SCIENCE-BUSINESS LINKAGES IN UNECE (TRANSITION) ECONOMIES’

UNECE Innovation Policy Outlook (IPO) policy dialogue

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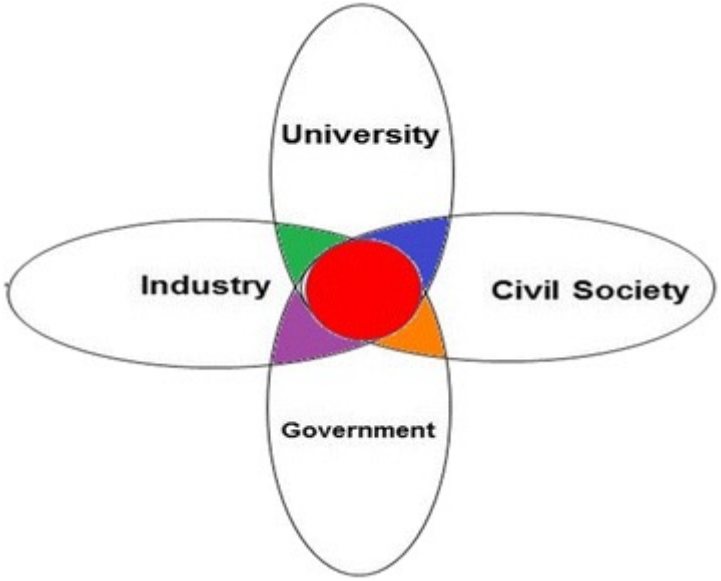

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Why science-business linkages (science – industry) (SIL) matter?

- PROs/UNIs, together with firms, are fundamental players in national and regional innovation systems
- SIL are considered as a mechanism to improve the innovation capacity, productivity and competitiveness of firms.
- Assumption of conventional SIL policy: the more advanced the R&D conducted at local PROs/UNI, the greater the knowledge production which neighbouring firms can potentially benefit from…..

But…..

- Science – industry linkages (SIL) are evolving depending on capabilities of firms and capabilities of universities and R&D system
- SIL appears to be fundamentally driven by the characteristics of the firm rather than by the intensity and quality of the research conducted at the PRO/UNI
- SIL reflect quality of other links in innovation system
  - SIL are part of linkages between large and small firms, between universities and public research organizations (PROs) and knowledge links between domestic and foreign firms

Three competing perspectives on the SILs

1. Triple Helix Ho: PRO/UNI should form direct links with industry to maximize "capitalization of knowledge", academia should be closely integrated with the industrial world
2. 'New Economics of Science': "Open Science" (academia) and "Proprietary Technology" (industry) are distinctively organized and functionally differentiated spheres > a proper division of labor between the two is required
3. 'A context specific' perspective: (1) and (2) are not applicable to emerging economies > not general formula > SIL depend on the capabilities of firms and of the PROs/UNIs
   - Example: The Chinese path shows a shift from close integration to gradual separation within the period of less than two decades (Lee, 2022;

A look at the diverse evidence I

- Silicon Valley as a paradigmatic case of R&D and public sector based private innovation startups …
  - With numerous attempts across the world to emulate it including the US itself (Bayh-Dole Act 1980 with disputable assessment of its impacts)
- Today's presentations on the EU initiatives and Sweden
- Japan in the 1960s and 1970s and Korea in the 1980s, industrial firms (especially, large conglomerates) had a stronger research capacity than local universities
- Taiwan PRC: PROs were essential in technology upgrading in electronics
- Universities in developing countries are oriented towards undergraduate education that mostly utilizes knowledge that is imported from advanced countries

A look at the diverse evidence: China

- China has successfully reared some national champion firms in high-technology sectors **by exploiting its own scientific knowledge base**
- The University Research Enterprises UREs in China are typically **established,** staffed, funded, and managerially controlled **by the mother institutions (i.e. universities).**
- UREs are **"spin-arounds" rather than "spin-offs"**, because they are not really spun "off" from the universities but, on the contrary, **remain strongly connected to the mother institutions**
- Chinese universities were very much oriented toward **downstream activities** (i.e.applied and developmental research and practice of manufacturing prototypes)
- They also enjoyed an IPR regime that is **similar** to that of the United States after the Bayh-Dole Act
- Key factor: **firms' capabilities were very weak**: '*It was very hard to find a firm that has a capability to commercially develop our technologies*'
- Source: Eun et al (2006)

The choice of SIL strategies depend on the capabilities of firms' vs capabilities of PRO/UNI vs opportunities to learn from FDI

