The European Commission's science and knowledge service

Joint Research Centre

Towards a better understanding of firms' R&D and innovation value chains: insights from qualitative and quantitative evidence

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CONCORDi 2019

INDUSTRIAL INNOVATION FOR TRANSFORMATION

Seville, 25th-27 th September 2019

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AIM

- Structural changes in the international organisation of R&D and innovative (RDI) activities : fragmentation, disintegration, outsourcing

- New directions for collection of evidence on the geography and organisation of RDI activities

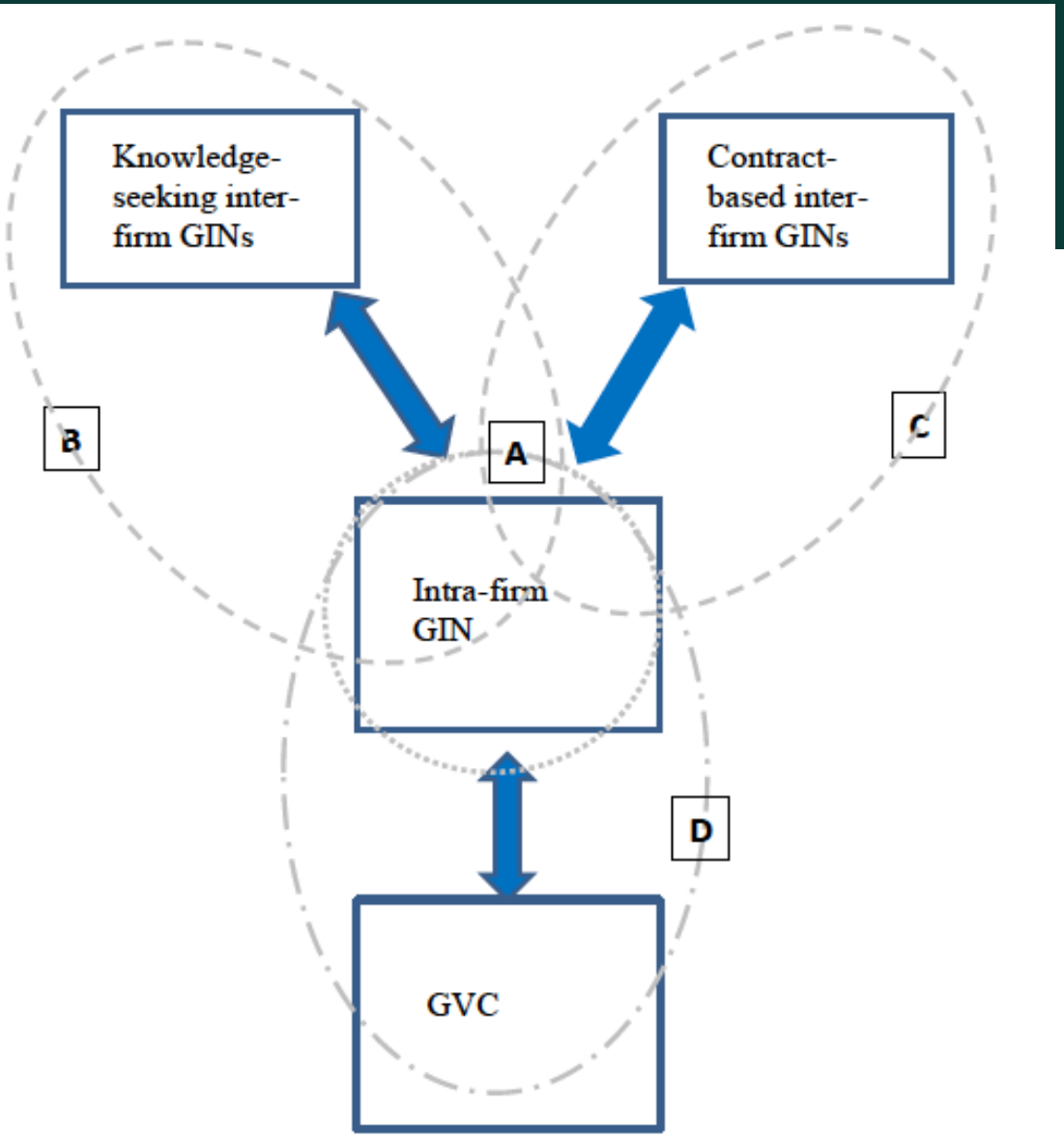
Literature Review (1/2)

