



# Globalization of innovation Theoretical and empirical challenges

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# Outline

1. Background
2. Changes in global innovation
3. Can we explain those changes? Theoretical challenges
  - Offshoring of R&D
  - Global innovation networks
  - Conceptual stretching
4. Conclusions



# 1. Presentation

- Prof. in Innovation studies at Circle (Lund University) until august 2016
  - Head of the research platform on globalization of innovation
- Currently
  - Prof. in Innovation studies at Economic history, LUSEM, Lund University
- Main research topic
  - Globalization of innovation
  - Innovation in emerging economies and developing countries
  - Innovation policy
  - Innovation for sustainable development

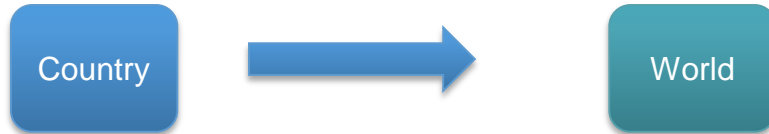


# 1. Background

## Basic concepts

### What is globalization of innovation

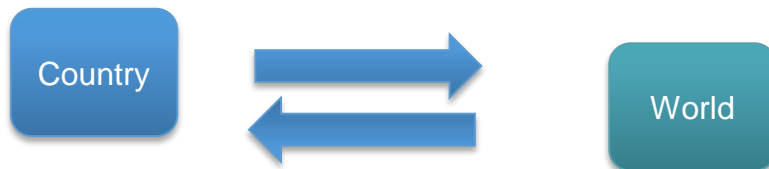
- Exploitation of innovations



- Sourcing of technology



- **Global research collaboration /global innovation networks**



- **Offshoring of R&D** (R&D related foreign direct investment FDI )



(adapted from Archibugi and Mitchie, 1995)



# 1. Background

## Basic concepts

### What is globalization of innovation

- Dickens (2007) distinguishes between:
  - **International processes:** simple geographical spread of economic activities across national boundaries with low levels of functional integration
  - **Global processes:** both **extensive geographical spread** and also high degree of (vertical) **functional disintegration**
  - **Regional processes:** the operation of ‘globalizing’ processes at a more geographically limited (but supranational) scale, ranging from the highly integrated and expanding European Union to much smaller economic agreements.



# 1. Background

## Globalization of innovation as a research field

### Extremely fragmented literature, anecdotal

- Economic Geography
  - Concept: “Globally distributed knowledge bases”; Global Production Networks
  - Authors: Asheim et al (2007); Bathelt and Malmberg (2004); Henderson et al (2002); Dicken et al (2001)
- International business
  - C: Internationalization of R&D; Offshoring R&D
  - A: Cantwell (2000); Cantwell and Piscitello (2007); Dunning and Lundan (2009); Narula and Zanfei (2004)
- Innovation studies
  - C: Techno-globalism; global innovation networks
  - A: Archibugi and Michie (1995); Cooke (2013);
- Development studies
  - C: Global value chains
  - A: Pietrobelli & Rabellotti (2009)



# 1. Background

Is that so today?---

- What we know about internationalization/globalization of innovation...
  - Innovation has long been an international phenomenon but **hardly** a **global** one
    - The majority of R&D is conducted close to headquarters
    - When internationalized is usually in neighbor countries (within EU, for example)
  - Globalization of innovation is associated almost exclusively to **large multinationals**
  - Internationalization of **innovation** towards South is more related to adaptation to markets (D) than to development of new products or services (R)



# 1. Background

- **What has changed? Who are the new actors?...and**
- **What are the consequences in theoretical, conceptual and empirical terms?**





# 1. Background

## Background – data sources

- Analysis presented today is based on
  - fDi markets data – Financial Times, all greenfield investments
  - INGINEUS database (survey in 9 countries in Europe + BICS) – global innovation networks
- 2 mechanisms
  - Cross border R&D investments – greenfield FDI
  - Global research collaboration



# Outline

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## 2. Changes in global innovation

What has changed is (at least):

