraine', 'Activities related to the protection of property rights', 'Support for small enterprises', and so on.

Expenditure items that had explicit reference to 'innovation', 'investments in new technology', and 'programs related to the introduction of energy efficiency methods', among others, were attributed to **Category 3**.

Expenditure items that had a broader scope and were related primarily to 'management', 'organization', 'functioning' of government institutions or programs on science, innovation, and entrepreneurship were mapped to **Category 2** labeled as 'program/expenditure line items related to the administrative functions'.

Lastly, expenditure items labeled as 'fundamental research', 'applied research', and some items that were not attributed to Category 1 can be found in **Category 4**. This rubric also includes some expenditure line items that were excluded from the COFOG classification as R&D related.

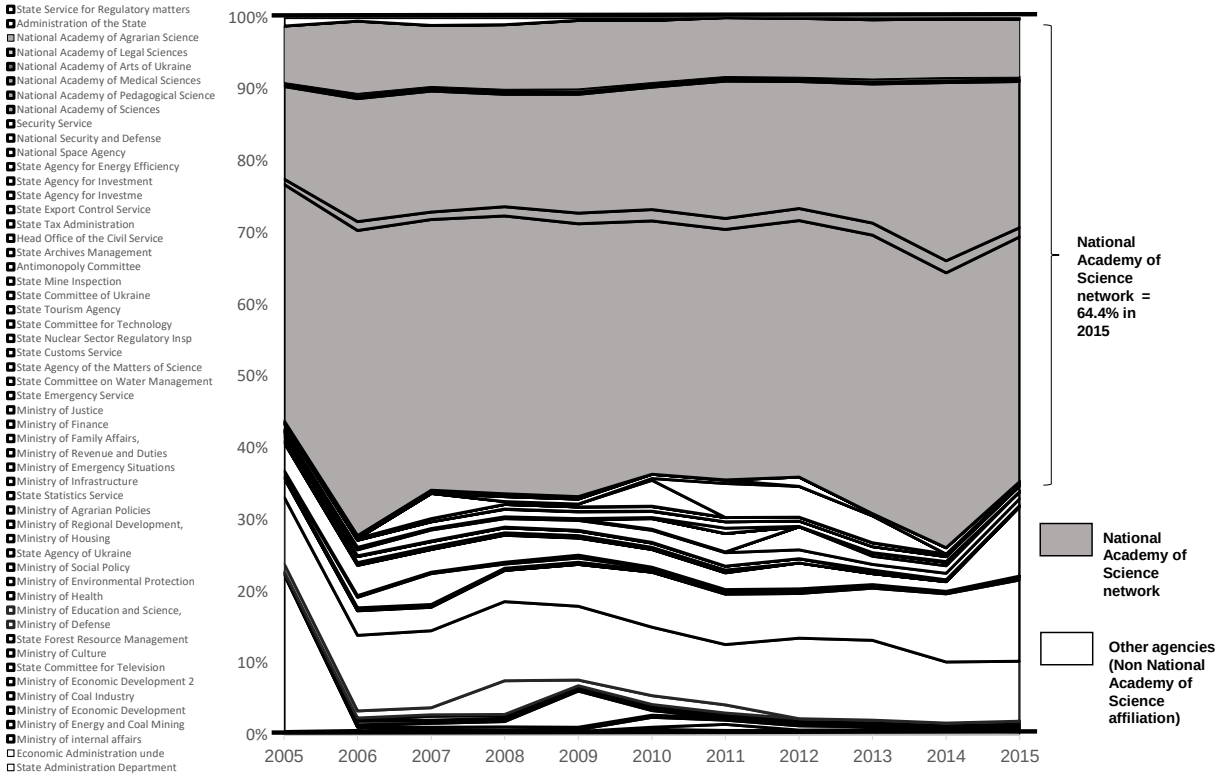
Table 2.1. Typology to Identify Government Spending on R&D, Innovation, and Entrepreneurship Development in Ukraine

ID	Typology
1	Sector-specific R&D and other
2	Program/expenditure line items related to the administrative functions
3	Activities related to the support of innovation and national programs on innovation, including investments in new technology, energy efficiency, and so on
4	Fundamental research and government programs on applied research, science, and other (not attributed to Category 1)
5	Entrepreneurship support and development

