

Chapter 4: KNOWLEDGE GENERATION AND ABSORPTION

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An outline

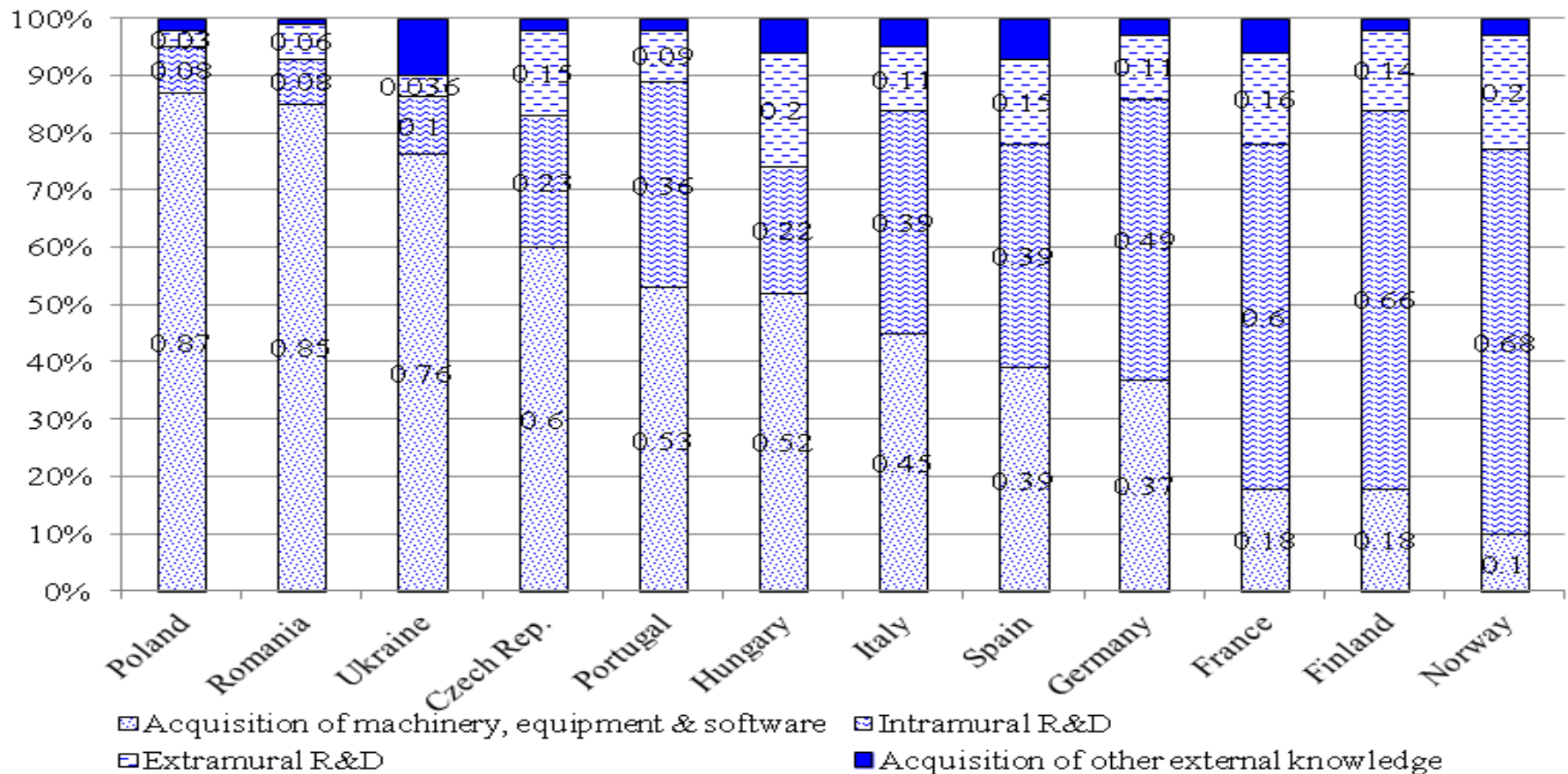
- Innovation in the business sector
- The science and technology system
- The potential of selected industries
- Assessing policy options
- Recommendations

Lessons from innovation studies for Ukraine

- Innovation is **not only about high technology**, and innovative enterprises can be found in high as well as in low-technology industries
- A high proportion of firms in countries like Ukraine innovate **without investing in R&D**
- high growth firms exist not (only) in high-technology sectors
- Policy needs to facilitate technological upgrading of **its** enterprises i.e. it has to be **country specific**
- Is Ukrainian policy country specific ?

Innovation activities of Ukrainian firms are focused primarily on the adaptation of machinery, equipment and software

Structure of innovation expenditures in selected countries, 2008 (except Ukraine 2010)



A low share of innovative enterprises but largely the weakness is in the sector of large firms

| | SMEs innovating in-house <i>Share of total (%)</i> <i>(average 2004-08)</i> | Proportion innovative enterprises <i>Share of total (%)</i> <i>2008</i> |
|----------------|--|--|
| Germany | 46.2 | 79.9 |
| Austria | 39.2 | 56.2 |
| Finland | 37.8 | 52.2 |
| Estonia | 37.1 | 56.4 |
| Portugal | 33.7 | 57.8 |
| EU | 31.7 | 51.6 |
| Czech Republic | 29.8 | 56.0 |
| France | 29.1 | 50.2 |
| Spain | 24.4 | 43.5 |
| Ukraine | 18.4 | 21.0 |
| Romania | 16.9 | 33.3 |
| Poland | 16.8 | 27.9 |
| Slovakia | 16.3 | 36.1 |
| Bulgaria | 16.1 | 30.8 |
| Hungary | 13.0 | 28.9 |

Why large Ukrainian firms are lagging so much as innovators?