- R&D/Innovation often examined as homogenous
- Focus : patents, R&D expenditure, strategic alliances
  - ➔ Linkages with science-base (hence patents) much less to R&D linked to development or production **(e.g. Castellani et al 2013)**
  - ➔ Foster science-base to attract R&D FDI … manufacturing less important But…

- Innovation literature → scientific advances + important source of innovation
- Most firms do industrial R&D, DDT rather than Science **(Pavitt 1989)**
- R&D = different activities… **but little is known about the organisational or geographical configuration**

Cantwell and Mudambi 2011; Narula and Zanfei 2005; Iammarino and McCann 2013; Alcácer et al 2016; Dachs et al 2014; Moncada-Paterno-Castello et al 2011; OECD 2008; Dernis et al 2015

Literature Review (2/2): different types of corporate GINs



Ramirez (2018), *Global Innovation Networks: State of the art and issues at stake for GVCs.*
GLORIA Research collaborations, JRC

Methodology (1/3): Mix Methods

Structured interviews (IDEA/VDI on R&D across GVCs; Dosso, Potters & Tübke 2019)

60 interviews with RDI managers from 10 MNEs : pharmaceuticals, automotive, aerospace, ICT (2017)

→ Technology Readiness Levels (TRLs) → guide to understand the partitioning of RDI

Semi-structured interviews (Dosso & Ramirez)

European MNEs: electric equipment & appliances, pharma firm - Senior R&D managers

Industry expert from Automotive industry

Cross-border greenfield FDI data (creation of new unit(s)) : R&D, DDT, Education & Training, Maintenance & Servicing - fDi Markets database (Financial Times)

TRL: generic R&D value chain

TRL1 - Basic principles observed	**Scientific research is at initial stages.** Initial results are being translated into future research and development plans.
TRL 2 - Technology concept formulated	Once the basic principles are studied & initial findings can be applied to practical applications. At this stage the tech is very speculative as there is little or no experimental proof of concept.
TRL 3 - Experimental Proof of concept	When active research and design begin. Generally both analytical & lab studies are required at this level to see if a technology is viable & ready to proceed further via the development process. Often during TRL 3, a proof-of-concept model is constructed.
TRL 4 - Technology validation in lab	At this stage **multiple component pieces are tested with one another.**
TRL 5 - Technology validation in relevant environnent	Continuation of TRL 4, but, at this stage a technology must undergo more rigorous testing . Simulations should be run in environments that are as close to realistic as possible.
TRL 6 - Demonstration in relevant environment	At this stage a technology has a fully functional prototype or representational model.
TRL 7 - Demonstration in operational environment	The technology requires that the working model or prototype be demonstrated in a space environment.
TRL 8 - System complete and qualified	The technology has been **tested and is ready for implementation** into an already existing technology or technology system.
TRL 9 - Successful missions ops	Once a technology has been proven

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Methodological framework (3/4)

Examples of greenfield FDI project description

Research and Development (R&D): "*an pharmaceutical company, has opened a new **global medicines development facility in Bangalore, India. The centre, which is one of nine worldwide**, will focus on oncological, respiratory, cardiovascular and metabolic diseases. It will create 30 new jobs.*"

Design Development and Testing (DDT): "*a power and automation specialist, has set up a **new robotics application centre in China**. The centre, …, aims to integrate resources in south-west China by providing robots, application, system integration and related customer service. The **centre will develop robots for its clients from various industries**, including automobiles, computers, communications, consumer electronics, equipment and consumer goods manufacturing.*"

Source: fDi Markets database, Financial Times (access in October 2018)
Note: the description of the project is only available for some projects

Methodological framework (4/4)

Examples of greenfield FDI project description

Maintenance and Servicing: " *an engine manufacturer, has opened a new service delivery centre in Bangalore, India. It is the company's first such facility in the country and* ***provides support for more than 750 defence engines used by the Indian Armed Forces****. Located in Manyata Technical Park, the facility provides fleet management, service engineering and supply chain co-ordination as well as serving as a base for field service representatives to provide technical support across the country."*

Education and Training: "*a supplier of photolithography systems for the semiconductor industry, has signed a memorandum of understanding with* ***China-based public research consortium Shanghai Integrated Circuit Research & Development Center to establish a training centre in Shanghai, China****. The facility will provide training to the local customer support workforce as well as to existing and potential customers in the local IC industry.*