Appendix III. STI Expenditure by Agency during 2005–2015

Agency	UAH	Per	cumm per
654 National Academy of Sciences of Ukra	26,400,000,000	0.37	0.37
656 National Academy of Medical Sciences	13,300,000,000	0.19	0.55
220 Ministry of Education and Science, Y	7,090,000,000	0.10	0.65
659 National Academy of Agrarian Science	6,100,000,000	0.09	0.74
230 Ministry of Health of Ukraine	4,870,000,000	0.07	0.81
280 Ministry of Agrarian Policies and Fo	2,520,000,000	0.04	0.84
110 Ministry of Energy and Coal Mining I	1,090,000,000	0.02	0.86
630 State Agency for Investment and Nati	1,080,000,000	0.02	0.87
655 National Academy of Pedagogical Scie	1,030,000,000	0.01	0.88
350 Ministry of Finance of Ukraine	853,000,000	0.01	0.90
210 Ministry of Defense of Ukraine	635,000,000	0.01	0.91
601 Antimonopoly Committee of Ukraine	608,000,000	0.01	0.91
360 Ministry of Justice of Ukraine	584,000,000	0.01	0.92
624 State Agency of Ukraine for Investme	471,000,000	0.01	0.93
121 Ministry of Coal Industry of Ukraine	412,000,000	0.01	0.93
260 State Agency of Ukraine for State Co	383,000,000	0.01	0.94
030 State Administrative Department	370,000,000	0.01	0.95
612 Head Office of the Civil Service of	339,000,000	0.00	0.95
320 Ministry of Emergency Situations of	326,000,000	0.00	0.95
503 State Agency of the Matters of Scien	300,000,000	0.00	0.96
658 National Academy of Legal Sciences o	298,000,000	0.00	0.96
868 State Service of Ukraine for Regulat	297,000,000	0.00	0.97
638 National Space Agency of Ukraine	240,000,000	0.00	0.97
130 Ministry of Economic Development and	210,000,000	0.00	0.97
120 Ministry of Economic Development and	205,000,000	0.00	0.98
250 Ministry of Social Policy of Ukraine	177,000,000	0.00	0.98
657 National Academy of Arts of Ukraine	173,000,000	0.00	0.98
636 State Agency for Energy Efficiency a	154,000,000	0.00	0.98
180 Ministry of Culture of Ukraine	150,000,000	0.00	0.99
100 Ministry of Internal Affairs of Ukra	145,000,000	0.00	0.99
310 Ministry of Infrastructure of Ukrain	123,000,000	0.00	0.99
190 State Forest Resource Management Age	102,000,000	0.00	0.99
549 State Mine Inspection and Industrial	85,300,000	0.00	0.99
240 Ministry of Environmental Protection	83,500,000	0.00	0.99
170 State Committee for Television and R	83,300,000	0.00	0.99
650 National Security and Defense Board	78,700,000	0.00	0.99
370 State Emergency Service of Ukraine	75,600,000	0.00	1.00
275 Ministry of Regional Development, Co	74,700,000	0.00	1.00
270 Ministry of Housing and Communal Ser	51,400,000	0.00	1.00
340 Ministry of Family Affairs, Youth an	42,700,000	0.00	1.00
330 Ministry of Revenue and Duties of Uk	37,900,000	0.00	1.00
041 Economic and Finance Department unde	15,000,000	0.00	1.00
300 State Statistics Service of Ukraine	11,400,000	0.00	1.00
536 State Committee of Ukraine for Techn	10,600,000	0.00	1.00
527 State Nuclear Sector Regulatory Insp	10,400,000	0.00	1.00
652 Security Service of Ukraine	10,400,000	0.00	1.00
611 State Archives Management Service of	10,300,000	0.00	1.00
614 State Tax Administration of Ukraine	7,063,888	0.00	1.00
516 State Customs Service of Ukraine	5,387,299	0.00	1.00
500 State Committee on Water Management	4,681,156	0.00	1.00
548 State Committee of Ukraine for Labor	2,316,982	0.00	1.00
664 Administration of the State Special	1,871,664	0.00	1.00
617 State Export Control Service of Ukra	1,813,300	0.00	1.00
538 State Tourism Agency of Ukraine	239,719	0.00	1.00
	71,739,574,008	1.00	

Appendix IV. STI Expenditure by Agency during 2005–2015, Highlighting Expenditures by the National Academy of Science Network

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