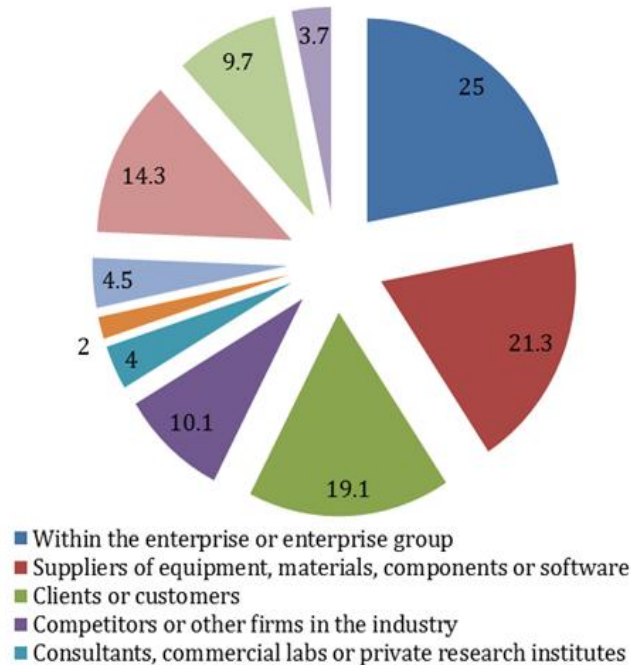
A stable number of around 1,000 enterprises innovators annually
+
The declining innovation intensity or commercial relevance of innovation

Number of innovative enterprises and share of innovative sales in overall sales of industry 2000-2011



Innovation is developed and implemented within its market and institutional context,

i.e. within the value chain and broader industry environment (as represented by fairs and exhibitions).



- **Distribution of innovative enterprises by the most important sources of information for innovation and economic activities, 2008-10**
- Largely, innovation is not based on R&D and does not originate from or in close cooperation with R&D organizations.

Enterprises, which are the major sources of innovation in general, play only a small role in R&D.

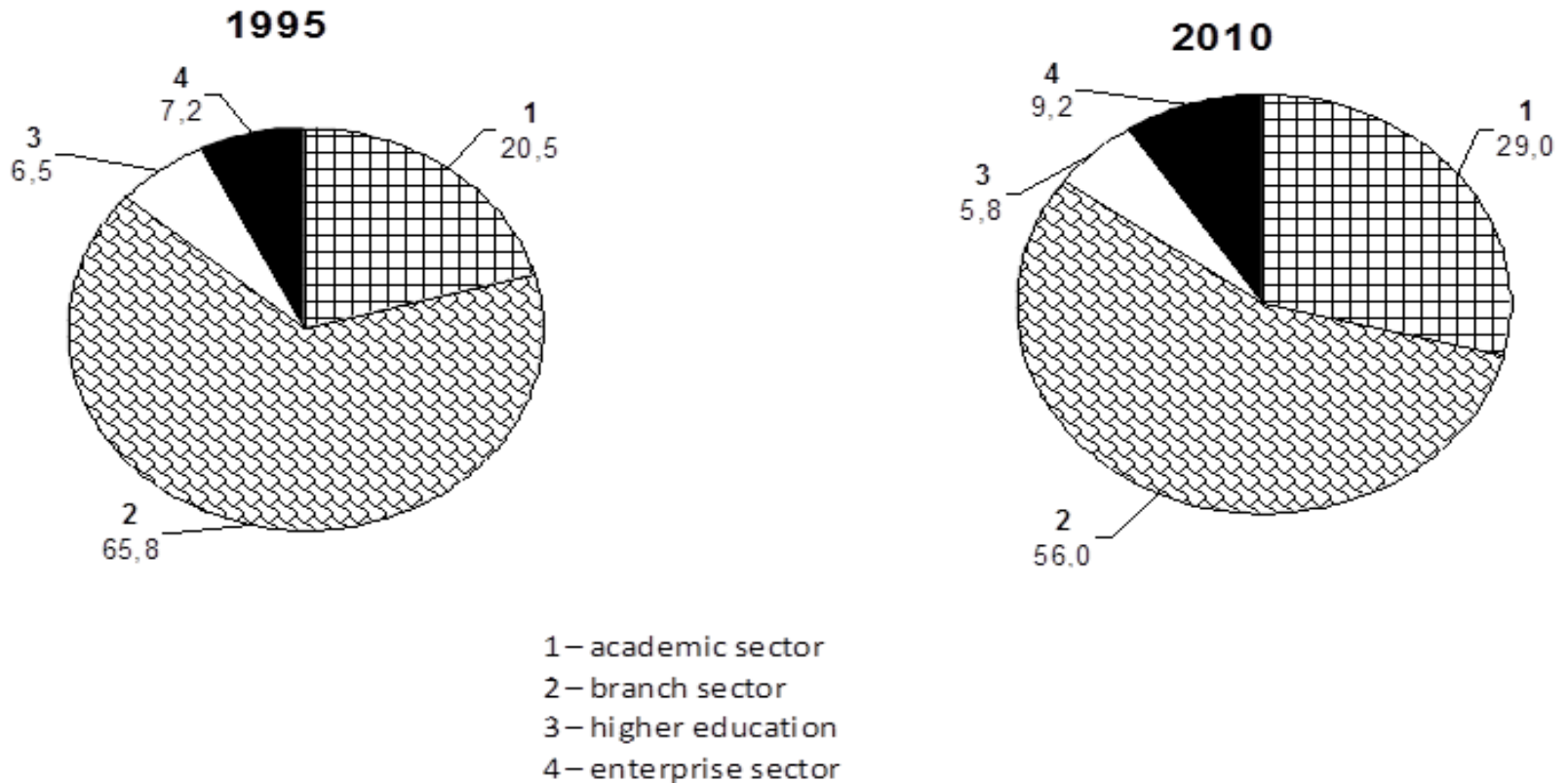
Percentage of innovative enterprises performing intramural and extramural R&D, by size, per cent

| | Intramural R&D | Extramural R&D |
|--------|----------------|----------------|
| Total | 5 | 10.1 |
| 250 > | 18.4 | 22.5 |
| 50-249 | 3.9 | 11.2 |
| 10-49 | 2.7 | 7.2 |

The legacy of branch industrial institutes as performers of R&D

..... a gradual diversification in the performers of R&D.