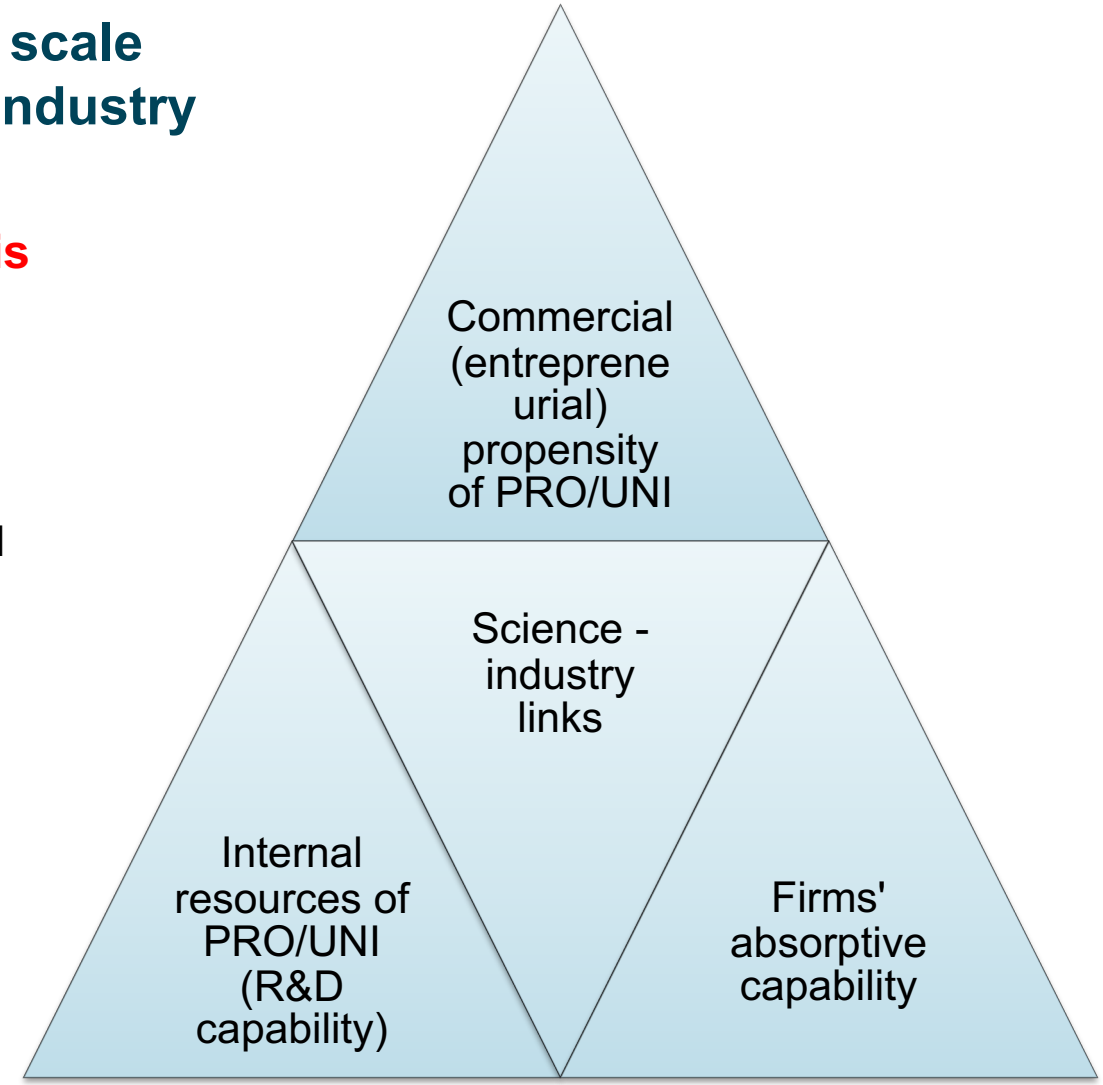
- **"Forward engineering":** new S&T knowledge in public R&D is processed in top–down fashion until it is applied to commercial uses
  - Feasible when firms' capabilities are weak and public R&D in applied areas is strong
- **"Reverse engineering":** upgrading of production capabilities and mastery of imported technology
  - SIL are focused on assisting firms in problem solving, adoption and assimilation of imported knowledge
- **"Parallel learning":** the coordinated acquisition of foreign technology via FDI with the plan for domestic capability building
  - SIL are integral part of strategic FDI policy; if not, SIL weaken

Source: Eun et al (2006)