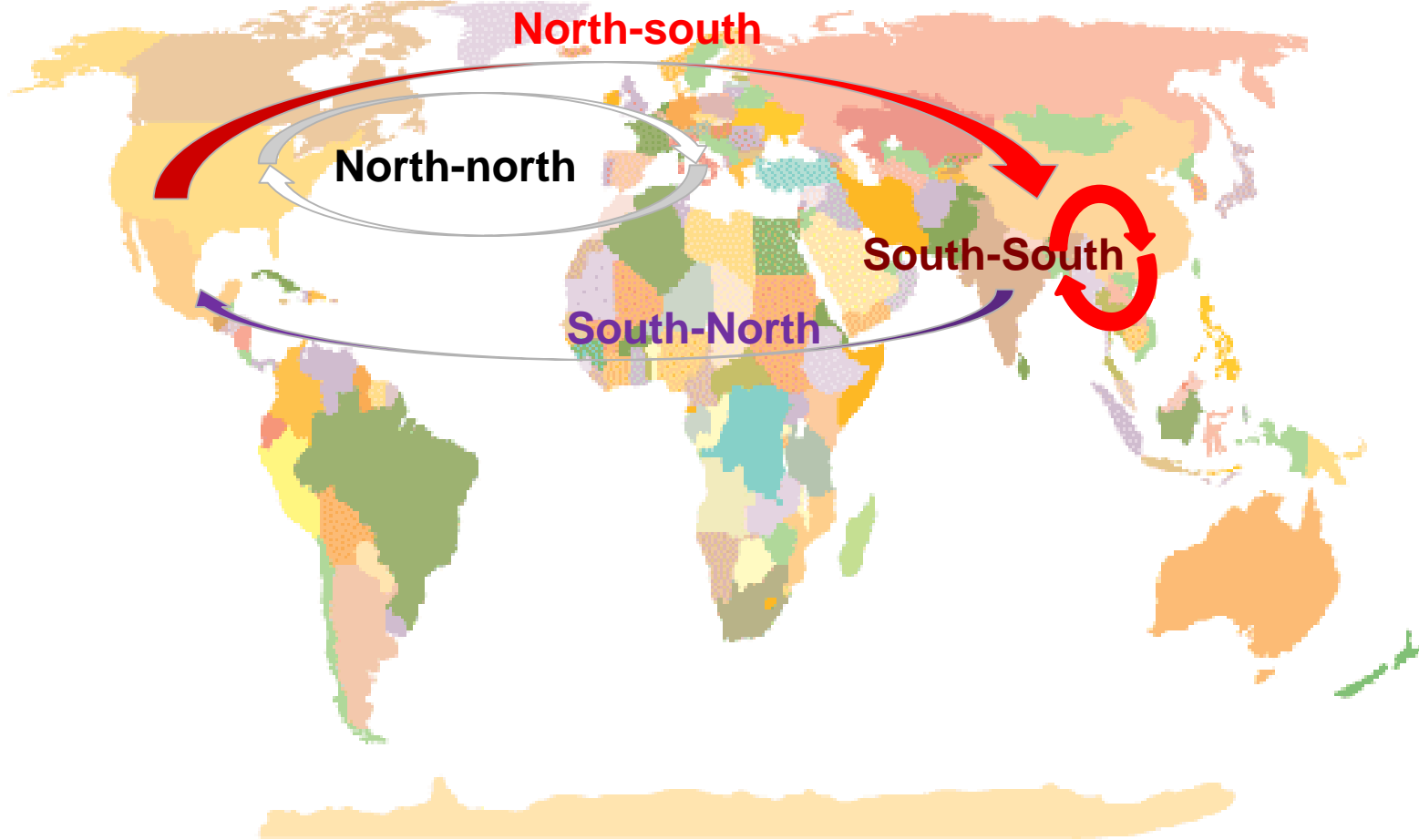
1. The **geography** of the flows: from innovation within the Triad (Japan, US, Europe) to global innovation (China, India)
2. The **nature** of innovative activities, particularly in some emerging economies: from D to R
3. The **actors**, from large multinational companies, to SMEs and standalone

...and this has important implications for theory and empirics



## 2. Changes in global innovation

### Changing geography



## 2. Changes in global innovation

### Changing geography

### Offshoring of R&D, by destination

Cross-border investment projects in R&D-related and manufacturing activities, by country of destination (January 2003 - August 2012)

Design, development and Testing			R&D			Manufacturing		
Rank	Country	% share	Rank	Country	% share	Rank	Country	% share
1	India	20.3%	1	China	16.9%	1	China	16.3%
2	China	12.8%	2	India	14.7%	2	US	9.1%
3	US	7.9%	3	US	7.9%	3	India	6.1%
4	UK	6.6%	4	UK	5.9%	4	Russia	4.3%
5	Germany	3.5%	5	Singapore	4.8%	5	Brazil	3.5%
...	...	...	...	...	...	.....		
22	Sweden	1.0%	27	Sweden	0.7%	43	Sweden	0.4%
Total		100%	Total		100%	Total		100%
		(3980)			(3162)			(30554)
Top 5		51.2%	Top 5		50.2%	Top 5		39.3%
Top 20		78.7%	Top 20		83.4%	Top 20		73.5%

Source: Castelli and Castellani (2013)



## 2. Changes in global innovation

### Changing geography

### Offshoring of R&D, by origin

Cross-border investment projects in R&D-related and manufacturing activities, by country of origin (January 2003- August 2012)