Source: fDi Markets database, Financial Times (access in October 2018)
Note: the description of the project is only available for some projects

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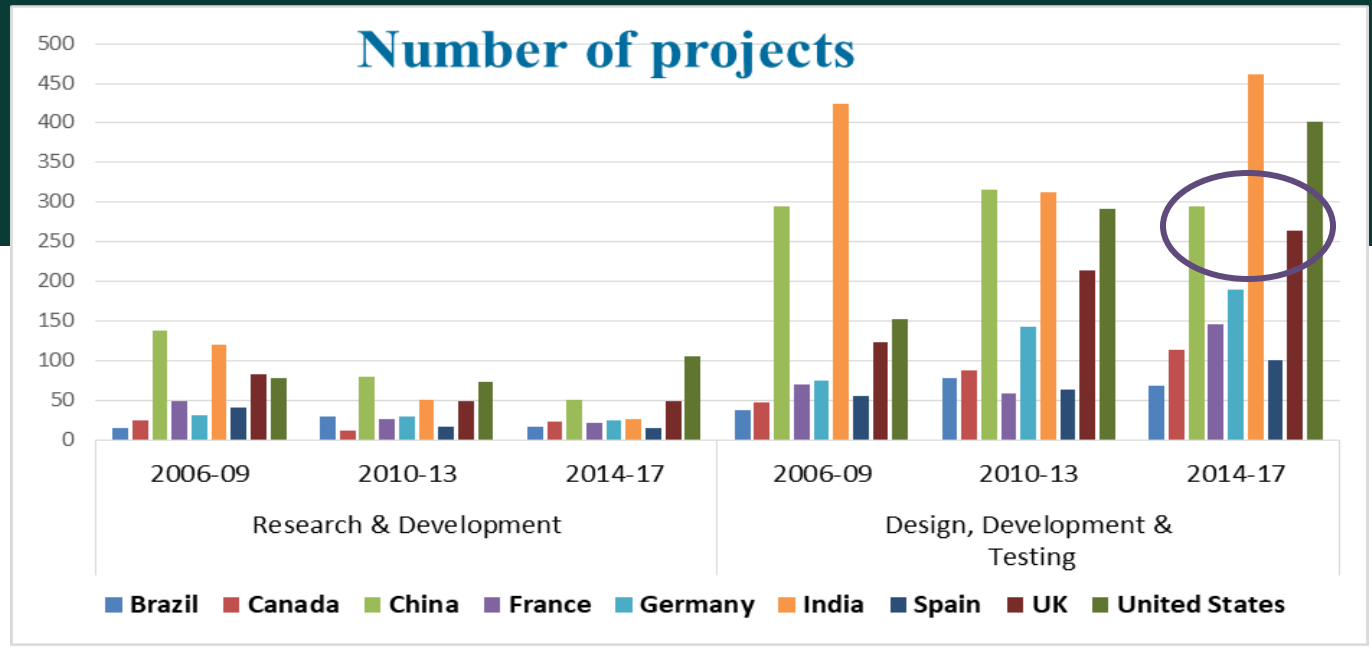
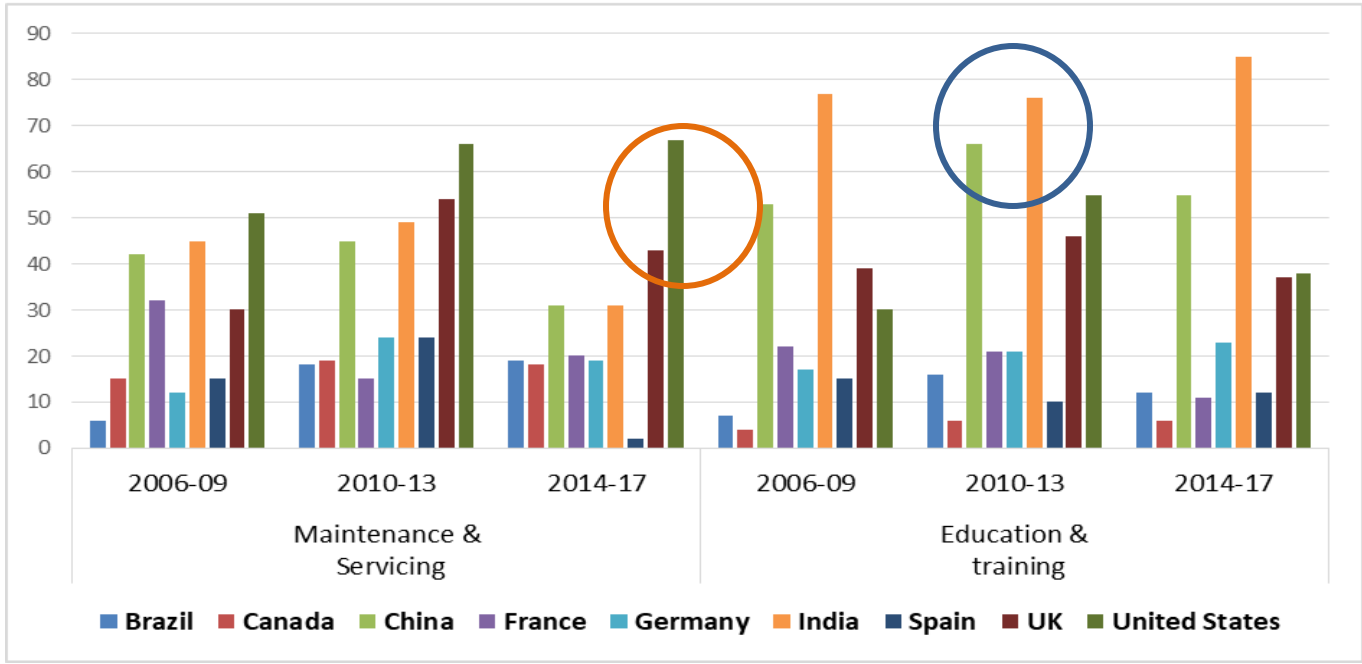
RESULTS