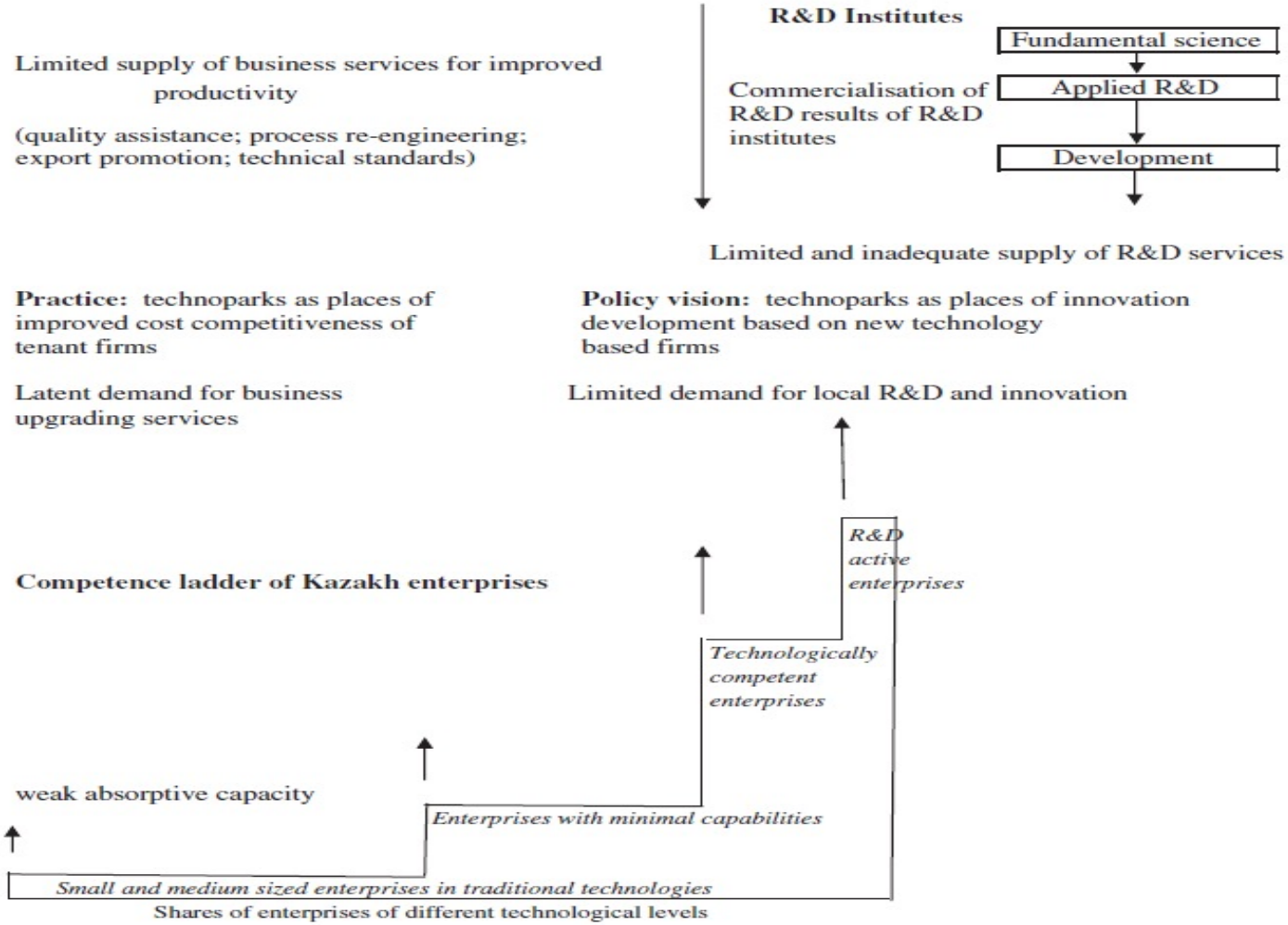
Factors determining the scale and scope of science – industry links

What if none of three nodes is strong as in the UNECE (transition) region?

- UNECE PRO/UNI have low capacity to respond to industrial needs and to pursue economic gains. If so, none of three strategies could be strong
- Key in this case is to **enhance absorptive capacity of industrial firms** and build capabilities of firms through **education and training, joint curricula, contracts, testing and certification services, problem solving**

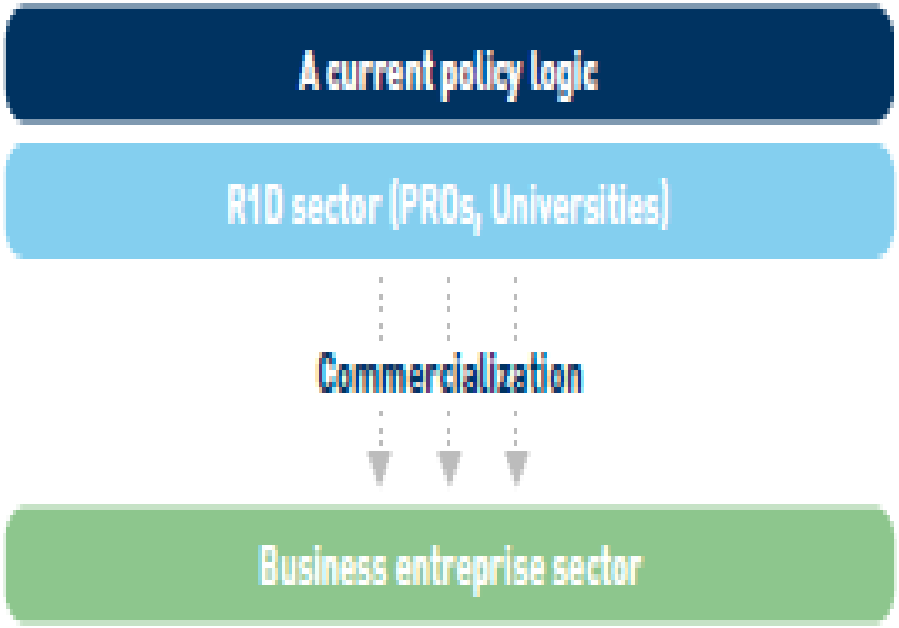


The linear innovation model logic underpinning Kazakhstan's innovation policy: between policy vision and practice