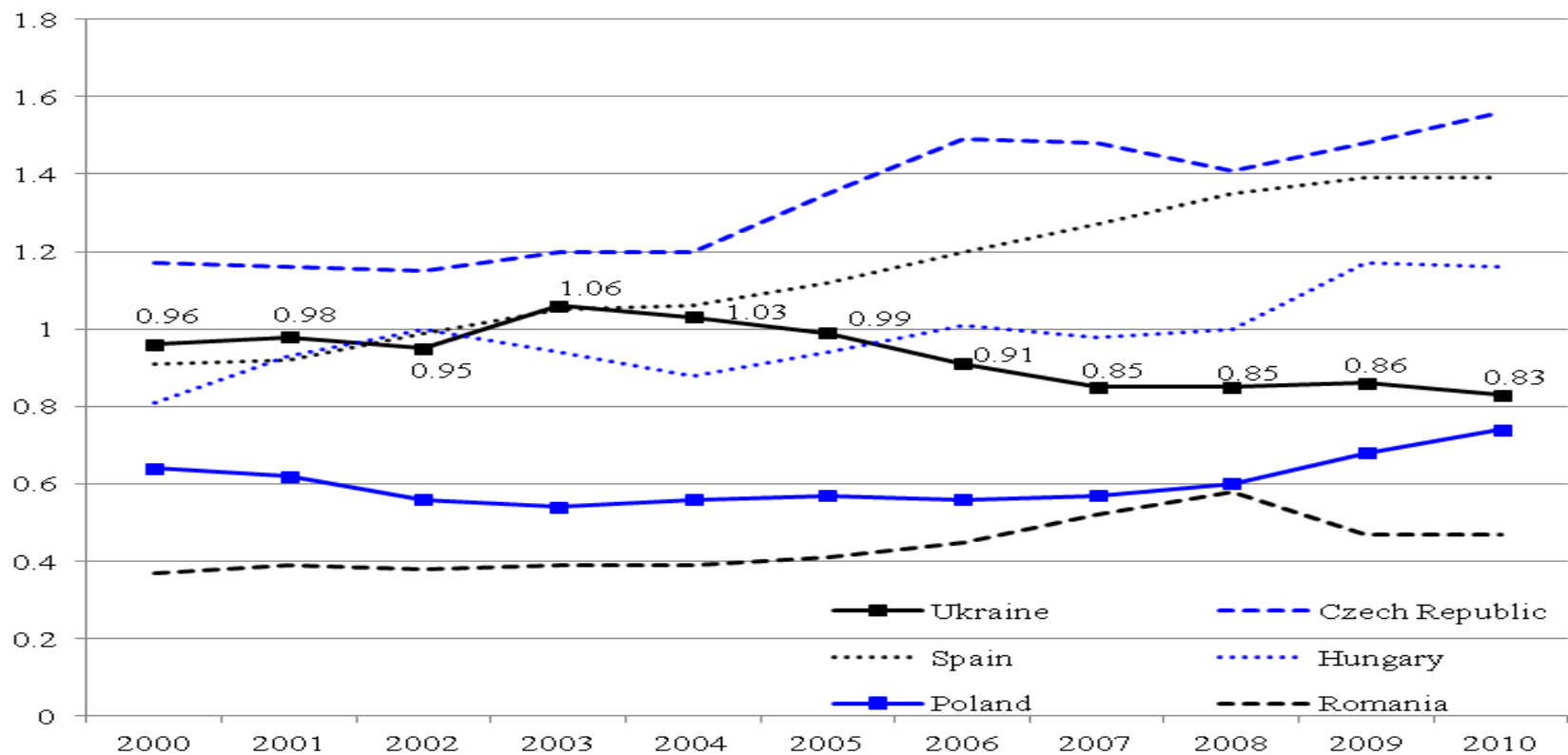
Share of R&D performed by institutional sectors, per cent



The R&D system is not the key driver of the innovation process in Ukraine

1% GERD/GDP: reflect the inherited, public sector oriented R&D system rather than an R&D system that supports ongoing innovation activities and their commercialization.