Design Development & Testing			R&D			Manufacturing		
Rank	Country	% share	Rank	Country	% share	Rank	Country	% share
1	US	45.3%	1	US	42.7%	1	US	17.6%
2	Germany	9.7%	2	Germany	9.1%	2	Japan	14.2%
3	UK	7.0%	3	Japan	8.0%	3	Germany	12.1%
4	Japan	6.9%	4	France	5.2%	4	France	5.5%
5	France	5.5%	5	UK	5.1%	5	UK	4.7%
6	India	3.3%	6	Switzerland	3.8%	6	Italy	3.5%
7	Switzerland	2.9%	7	China	3.1%	7	Switzerland	3.4%
8	Netherlands	2.1%	8	South Korea	2.5%	8	South Korea	3.1%
9	Canada	1.9%	9	Netherlands	2.4%	9	Netherlands	2.6%
10	Sweden	1.3%	10	Canada	2.2%	10	Taiwan	2.3%
11	China	1.3%	11	India	2.1%	11	Canada	2.3%
12	Spain	1.2%	12	Sweden	1.8%	12	Spain	2.3%
13	Finland	1.2%	13	Finland	1.3%	13	China	2.1%
14	South Korea	1.1%	14	Italy	1.2%	14	Sweden	2.1%
15	Denmark	0.9%	15	Denmark	1.2%	15	India	2.0%
	Other countries	8.50%		Other countries	8.40%		Other countries	2.0%
	Total	100%		Total	100%		Total	100%
		(3980)			(3162)			(30,554)

Source: Castelli and Castellani, (2013)

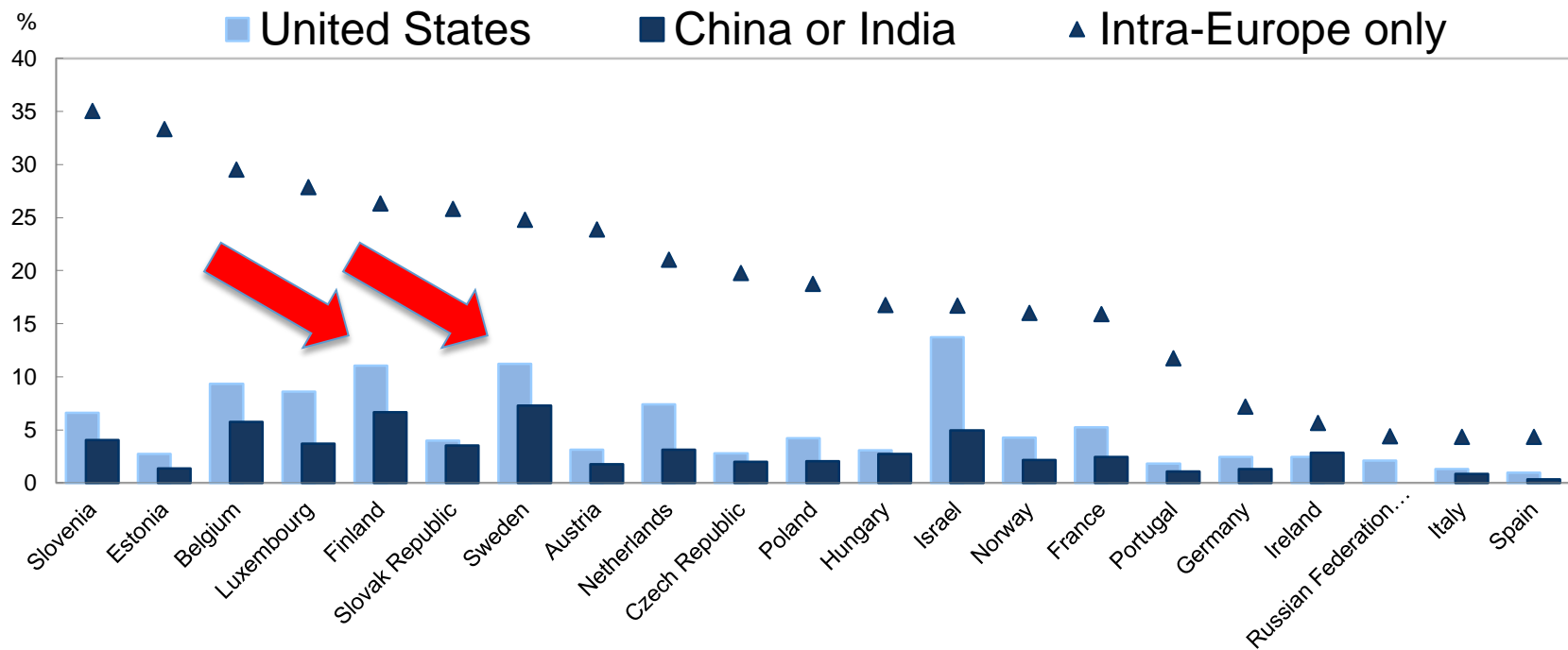


## 2. Changes in global innovation

### Changing geography

### Research collaboration

- OECD firms engaged in international research collaboration by partner country (OECD, Science and Technology indicators, 2012)



