



# Changing knowledge dynamics and globalization of innovation - theoretical and empirical challenges

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# Background

- For decades, innovation was rather confined to the Triad (US, Europe, Japan), however
- Knowledge flows and innovation is becoming truly global (UNCTAD, 2005)
- **What has changed? Who are the new actors?...and**
- **What are the consequences in theoretical and empirical terms?**



# Outline

1. Basic Concepts
2. Globalization of innovation as a phenomenon-  
what has changed?
3. Globalization of innovation as a research field-  
how existing theories are challenged?
4. Empirical research
5. Summing up





# Outline

## 1. Basic Concepts

- What is globalization of innovation?
  - Why do firms globalize?
  - How do firms globalize?
2. Globalization of innovation as a phenomenon- what has changed?
  3. Globalization of innovation as a research field- how existing theories are challenged?
  4. Empirical research
  5. Summing up





# 1. Basic concepts

## What is globalization?

- 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.

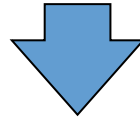




# 1. Basic concepts

## Understanding Global Vertical disintegration

From innovation occurring within a singular organization



To innovation occurring among **different organizations**, each performing a limited subset of activities

Global when the fragmentation of the innovation process happens **across various countries**





# 1. Basic concepts

## GLOBAL INNOVATION NETWORKS

***”Transnational web of collaborative interactions between different organizations engaged in knowledge production that is **related to** and resulting in **innovation and that occurs in an extensive geographical area** ”*** (Borras et al, 2009)

- Global exploitation of innovations
- *Global sourcing of technology and knowledge*
- **Global research collaboration**
- **Global generation of innovation (offshoring of R&D)**





# Outline

1. Basic Concepts
2. Globalization of innovation as a phenomenon-  
what has changed?
  - Geography
  - Nature
  - Actors
3. Globalization of innovation as a research field-  
how existing theories are challenged?
4. Empirical research
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## 2. Overview of changes Looking at Global Innovation Networks

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





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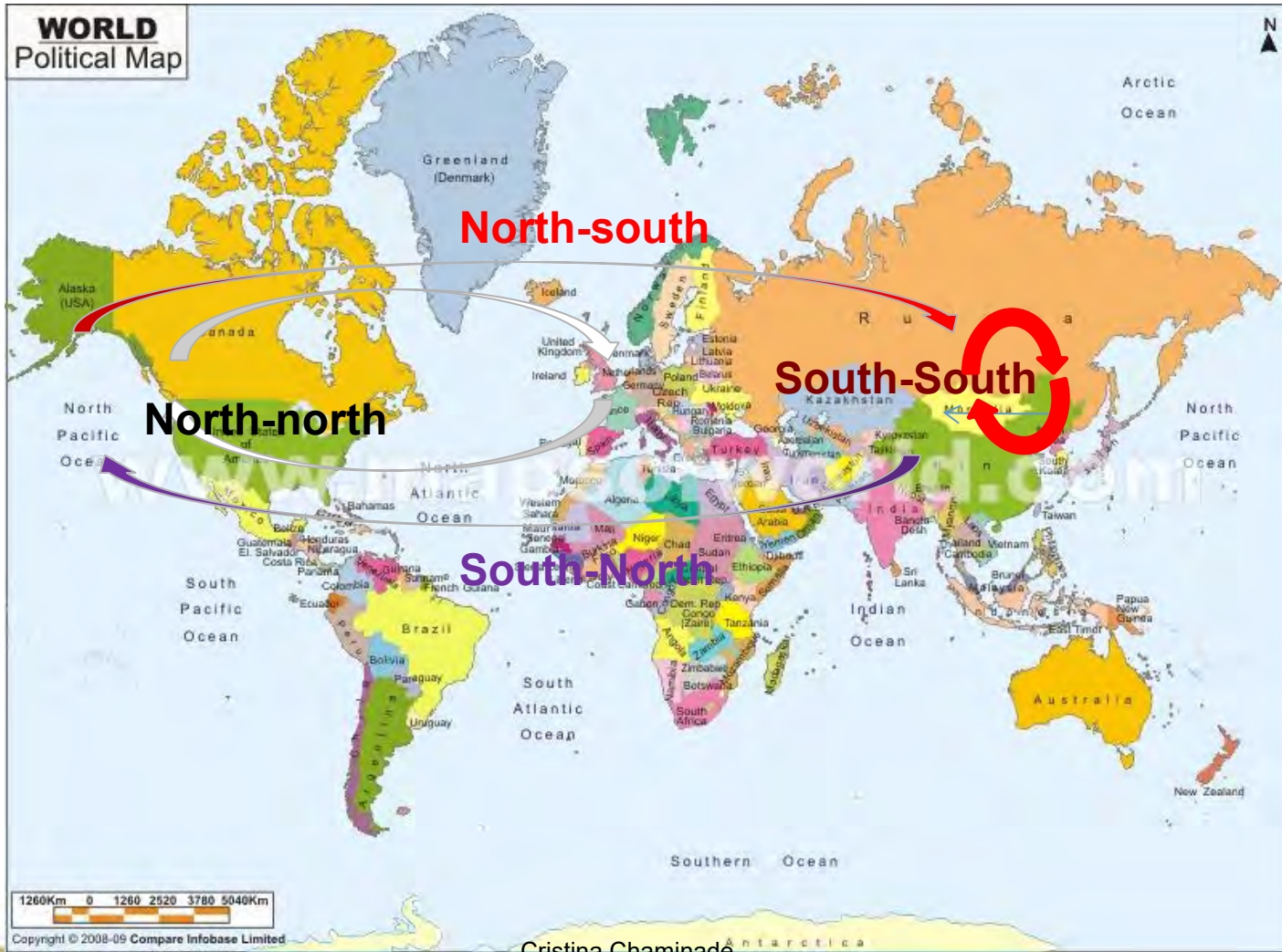
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...and this has important implications for theory and empirics