Share of gross expenditures on R&D in GDP 2000-2010, per cent

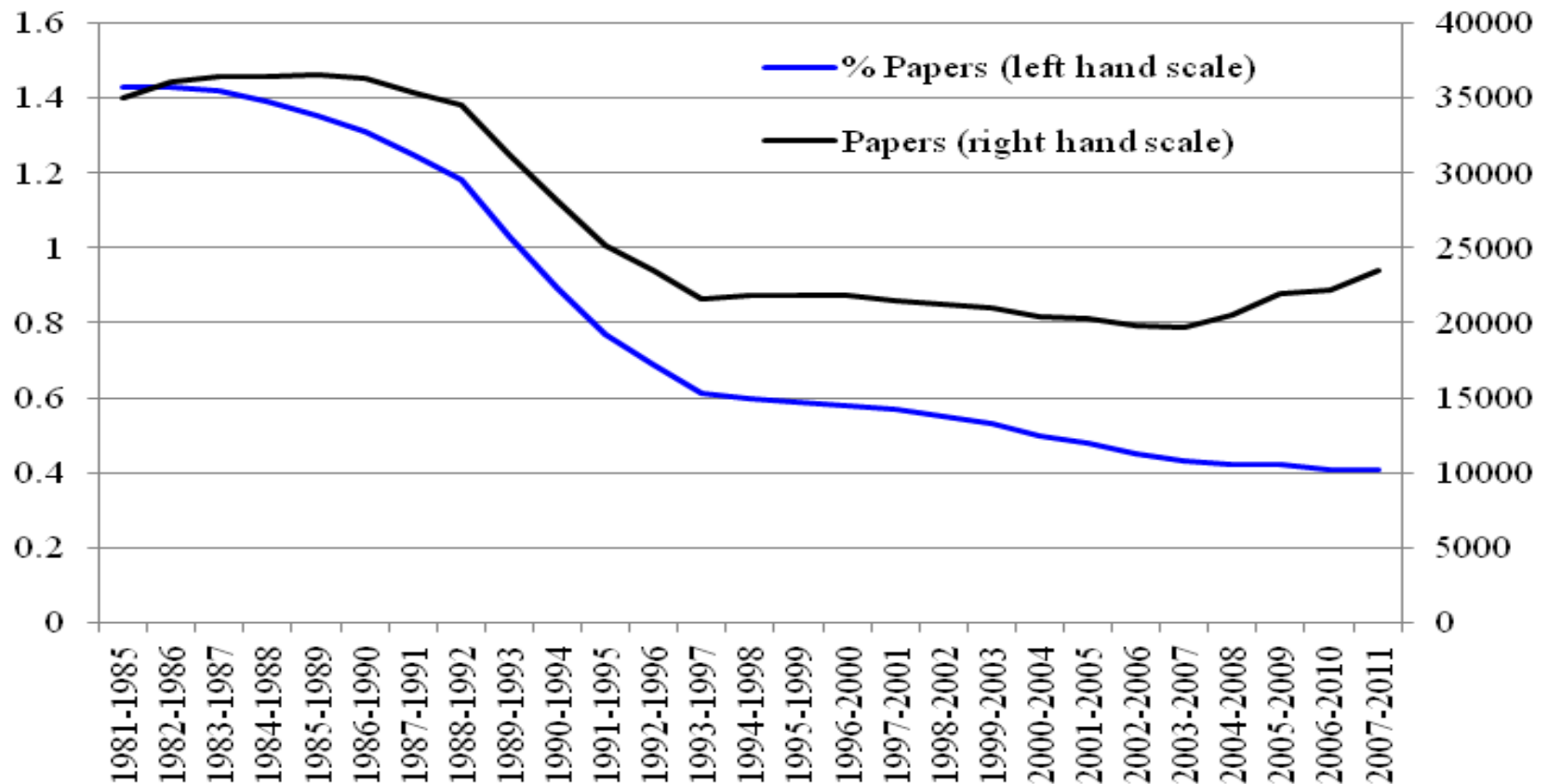


A current policy thinking on science and innovation in Ukraine, according to which R&D is the key source of technology and innovation, is (probably) mistaken

- R&D does play a role, but its effect on local and national economic development is modest in the short to medium term.
- Instead, greater attention should be paid to **helping innovative enterprises to improve productivity** and thus generate **greater demand for R&D**, which would also accelerate the structural changes that have been slowly taking place in the R&D sector.

Ukraine has lost the advantages in science inherited from the Soviet period

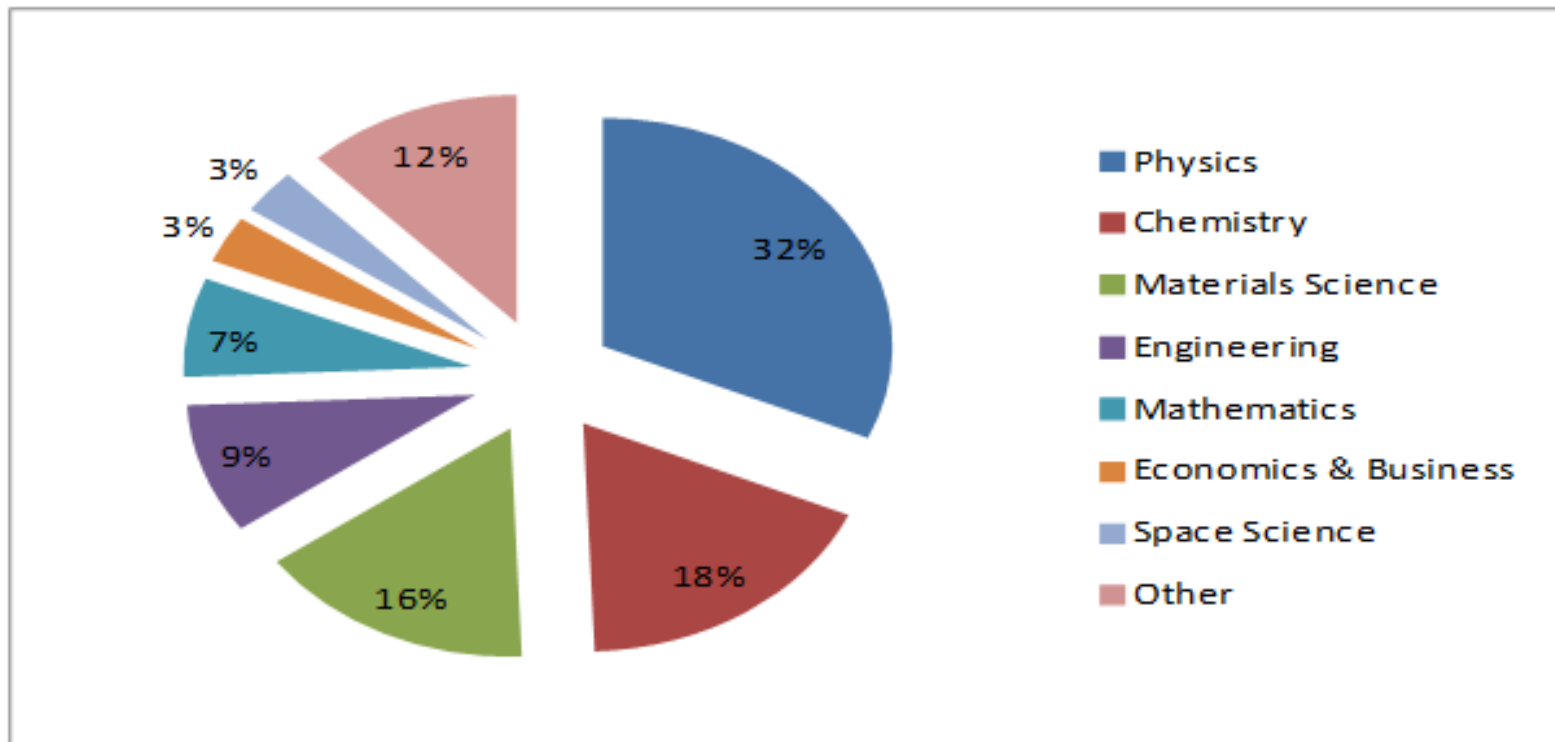
Number of scientific papers and world share, 1981-2011



Physics, chemistry, materials science and engineering dominate scientific output, while the share of life sciences and environment is negligible