## 2. Changes in global innovation

### Changing actors

### Some characteristics of balanced GINs

Barnard and Chaminade (2017) –  
Characteristics of firms involved in research  
collaboration networks that are highly global,  
networked and innovative

- Mainly standalone firms (!)
- Mainly SMEs (between 50-250 employees)
- Mostly located in middle-income countries
- Mostly in ICT and agro – no auto!





## 2. Changes in global innovation

### Globalization of innovation

- What we know about internationalization/globalization of innovation...
  - Innovation has long been an international phenomenon but **not a global one**
    - The majority of R&D is conducted close to headquarters
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# 3. Theoretical challenges

## Offshoring of R&D

### Basic jargon

- FDI
- TFDI
- Offshoring
- Host firm / host country
- Home firm / home country
- Greenfield
- Mergers and Acquisitions
- MNEs, AMNEs, EMNEs



Mode of entry



# 3. Theoretical challenges

## Offshoring of R&D

### The OLI model

- Traditional model – OLI (Dunning 1981) also known as the “Eclectic model”- Firms will engage in FDI to exploit *existing* advantages in terms of
  - Ownership (of specific knowledge or assets): trademark, production technique, skills, scale
  - Location: raw materials, low wages, special taxes in particular locations
  - Internalization: advantages of own production instead of outsourcing or contracting (transaction costs theory)



# 3. Theoretical challenges

## Offshoring of R&D

### The OLI model

- Traditional OLI model
  - Asset exploiting or home base exploiting strategy (Castellani and Zanfei, 2006)
  - In this model, R&D follows production
    - Support function to *adapt* products to host markets (Amighini et al, 2013)
    - The bulk of R&D remains at home
- Typically reflects the technological advantage of the source firm & home country (Narula, 2005)



# 3. Theoretical challenges

## Offshoring of R&D

### The OLI model- Evidence

- Evidence (Cantwell & Piscitello, 2000 cf Dunning and Lundan, 2009)
  - Until 1970's – Subsidiaries R&D mainly for adaptation
  - Early 1980's – change of technological paradigm – economies of scale and scope no longer profitable
  - Early 1990's – subsidiaries R&D for generating new knowledge



# 3. Theoretical challenges Offshoring of R&D

## The OLI model- Evidence

- Why?

- Increased technological complexity
  - Higher costs
  - Higher risks
- Increased modularization
- Increased number of countries with accumulated technological capabilities
  - Example China



# 3. Theoretical challenges

## Offshoring of R&D

### Asset augmenting and asset creation

- Asset augmenting (Dunning, 2001; Dunning and Narula, 2005)
- From exploiting home-based advantages to
  - Improving existing technological assets
  - Acquiring technological assets
  - Generating new technological assets
- Foreign locations provide technological “complementary” assets to the home country (Ietto-Gillies, 2001)





# 3. Theoretical challenges

## Offshoring of R&D

### Asset augmenting and asset creation

- Evidence (Le Bas and Sierra, 2002)
  - 345 MNEs with greatest patent activity in Europe 1988-1996- index of technological competitive advantage

		Technological activities in host country	
Technological activities in home country	Weak		Strong
	Weak	Market seeking (10%)	Technology seeking (13%)
	Strong	Asset exploiting (30%)	Asset augmenting (47%)

Most activities are in technological fields where firms are strong at home



# 3. Theoretical challenges

## Offshoring of R&D

## Asset augmenting and asset creation

- Implications of Le Bas & Sierra (2002)
  - Both host and home country strengths are important
  - R&D abroad tends to *complement* R&D at home – not hollowing out
  - In this respect – internationalization of R&D very different from internationalization of production (*substitute*)



# 3. Theoretical challenges

## Offshoring of R&D

### Asset exploiting vs asset augmenting/creation - summary

Asset exploitation – OLI model	Asset exploration or asset augmenting
<ul style="list-style-type: none"><li>• Knowledge generated in the home country – adapted to local markets; economies of scale</li><li>• Core R&amp;D close to headquarters</li><li>• <b>Home innovation system is important</b></li><li>• Greenfield</li><li>• Typically North-South</li></ul>	<ul style="list-style-type: none"><li>• Knowledge acquired globally</li><li>• R&amp;D abroad <i>complements</i> R&amp;D at home</li><li>• R&amp;D subsidiaries also generate knowledge</li><li>• <b>Both host and home innovation systems are important</b></li><li>• Greenfield, M&amp;A</li><li>• Typically North-North</li></ul>