Source: Radosevic and Myrzakhmet, 2009

A conventional view of science – industry linkages which underpins innovation policy in UNECE (transition) economies……



…. is not compatible to reality

SIL in Moldova ranked based on their relevance

Generating public knowledge and training	1. Training skilled graduates 2. Increasing the stock of useful knowledge (publications, patents and copyright);
Problem-solving, informal knowledge transfer and knowledge-intensive services	3. Providing knowledge-based services (testing, certification and metrology etc.) 4. Providing informal networking and knowledge networks 5. Ensuring scientific and technological problem solving
Commercializing	6. Ensuring the sale of intangible knowledge (patents, plant varieties and know-how licences) 7. Creating new firms

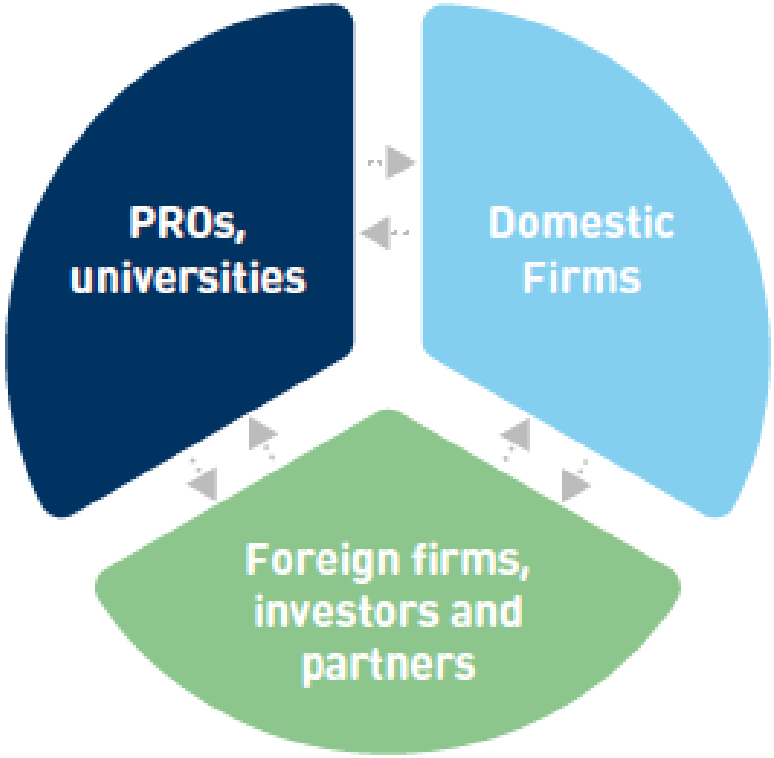
Assessing SIL landscape in Moldova

The conventional view of SIL emphasizes a one-way transfer of knowledge or its means of commercialization from R&D sources to the business sector.

A significant policy focus in Moldova on publicly funded research and its potential commercial applications

However, SILs in Moldova most often involves SMEs seeking assistance in solving problems related to production or certification issues rather than exploring ways to commercialize innovations discovered by publicly-funded R&D.

SILs are very sector-specific, and accounting for the differences across sectors is crucial for policy to be meaningful.