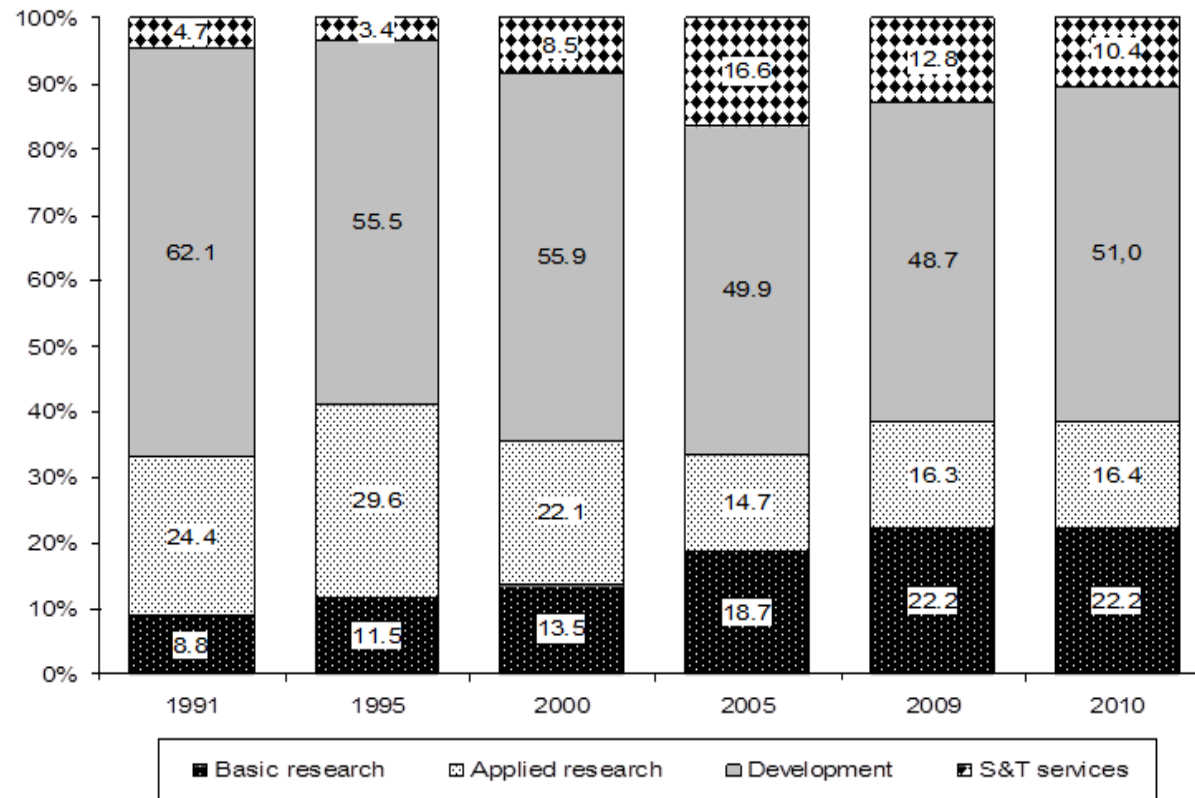
The limited international cooperation on the Ukrainian science system, despite a relatively high share of income which comes from abroad (largely from Russia).

Disciplinary structure of scientific papers of Ukraine 2007-2011



The increasing ‘polarisation of the R&D spectrum’ ie. differentiation in the academic sector between basic science and close to market activities > squeezed applied research

The distribution of academic R&D performed by type of activities %



The effects of polarization of R&D spectrum

- A part of R&D is functioning as a de facto **knowledge intensive services sector** providing testing, measurements, design, engineering services, etc. for the business sector.
- It provides an important source of **complementary expertise** in the form of value-added through technology conceived to enhance clients' productivity.
- The other part of the Ukrainian academic sector has **shifted towards basic research**, and therefore should operate under criteria of **world excellence**.

The criteria of world excellence are not widespread in the Ukrainian academic sector > a significant proportion of the sector is contributing neither to the local economy nor to world science.

It is largely operating in the policy quadrant (4)

A long term policy goal should be **to prioritize locally relevant and internationally excellent basic research**, i.e. to shift from the fourth to first quadrant.

Strategic dilemmas of S&T: between locally (ir-)relevant and internationally (non-)excellent R&D

| | Locally relevant | Locally irrelevant |
|----------------|---|--|
| Excellence | (1) First best/ Virtuous cycle | (2) Second best/Islands of excellence but not relevant locally |
| Non-excellence | (3) Third best/ Locally relevant but mediocre R&D | (4) Bad strategic option/ Locally irrelevant and mediocre in terms of quality/ Vicious cycle |

Policy of passive adjustment ('muddling through') still dominates

- i.e. leaving the academic sector to adjust to changing demand without a clear plan of what model of academic R&D Ukraine should aim towards.
- This 'muddling through' policy seems to have been a rational response in conditions of high uncertainty and decline in GDP during the 1990s.
- However, it is much more difficult to justify continuing this policy for so long.
- Its effect is a very low contribution of the academic sector to innovation in the business sector, as the unreformed academic sector cannot readily offer new types of services.
- At the same time, the business sector does not generate strong demand for academic R&D and innovation services.
- These failures on both the supply and demand side of R&D services have led to a waste of accumulated R&D resources from the past and to an overall decline of R&D intensity in the economy