### 3. Theoretical challenges

#### Offshoring of R&D

#### Advanced MNEs vs Emergent MNEs

#### R&D offshoring strategies

- The changing playing field (mid 2000's)
  - Increasing technological capabilities in the South
  - Nature of R&D offshoring North-South is changing – exploitation to generation
  - Rise of emerging MNEs (EMNEs) and their R&D offshoring strategies
    - Marginal but existing South to South R&D offshoring

**Can existing theories explain R&D offshoring by EMNEs?**



# 3. Theoretical challenges

## Offshoring of R&D

### Advanced MNEs vs Emergent MNEs R&D offshoring strategies

- What is so special about EMNEs? The two puzzles (Ramamurti, 2009, 2012)
  1. “EMNEs do not have ownership advantages just location advantages (cheap labor & natural resources)”
    - EMNEs internationalize to obtain the ownership advantages that they lack
  2. EMNEs follow a different internationalization model
    - Go far away first and then to countries in close proximity
    - Skip production and go directly to innovation



### 3. Theoretical challenges

#### Offshoring of R&D

#### Advanced MNEs vs Emergent MNEs R&D offshoring strategies

- What is so special about EMNEs? The two puzzles (Ramamurti, 2009, 2012)
  1. **“EMNEs do not have ownership advantages just location advantages (cheap labor & natural resources)”**
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# 3. Theoretical challenges

## Offshoring of R&D

### Advanced MNEs vs Emergent MNEs R&D offshoring strategies

- The alternative explanations (Ramamurti, 2009, 2012)
  1. EMNEs have ownership advantages, but they are different (Cuervo-Cazurra & Genc, 2008, cf Ramamurti, 2009)
    - Capital
    - Ability to understand customers in developing countries
    - Ability to deal with complex environments
    - Ability to generate low-cost innovations (nano car, nano computer)
  2. EMNEs are much younger – they will develop ownership advantages over time
  3. EMNEs go abroad to acquire technology that will be further exploited in their *home* markets



### 3. Theoretical challenges

#### Offshoring of R&D

#### Advanced MNEs vs Emergent MNEs R&D offshoring strategies

- What is so special about EMNEs? The two puzzles (Ramamurti, 2009, 2012)
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### 3. Offshoring of R&D

#### Advanced MNEs vs Emergent

#### MNEs R&D offshoring strategies

- The explanations
  - EMNEs deal better with different institutional environments – institutional void – geographically distant
  - EMNEs use offshoring R&D to **build** technological capabilities, often state-of-the-art in the North (Deng, 2007, 2009; Binz et al 2017). Production at higher costs does not make sense



# 3. Theoretical challenges

## Offshoring of R&D

- In sum
  - Theoretical development is catching up with new phenomenon – TFDI from EMNEs but
    - What is the impact?
    - Differences by modes of entry?
    - Differences by country host/home country?
    - Differences by industry?
    - South – south?
    - Reshoring by EMNEs?



# Outline

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4. Conclusions



### 3. Theoretical challenges

## Global innovation networks What's so special about networks?

- Networks are reciprocal, preferential and mutually dependent (Powell, 1990)
- Networks requires that the firm and the partner adhere to a certain structure of exchange (Laursen and Salter, 2014)
- Networks are specially adequate for the transfer of tacit, disembodied knowledge (know who, how and why)
- Networks are based on trust



# 3. Theoretical challenges

## Global innovation networks

### Networks and geography

- Trust is facilitated by geographical and institutional proximity (Hansen, 2012)
  - Probability of establishing *networks* between partners in close proximity is higher
  - Economic geography – extensive literature on the importance of local *networks* for innovation
- However, innovation networks are becoming **global**



# 3. Theoretical challenges

## Global innovation networks

### Networks and geography

- Network of international technological collaboration is much denser (125 countries in 2007 compared to 79 countries in 1996) Prato and Nepelski (2012)
- Proportion of international technological collaboration is growing over time (Van Looy et al, 2014)