Greenfield FDI by destination countries in

- **R&D**
- **Design, Development and Testing**
- **Maintenance & Servicing**
- **Education & Training,**





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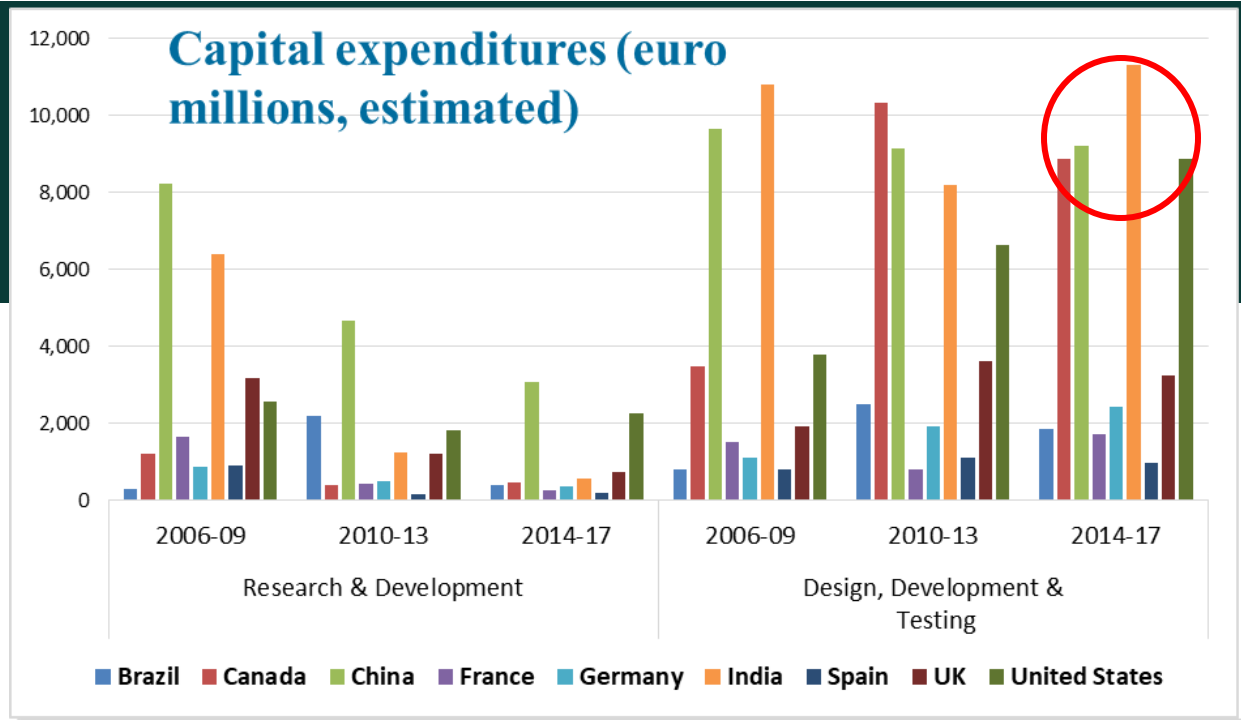