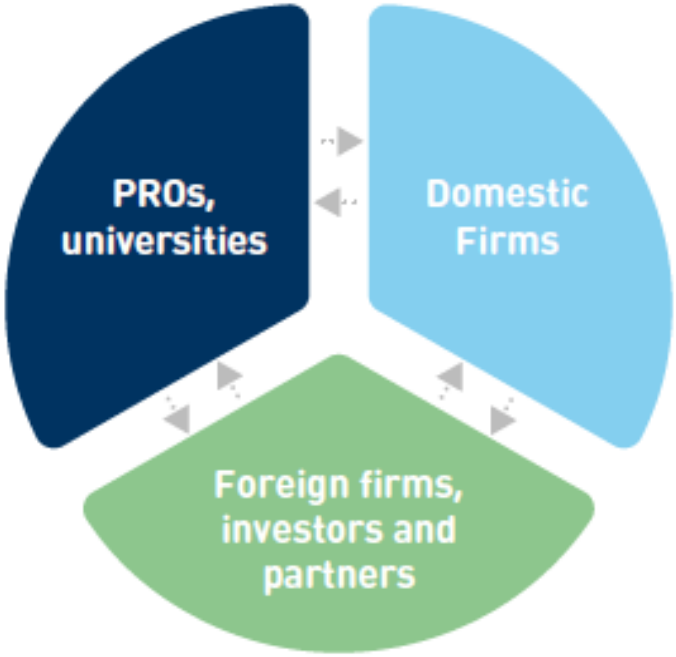


A real triple helix

The Moldovan triple helix model of science industry linkages

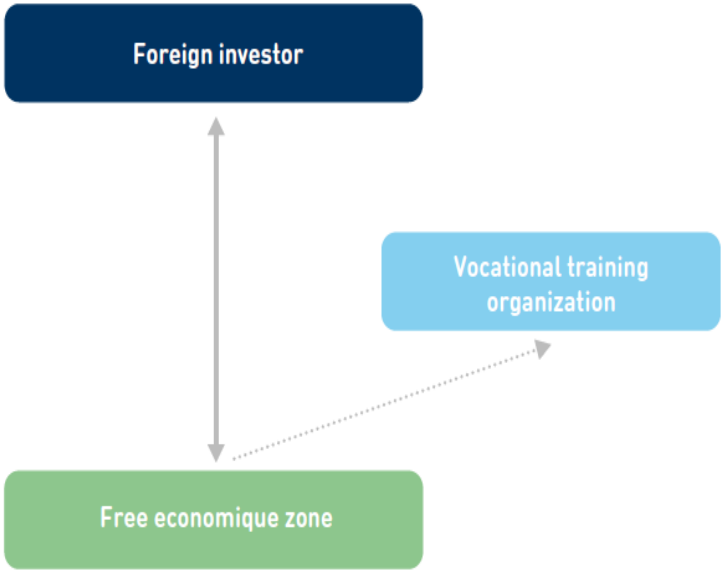
Assessing Triple Helix in Moldova

- Aggregate FDI inflows very limited, contributing to employment and technology upgrades in only a few sectors…. Still, unexplored FDI's potential to open up new areas of growth
- The R&D sector requires restructuring for enhanced quality and efficiency
- The Moldovan business sector lacks the capacity to systematically absorb new knowledge and technology