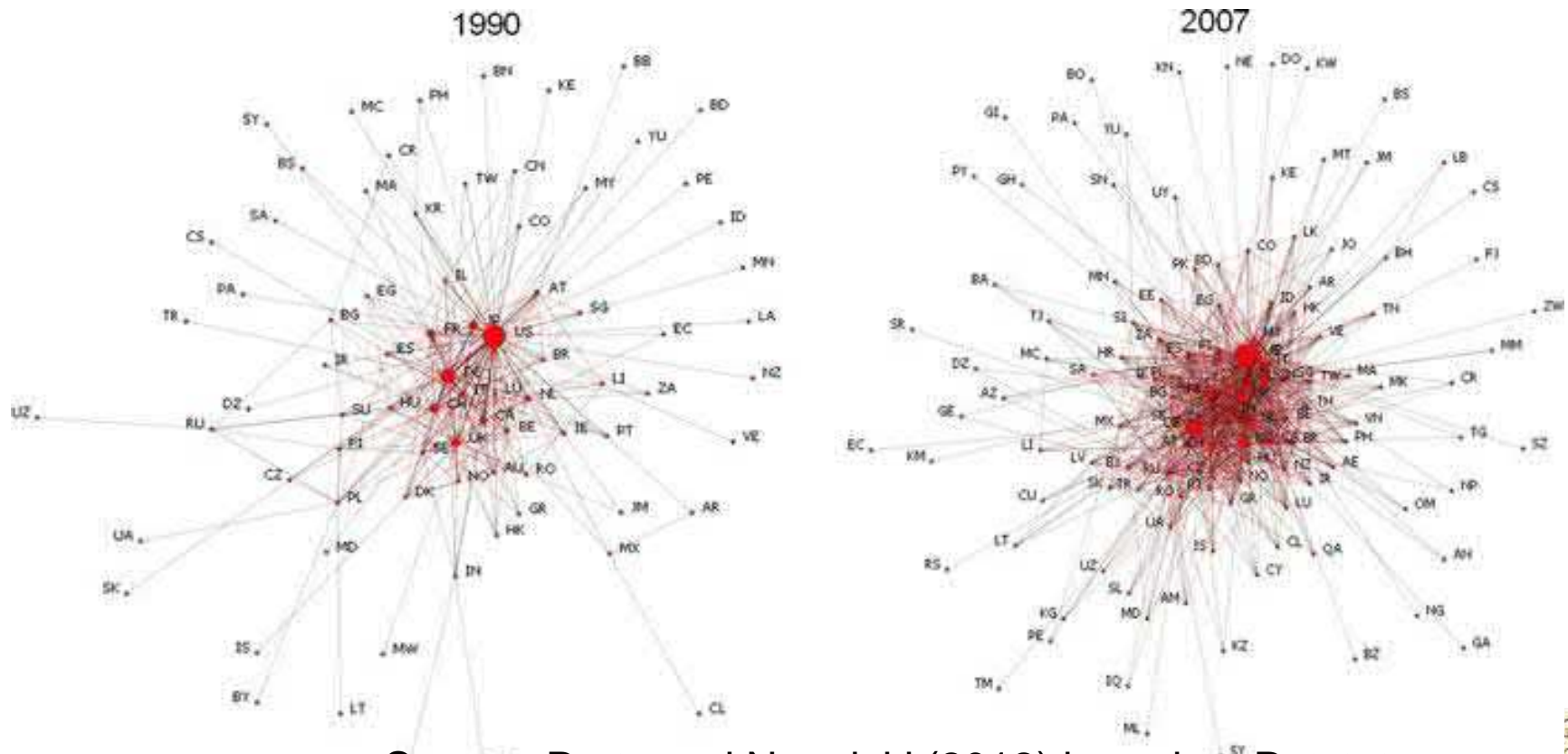


# 3. Theoretical challenges

## Global innovation networks

### Networks and geography

The evolution of the global technological collaboration network



Source: Prato and Nepelski (2012) based on Patstat



# 3. Theoretical challenges

## Global innovation networks

### Networks and geography

- However, innovation networks are becoming **highly global**
  - Network of international technological collaboration is much denser (125 countries in 2007 compared to 79 countries in 1996) Prato and Nepelski (2012)
  - Proportion of international technological collaboration is growing over time (Van Looy et al, 2014)