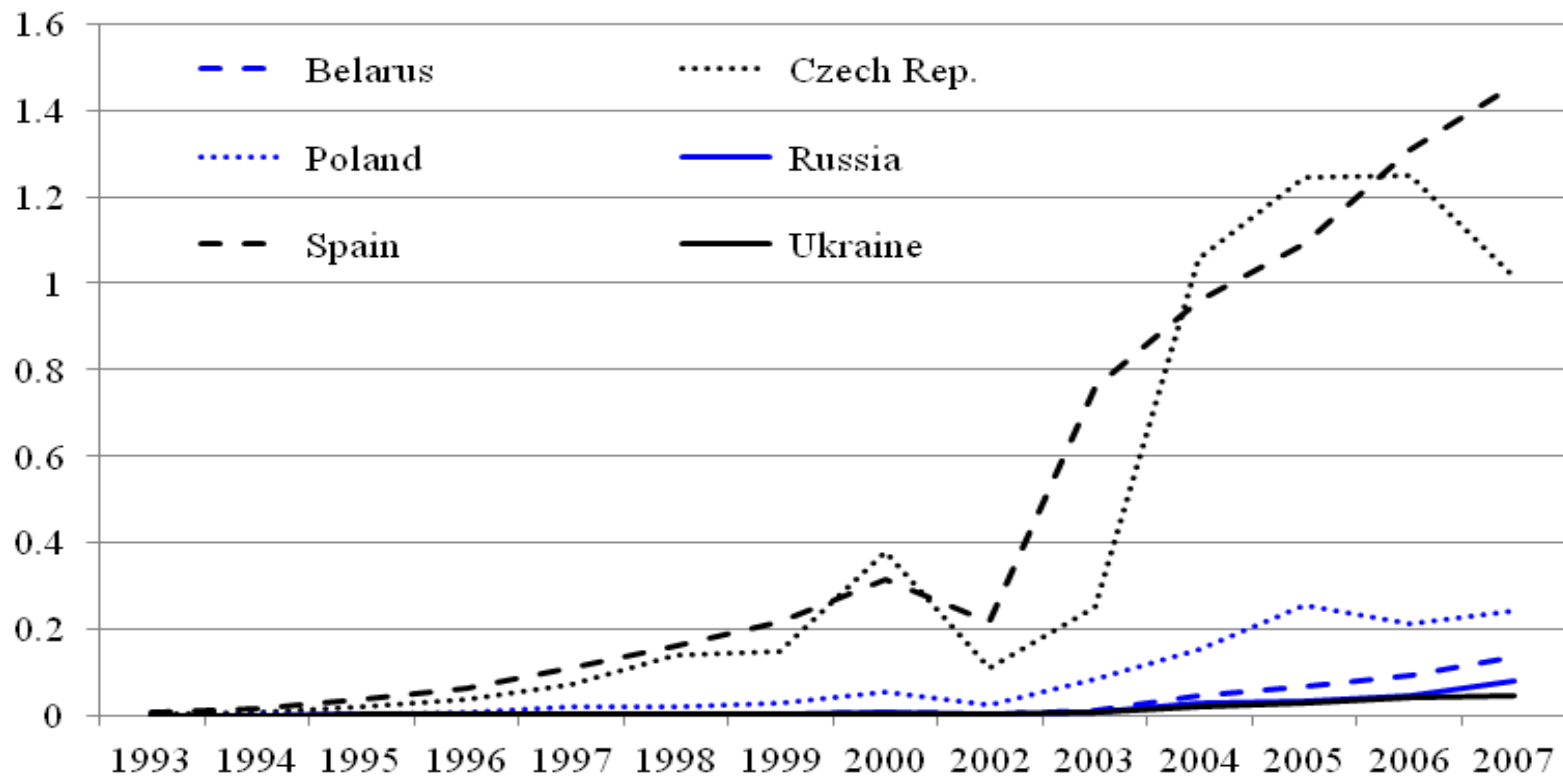
**A lack of competitive pressures in domestic markets
+ low level of integration with global value chains
+ limited FDI in key sectors**

**= a slow pace of technology and industrial upgrading in
Ukraine**

- Ukraine is outside both ‘buyer-driven’ networks such as clothing, as well as the ‘producer-driven’ global network, which includes trade in parts and final manufacturing products (World Bank, 2005)
- Low levels of productivity despite significant wage competitiveness indicate that there are **big problems in terms of reaching world standards in production capability based on standard technologies**

ISO9001 per capita = a sign of isolation from global value chains as well as an indicator of the huge scope for improvements towards best practice in the management of production capabilities.

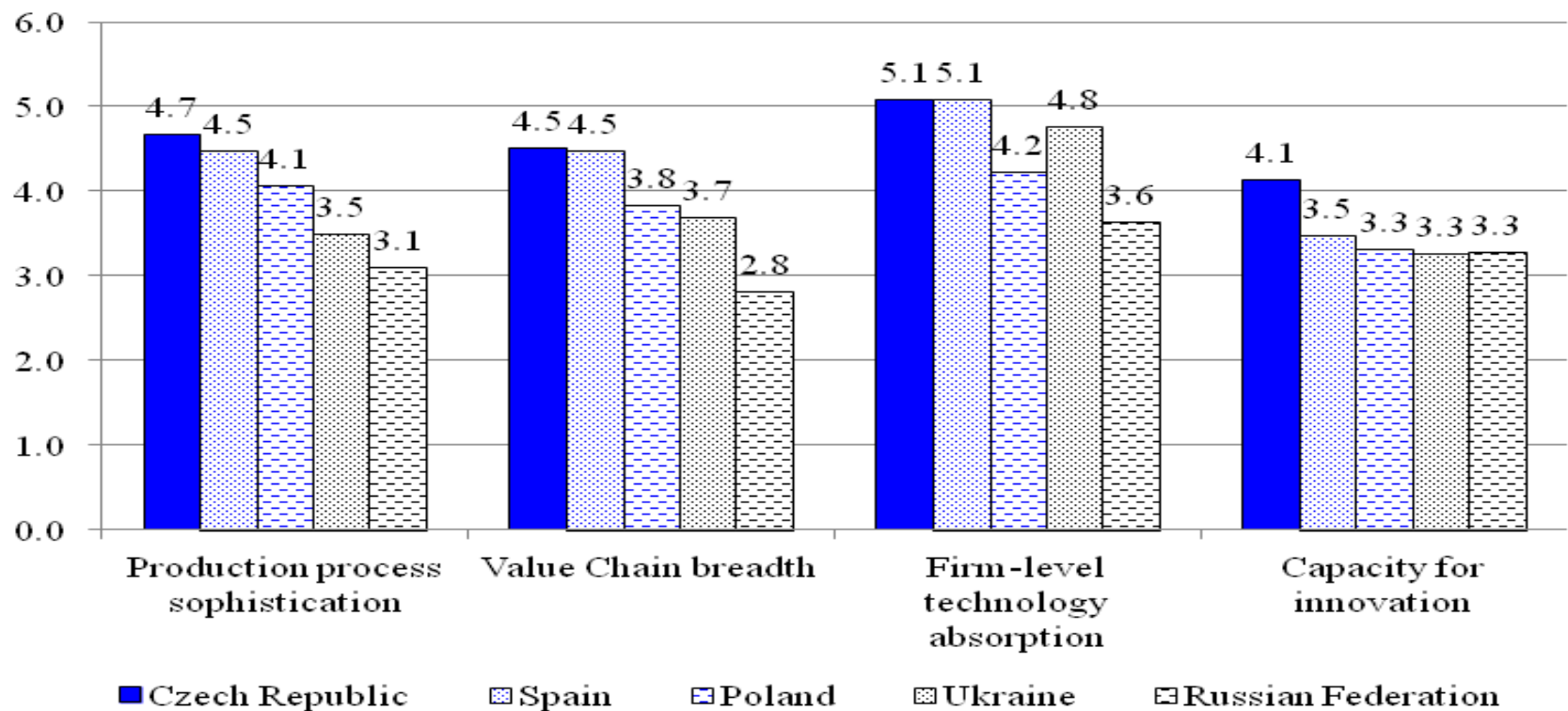
Number of ISO 9001 certificates per 1000 population, 1993-2008