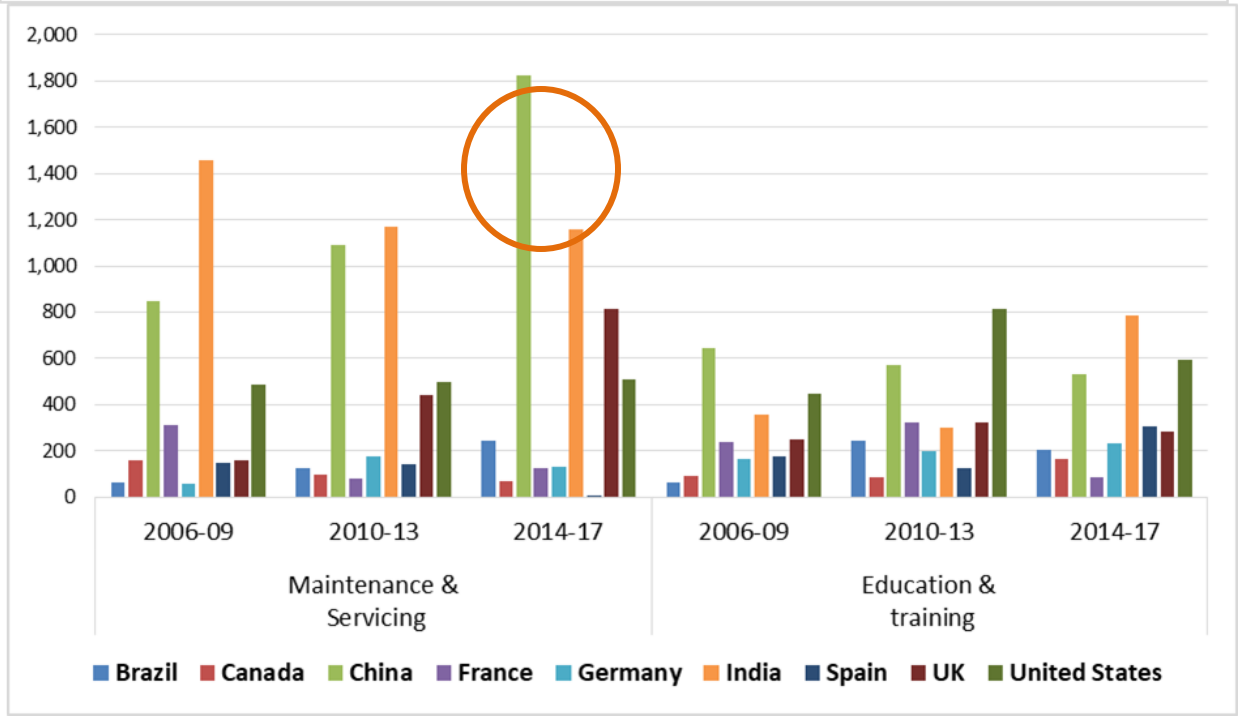

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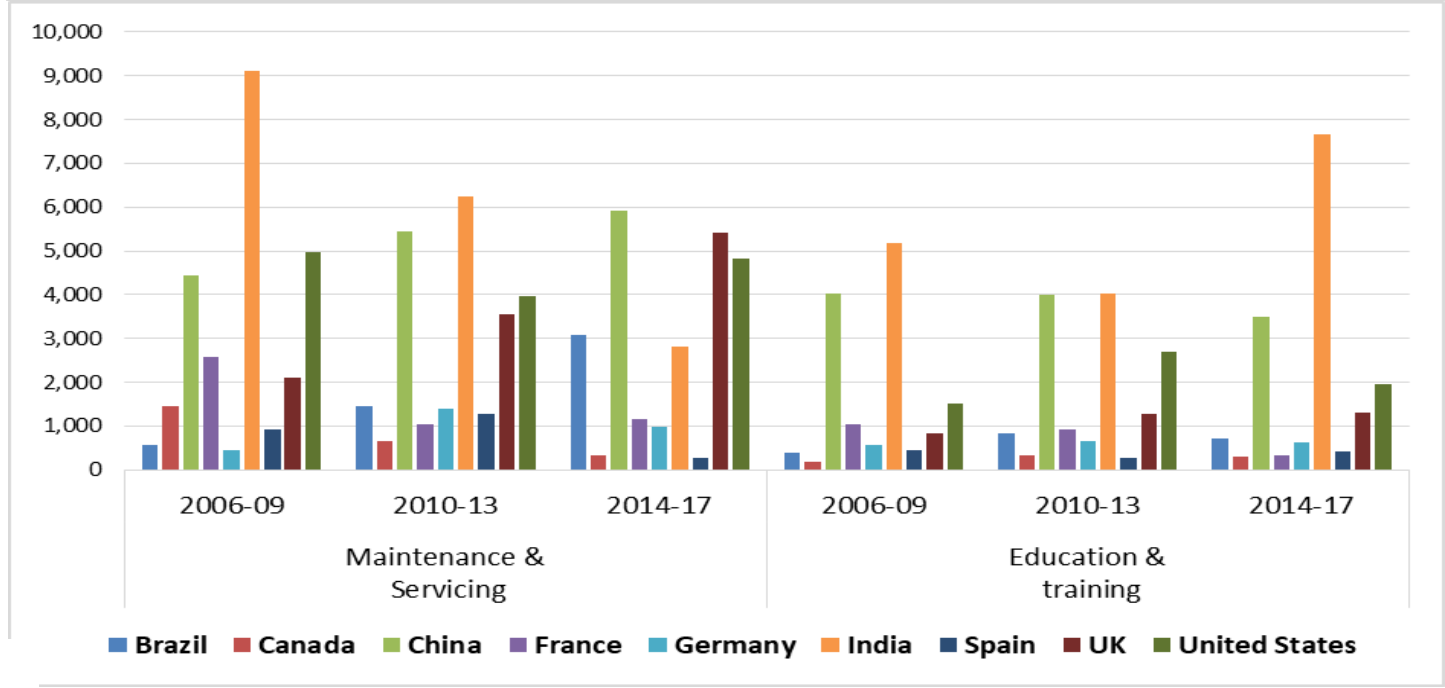

TRL and Structured interviews suggest that most firms do DDT

- Even within the same industry, firms aggregate R&D expenditures in different ways so not always possible to identify exactly what percentage of a company's total R&D expenditure goes to which specific TRL stage

- All companies interviewed: the **maximum that these high-technology firms spend on TRL1** (that is discovery research where patenting is most likely to take place) is 10% of their total budget

- Most of the firms interviewed spend **most of their R&D budgets in activities related to product testing and demonstration**

Different types of corporate GINs

- **Intra-firm GINs**
- **Inter-firm GINs**
  - ✓ **Alliances with universities and research organisations**
  - ✓ **Outsourcing relationships with contract research organisations**
  - ✓ **Collaborations with manufacturers → Links GIN and GVCs**

Semi-structured interviews

- GINs based on universities and research institutes wide spread
- Scope & magnitude of collaboration changing
- CRO: GINs based on collaborations with geographically spread CROs exist; More geographically dispersed, new players…Not captured in existing indicators.

→ but little is known about them…..

- ✓ Role in the innovation strategy of firms,
- ✓ Integration in the MNCs' R&D value chains
- ✓ Effects on geographical configuration of R&D function of these large firms.
- ✓ Changes in the patterns of labour of innovative activities & knowledge production… what implications for NIS/RIS?

Semi-structured interviews

- Process of vertical disaggregation of production has resulted in increasing importance of **suppliers of components and sub-systems** in the R&D of final products.

  ➔ As a result **MNE's GINs now includes top tier suppliers**.

- This more important in modular products such as electronics and automotive than in more integral industries such as pharmaceuticals.

Why does it matter for policy, for regions?

- Science-base of countries/regions very important for early stage innovation but…
- Structured interviews suggest: Most industrial R&D activity is DDT… to attract gFDI in R&D territories need development & manufacturing capabilities as well as strong science base… **Importance of territorial systems of production**
- 'Knowledge economy' discourse which focused on strong science diverted attention from importance of manufacturing base
- **Good science-base not enough to create jobs in R&D and innovation**
- The rise of GVCs & GINs… intensifies the disconnection between a strong science-base, R&D and economic growth?

THANK YOU FOR YOUR ATTENTION

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