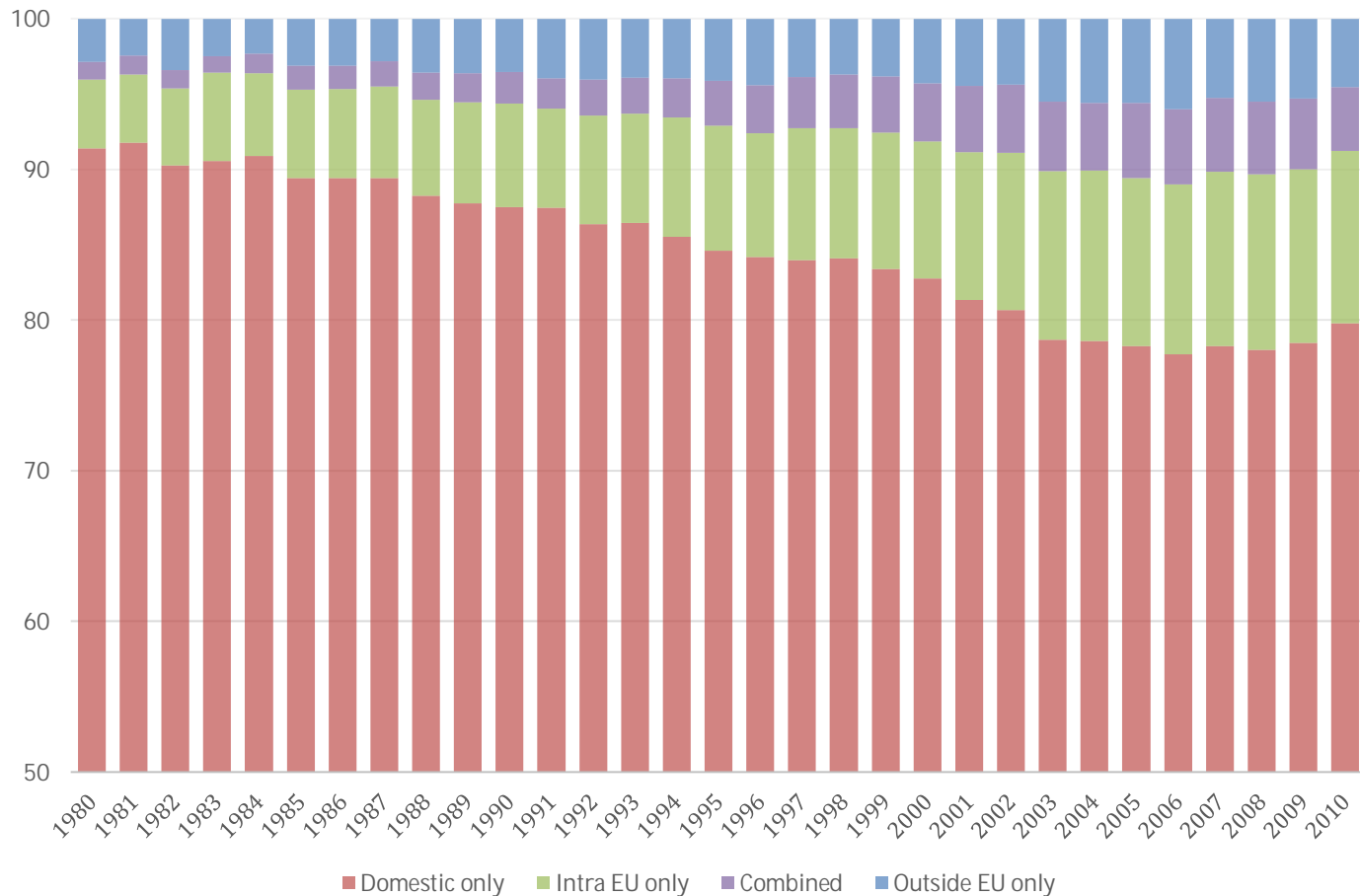


# 3. Theoretical challenges

## Global innovation networks

### Networks and geography

Evolution in the share of european registered inventions by location of the co-inventor (1980-2010)



Source: Van Looy et al (2014). Scale starts at 50%



# 3. Theoretical challenges

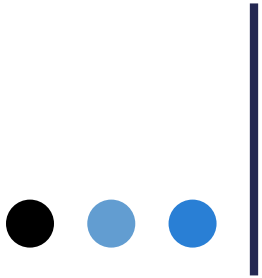
## Global innovation networks

### Networks and geography

- So innovation networks are becoming increasingly global
  - Increasing number of actors – beyond the Triad
  - Increasing proportion of international networks vs domestic & local
  - Increased variety of actors – SMEs vs MNEs (Barnard and Chaminade, 2017)

**How can we explain these changes?**





- 2 options

1. Use existing concepts to try to capture the new phenomenon – conceptual stretching
2. Develop new concepts



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# 3. Theoretical challenges

## Conceptual stretching

- New changing landscape in terms of innovation has raised interest in other communities
  - GVC and GPN stretched to explain growing globalization of innovation activities..

Are these the adequate concepts to understand the global dispersion of innovation activities?