Ukraine lags behind in terms of the level of sophistication of production processes, and the range of value chain functions

The capacity of Ukrainian firms to absorb new technology is an area of relative strength. Its firms are not out of line with comparable countries

Subjective assessment of development of production and technology capabilities in selected countries 2012-13 (scale 1-7)



So far, the policy focus in Ukraine has been on quadrants 1 and 2 i.e. on market enhancing governance reforms and on horizontal or generic innovation policy measures

Policy choices for industrial upgrading

| | Structural reforms | Innovation policy measures |
|--|--|---|
| Horizontal (generic) | <p><u>Market enhancing governance reforms (1)</u> (Property Rights; Rule of Law and Effective Contract Enforcement; Minimizing Rent Seeking and Corruption, and Transparent and Accountable Provision of Public Goods)</p> | <p><u>Horizontal (generic) innovation policy measures (2)</u> (Generic innovation infrastructure; Innovation vouchers; Cooperative R&D programs; RTD tax measures)</p> |
| Vertical (sector/technology specific) | <p><u>Sector specific regulatory regimes (sectoral governance) (3)</u> (Sector-specific privatisation rules; Sector-specific price subsidies; Sector-specific regimes of licences; Sector-specific local content requirements; Sector-specific FDI promotion programs)</p> | <p><u>Sector or technology specific innovation policy measures (4)</u> (Sector or technology specific infrastructure; Thematic R&D programs; Technology platforms Technology or sector specific vocational training programs)</p> |

Examples of bottlenecks in sector-specific regulations as well as in sector (technology) specific innovation policy measures.

- In **agriculture** there is need for removing the ban on the sale of land, but also for policy measures that help farmers reach the quality standards of neighbouring markets.
- In the **dairy industry** there is a need for higher levels of private investments and reduced level of taxation of inputs but also for improving human capacity in the fields of veterinary medicine, feeding efficiency, animal husbandry skills and management (OECD, 2012).
- In **the aircraft industry** the mixed-up defence and civilian status of Antonov is hindering foreign investment and the modernization of the company.
- The system of **technical regulations** is hindering modernization by its complexity, lack of self-regulation, obsolescence and huge scope for administrative discretion.

A trade-off between need for technology upgrading and need for regulatory reforms is false dilemma

- To increase their impact, regulatory reforms should be inextricably linked to potential areas and sources of growth
- Potential areas of medium term and long term growth should be exactly those areas where regulatory reforms should be prioritized.
- These should involve not only the removal of general obstacles for doing business but equally very sector-specific obstacles which are most often the major barriers, targeting specific areas with potential such as ICT or biomass or dairy sector or aircraft industry.
- The aim would be to remove sector-specific institutional obstacles to growth but without creating new distortions.
- This would require addressing failures in inadequate training and investment in human capital in these areas as well as designing technology-, sector- or area-specific investment promotion packages which would not give unfair advantages to foreign investors

Also, sectoral regulatory reforms are not sufficient without sector- or technology-specific innovation policy measures.

- The degree of sector or technology specificity of support can vary and **there is not blueprint.**
- A challenge for Ukrainian policy makers is *to balance horizontal with vertical regulatory reforms and horizontal with technology-specific innovation policy programs.*
- However, the bottom line is that **regulatory reforms and innovation policy measures should be implemented complementary to each other.**

A sector with great potential is ICT, which is the only sector in Ukraine that is integrated in global value chains through ICT outsourcing services