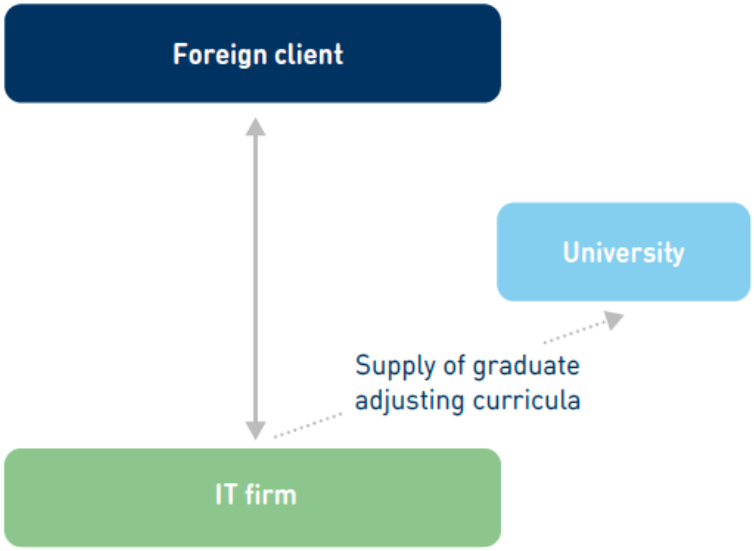


Business ecosystems in Moldova and their knowledge linkages I

Free economic zones' knowledge links

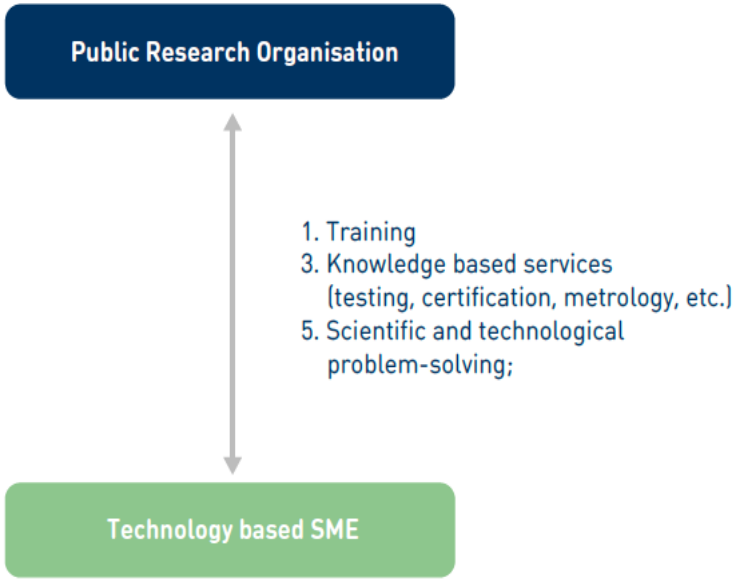


IT sector science-industry links

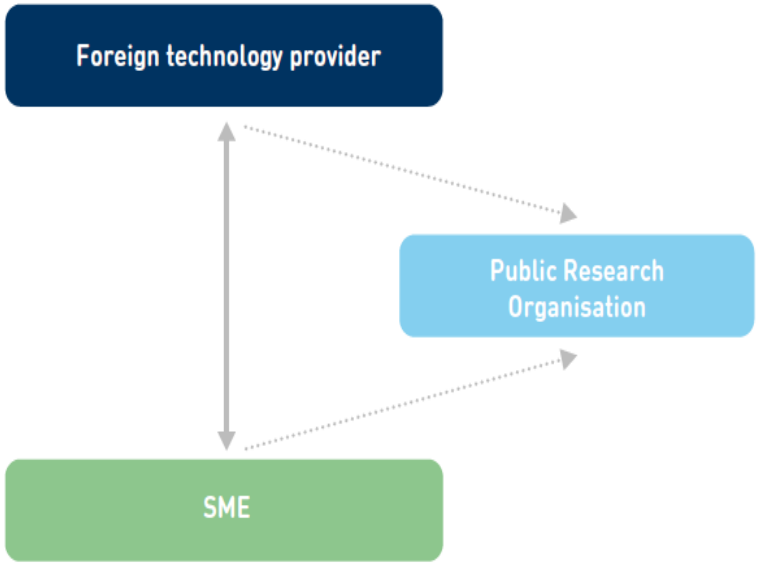


Business ecosystems in Moldova and their knowledge linkages II

SILs in technology-intensive niche sectors in Moldova

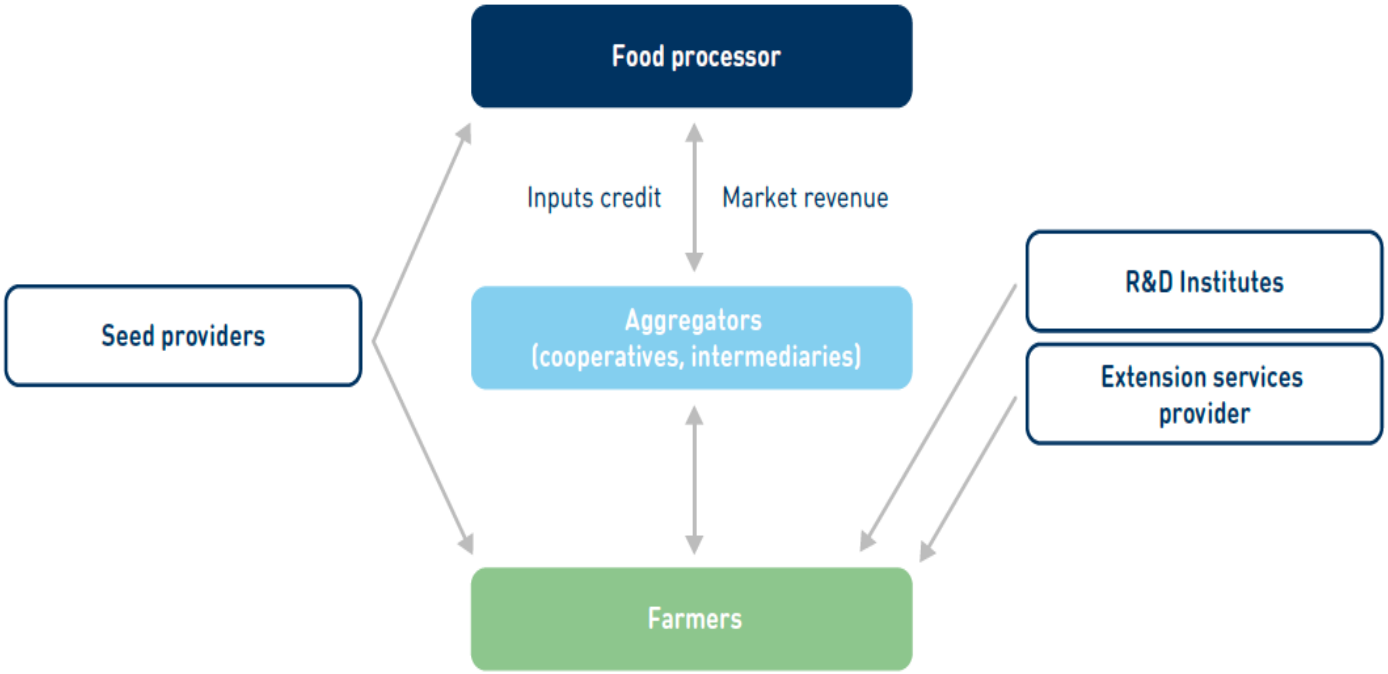


SILs in knowledge-intensive activities in traditional sectors

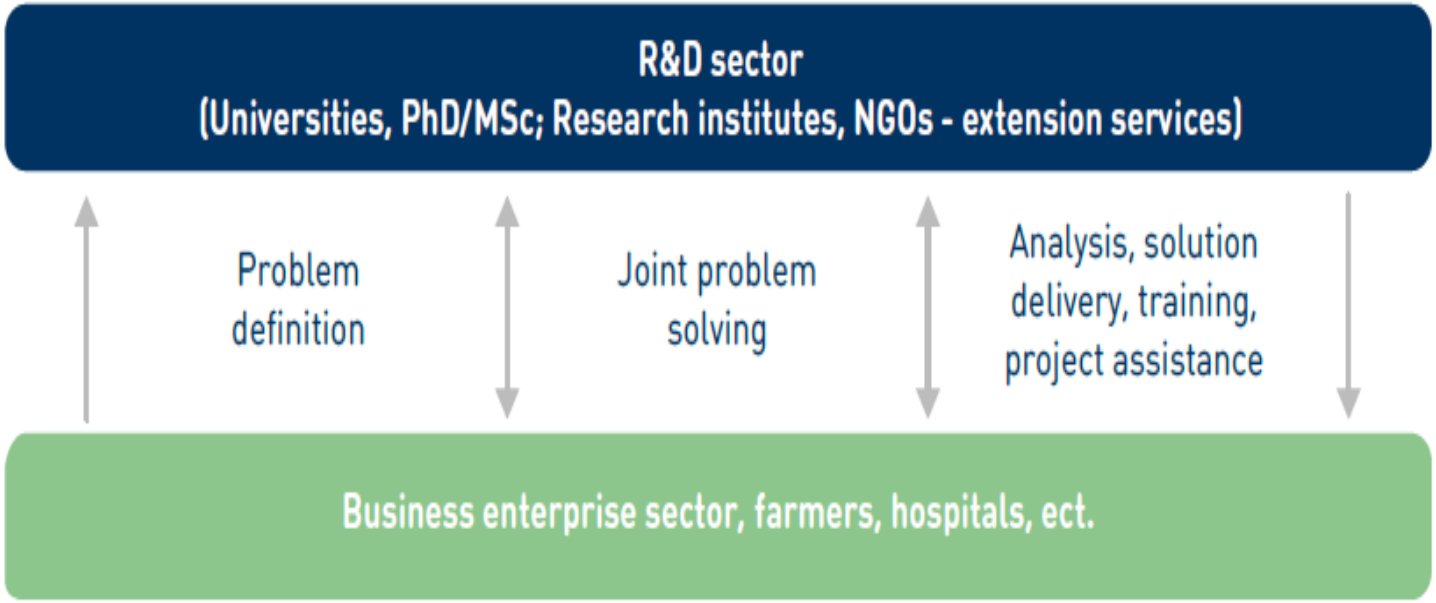


Business ecosystems in Moldova and their knowledge linkages III

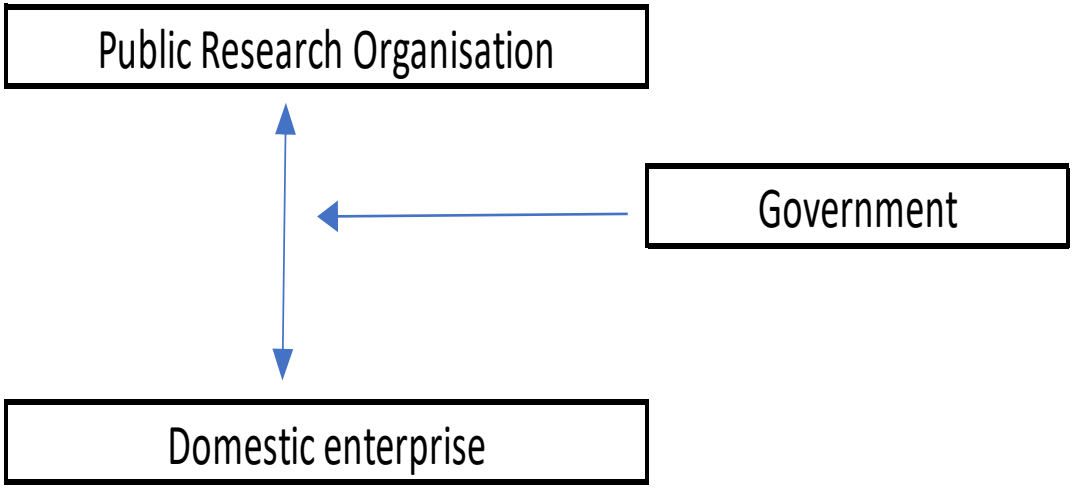
Independent farmers' knowledge and production links



The key features of SILs in Moldova: problem-oriented and demand-driven



Production driven model of Science- Industry linkages: Uzbekistan



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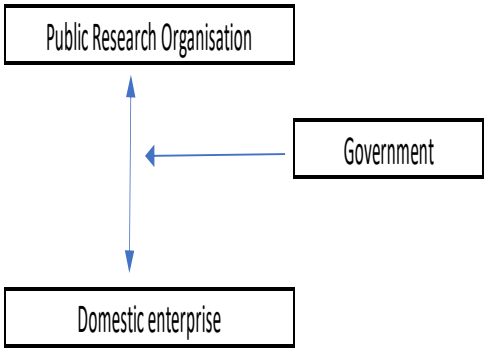


- The current SIL model reflects the policy of **import substitution and strong localisation** of production activities.
- This model has reached its **limits**
- It stimulates **local production and diversification**, which is beneficial in building a variety of technological capabilities
- But it **ignores innovation, specialisation, economies of scale, and export competitiveness**.
- It promotes **'reinventing the wheel'** type of activities and is probably insufficiently cost, energy and environmentally sensitive

Gradual transformation of SIL model: towards 'reverse engineering' and uncertain 'forward engineering' potential

Volume of R&D by types of activities: Uzbekistan

	2000	2020
Research	54.3%	**66.8%**
Design and technological activities	**10.5%**	7.5%
Prototypes, parts, productions	**15.1%**	0.4%
Design work for construction	**12.8%**	6.9%
Scientific and technical services	7.2%	**18.4%**