# 3. Conceptual challenges

## Global Value Chains

- **Emerged** in mid 90 ´s in development economics, re-vamp recently (Gereffi and Lee, 2012).
- **Objective:** understand upgrading of firms in developing countries, being suppliers of MNEs - Gereffi (1999, 2005, 2008), Humphrey (2003, 2004)
- **Focus:** how **value** is created and captured, power relations with lead firms, positioning of suppliers
- **Key concepts:** lead firm, value, governance and industry focus, upgrading (cluster)
- **Strengths:** well established literature, governance focus (Ponte and Sturgeon, 2014)



# 3. Conceptual challenges

## Global Value Chains

- ● ●
- **Innovation:**

- Upgrading towards more skill-intensive activities
- Link types of governance to interactive learning (Pietrobelli and Rabellotti, 2009)
- Applied to high tech products (ipod for example) (Dedrick et al, 2009) - in essence still mapping value in supply chains of high tech products.

- **Limitations:**

- Not focus on innovation but **power relations** between lead firm and suppliers
- No **micro insights** into why firms locate innovation abroad
- No attention to **embeddedness** in territories and institutions
- Empirical studies rather **static**



# 3. Conceptual challenges

## Global Production Networks

- **Emerged** in early 2000's, economic geography
- **Objective:** Understand the global distribution of production activities, introducing the embeddedness of networks in locations
- **Main authors:** Henderson et al (2002) Coe et al, (2004), Dicken, (2006)
- **Focus:** Spatial aspects of globally distributed production and trade (around industries)
- **Key concept:** lead firm, industries, location, policy
- **Strengths:** Territoriality of production, Measurability (production, trade and FDI in specific industries)





# 3. Conceptual challenges

## Global Production Networks

- **Innovation:**

- Production network includes R&D functions;
- GPN in high-tech industries (electronics) (Yeung, 2007)

- **Limitations:**

- Not trying to understand innovation; rather assuming innovation overlaps with production



# 3. Theoretical challenges

## Global innovation networks / global knowledge networks

- Emerged late 2000 ´s and more recent
- **Objective:** understand organization of innovation and knowledge creation globally
- **Authors:** Ernst (2006), Cooke (2013), Herstad et al (2014), Aslesen and Freel (2012), Chaminade and Plechero (2013, 2014), Cassi et al (2012), Balland et al.
- **Focus:** modularization of innovation and knowledge sourcing/linkages
- **Examples:** strategic R&D alliances, research collaboration, epistemic communities



# 3. Theoretical challenges

## Global innovation networks

- Network dynamics are affected by:
  - Type of innovation and lifecycle of the innovation project (Moodysson, 2008; Herstad et al, 2014)
  - Firm based characteristics (size, age) (Powell et al, 1996) – liability of newness or outsidership
  - Network structure – Balland et al (2013)
  - Industry lifecycle (Chen et al, 2014; Balland et al, 2013)
  - **Region**



# 3. Theoretical challenges

## Global innovation networks

### how regions affect GINs - Direct effect

1. **Organizational thickness** of a region affects engagement in GINs
  - Firms located in regions that are neither organizationally too thick nor too thin are those that engage more in GINs (Tödling et al, 2011; Plechero and Chaminade, 2015;)
  - Increasingly innovation is occurring outside the urban agglomerations (Rodriguez –Pose and Wilkie, 2015; Grillitsch and Nilsson, 2015)
2. Regional **specialization** affects engagement in GINs
  - Higher specialization, more importance of regional linkages (Plechero and Chaminade, 2014)



### 3. Conceptual challenges

#### What Offshoring of R&D and GINs

#### literature can provide (two examples)

- Understanding the **dynamics** of **strategic coupling** of **knowledge and innovation networks / FDI** and **territories** (different RIS)
  - Knowledge characteristics – transferability and appropriability,
  - Firm characteristics: accessibility
  - Regional characteristics: availability
- Understanding **evolution of global knowledge and innovation networks** by looking at **micro dynamics** of firm based decision
  - Competences, strategies, routines
  - Knowledge characteristics



# 3. Theoretical challenges

## Global Innovation Networks

- Unexplored issues
  - Emergence of GINs
  - Role of GINs in catching up in unrelated technological fields (Binz et al, forthcoming)
  - Relation of GINs with other mechanisms – GPNs and GVC..



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## 4. Closing up

- Innovation is becoming truly global in Dickens sense
- This is challenging existing theories in innovation studies, economic geography and international business
- Conceptual stretching and ambiguity
- Future: **beyond either-or** – how can the different frameworks be combined to better understand innovation dynamics globally?
  - Develop discrete theories to answer specific questions and link them together (Ponte and Sturgeon, 2014)
  - **Understand possibilities and limitations of existing theories & concepts**





## 6. Closing up

- New empirical challenges – new data is needed, comparable at global scale
- Novel and challenging research area
- Input from young researchers is needed!!!
- How can GLOBELICS help address the challenge of Globalization of Innovation?
  - Evidence from different regions/countries around the world
  - Large scale projects – comparative analysis
  - Data collection and sharing!