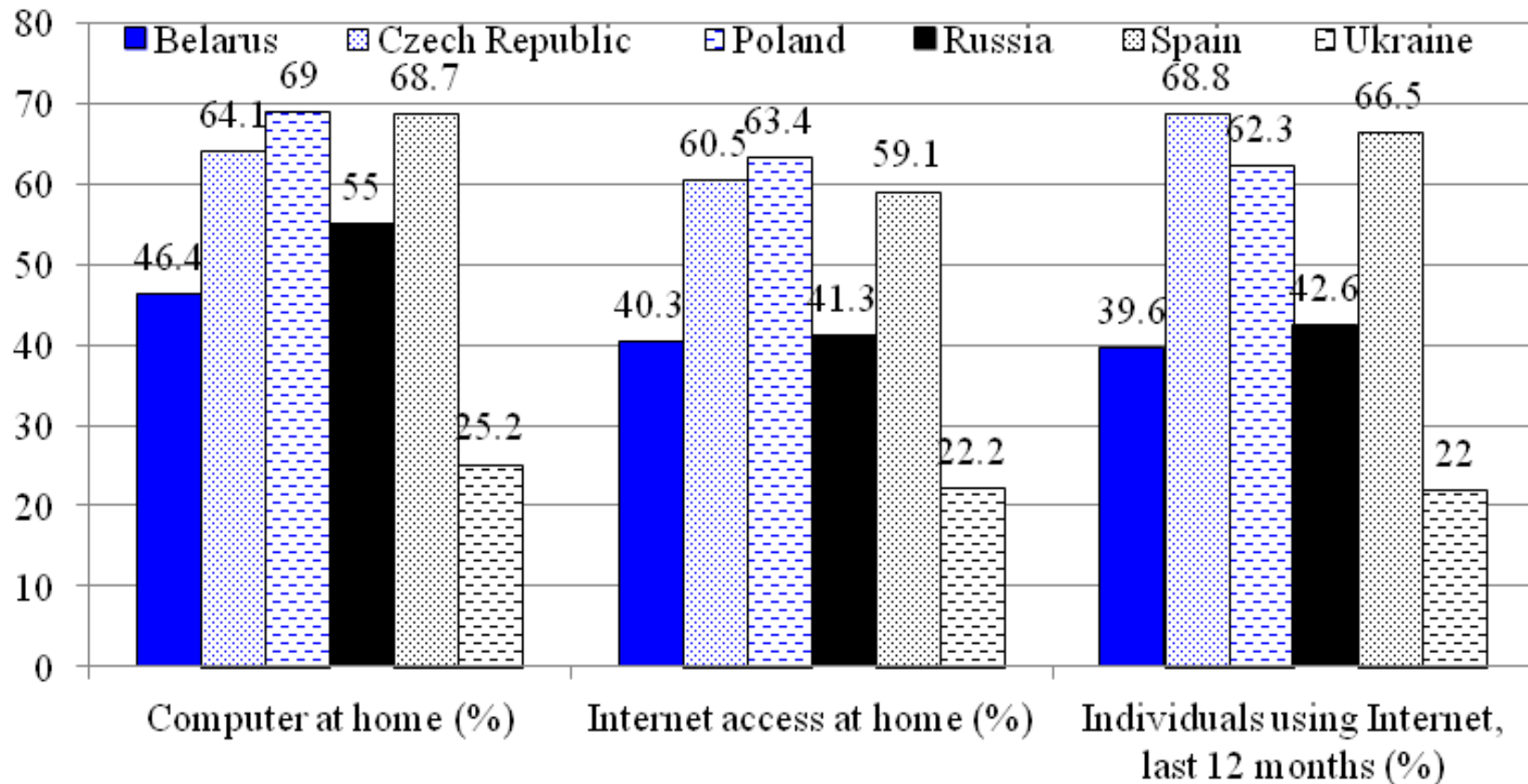
Indicators of Ukrainian ICT outsourcing services from 2007-2011

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|-------------|-------------|-------------|-------------|-------------|
| The volume of provided IT outsourcing services from 2003-2011 (\$m) | 544 | 533 | 697 | 874 | 1,100 |
| Number of IT specialists | 14,000 | 14,400 | 18,100 | 20,800 | 25,000 |
| Number of IT outsourcing companies | 800 | 850 | 940 | 990 | 1,050 |

... so, why its potential is not yet developed

- Why still large share of IT firms operate illegally ?
- A poor business environment that encourages many IT firms to operate informally ? > **market enhancing reforms**
- Not many companies are ISO certified and only four leading companies had earned software industry specific CMMI certificate in 2011. > **sector specific policies**
- A still limited diffusion of ICT among the general population, where low income levels constrain the diffusion of ICT, and Internet services in particular > **generic market reforms and technology diffusion policies.**
- = A good example of causes and solutions which fall within the *Policy choices for industrial upgrading* matrix

Diffusion of ICT among population in selected countries, 2010



R4.1: increases in R&D funding towards thematic programs and technology platforms

- Focused R&D efforts to address specific priorities and the problems of particular sectors would increase the effectiveness of public initiatives and the ability to attract resources from the private sector, including through concerted actions that rely on consultations between major stakeholders. Priority areas could include the food industry, energy efficiency, renewable energies and the ICT industry. The authorities should consider:
- Allocating future increases in public R&D funding to thematic RDI programmes based on criteria of technical excellence and local relevance; and
- Developing technology platforms linked to sectoral working parties for restructuring. These technology platforms should be led by industry and define research priorities and action plans on a number of technological areas. State support could be confined to a coordination role through a secretariat as well as thematic R&D and innovation programmes co-funded by the budget.

R4.2: from generic to technology specific FDI promotion policies

- Ukraine's FDI promotion policy is generic and not focused on promoting innovation. The possibilities opened by the establishment of the State Agency for Investment and National Projects could be used to ensure that **sector-specific FDI promotion is integrated into sector- or technology- specific R&D and innovation support programmes**. In particular, the authorities could consider:
 - **Linking FDI leading to the reduction of energy intensity to sector-specific diffusion programmes of new energy technologies**, as increased energy efficiency has been identified as a key priority;
 - Encouraging foreign companies to set up R&D facilities in Ukraine, through **closer alignment between FDI and innovation policies**; and
 - **Facilitate linkages between foreign companies and SMEs**, including through actions aiming to enhance capacity in the domestic business sector.

R 4.3: innovation vouchers

- The gap between ex-branch institutes and universities on the one hand and enterprises on the other hand could be bridged with the introduction of innovation vouchers.
- These would be given to enterprises and would allow them **to purchase different types of innovation services**; including innovation audit, training, new business and service development, knowledge transfer projects and many others (See recommendation 5.4).

R 4.4: Benchmarking and auditing of R&D systems

- In order to strengthen the effectiveness and coherence of R&D policies, the authorities should **take stock of the current situation and devise a robust evaluation system**. The Ukrainian authorities could consider:
- Conducting an international benchmarking of Ukrainian R&D, **as a whole and at the level of the major institutions** (institutes of the Academy of Sciences; major universities and selected ex-branch institutes) to facilitate comparison with other countries in the region and the EU members; and
- Establishing **different systems of project evaluation and selection for various types of projects and programmes** (basic, applied, cooperative, innovation based programmes and others). The appraisal methodologies should be clear and known to prospective applicants.

R 4.5: Public technology procurement to induce demand for RDI

- This would stimulate technological innovation while at the same time provide **government agencies with new, cost-effective, technical and scientific solutions to meet their needs**. Procurement programmes designed to stimulate the demand for innovation should:
 - **Specify the goals** to be met without pre-judging the technological ways through which these goals could be achieved;
 - **Be open** to both established companies and new ones;
 - **Include a grant element** and other forms of support for innovative companies to help them overcome potential problems with raising financing to develop technologies;
 - Involve **single company contracts** with no requirement for collaboration;
 - Allow companies **to retain the rights to intellectual property** developed through the use of public funds, with no royalties owed to the government, which will retain free use for a specified period; and
 - Be run **through open competition** under rules that are suited to the risky nature of innovation projects

THANK YOU!