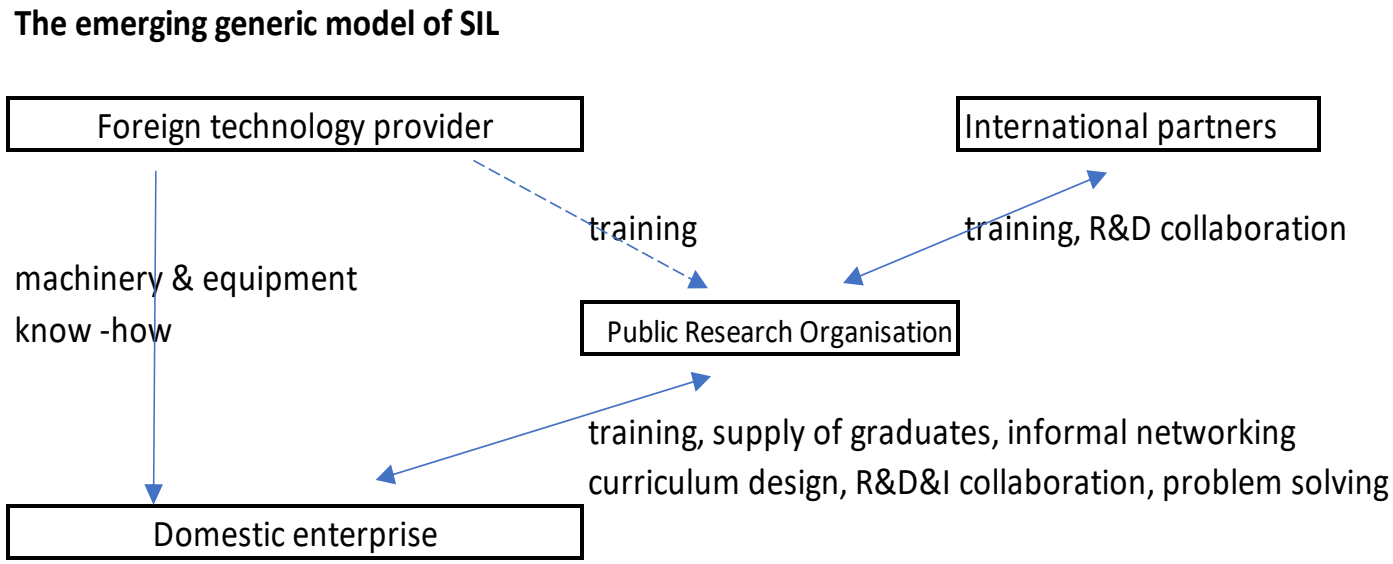
'Polarization of R&D spectrum'

- A significantly less engagement in the middle part of the innovation value chain (engineering design and prototypes) and more engaged in upper (research) and downstream (S&T services) part of the innovation chain.

Uzbekistan: the emerging transformation processes affecting SIL

- Increased privatisation may lead to a more substantial role of the knowledge links with foreign investors and much more extensive import of foreign technology with the significantly reduced role of localisation of production;
- Increased autonomy of RD organisations will mean that their criteria of evaluation will shift much more towards standards of international scientific excellence with less regard for daily challenges of the business sector;
- The role of 'sectoral institutes' that have operated as 'industry commons' organisations may be reduced if FDI and privatisation lead to fragmentation of the existing production chains.
- A strong inflow of foreign technology and greater dependence on global value chains (GVC) will lead to significant changes in demand for RTD services which these institutes may not be able to meet unless there is a concerted public program, including the issue of their status

The emerging generic model of the Science Industry links: Uzbekistan



Three strategic options to technology upgrading and science – industry linkages: Uzbekistan

- **New Technology-Based Firms (NTBFs)('Forward Engineering'**): Improve the R&D quality of higher education; active gradual restructuring of R&D institutes; R&D commercialization grants as part of a local start-up systema; matching grants for R&D projects with the private sector
- **Improve absorptive capacity of domestic firms ('Reverse Engineering'):** improve quality of middle-level skilled labour force and enhance production quality and innovation capabilities of firms in all sectors; innovation vouchers as a way to induce demand for productivity-enhancing activities in SMEs; SIL to enhance absorptive capacity of local firms
- **FDI assisted technology upgrading ('Parallel learning'):** using FDI and GVC as levers of technology upgrading (introduce supplier development programs; a strategic approach to FDI linked to domestic firms' technology upgrading)

Guiding questions for discussion:

1. What is the orientation and strategies of universities and PRO towards business sector? What types of linkages are the most developed?
2. What are the most significant institutional (organisational) forms of cooperation between science and business?
3. Which domestic firms are co-operating the most with universities and PROs? What are their attitudes and strategy towards cooperation with PRO and Universities? Are foreign firms involved in cooperation with universities and PROs?
4. Who is driving science business cooperation? Firms or universities and PROs? In which areas the science business cooperation is the most developed? Why?
5. What are the major instruments for supporting science business linkages in your country? Discuss their impact?

THANKS

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