# 3. Overview of changes Changing geography



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Concepts

Changes

Challenges

Research

Sum up





# 3. Overview of changes

## 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	N. projects	% share	Rank	Country	N. projects	% share	Rank	Country	N. projects	% share
1	India	809	20.3%	1	China	534	16.9%	1	China	4969	16.3%
2	China	511	12.8%	2	India	466	14.7%	2	United States	2776	9.1%
3	United States	316	7.9%	3	United States	249	7.9%	3	India	1879	6.1%
4	UK	261	6.6%	4	UK	187	5.9%	4	Russia	1323	4.3%
5	Germany	140	3.5%	5	Singapore	151	4.8%	5	Brazil	1061	3.5%
...	...	...	...	...	...	...	...	...	...	...	...
22	Sweden	41	1.0%	27	Sweden	21	0.7%	43	Sweden	115	0.4%
Total		3980	100%	Total		3162	100%	Total		30554	100%
Top 5		2037	51.2%	Top 5		1587	50.2%	Top 5		12008	39.3%
Top 10		2526	63.5%	Top 10		1713	66.4%	Top 10		12971	54.3%
Top 15		2868	72.1%	Top 15		2408	76.2%	Top 15		20145	65.9%
Top 20		3132	78.7%	Top 20		2638	83.4%	Top 20		22443	73.5%
Herfindahl Index			0.076	Herfindahl Index			0.071	Herfindahl Index			0.051

Source: Castelli and Castellani (2013)



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Changes

Challenges

Research

Sum up





# 3. Overview of changes

## 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)

DDT				R&D				Manufacturing			
Rank	Country	N. projects	% share	Rank	Country	N. projects	% share	Rank	Country	N. projects	% share
1	United States	1804	45.3%	1	United States	1351	42.7%	1	United States	5369	17.6%
2	Germany	386	9.7%	2	Germany	287	9.1%	2	Japan	4332	14.2%
3	UK	278	7.0%	3	Japan	253	8.0%	3	Germany	3689	12.1%
4	Japan	274	6.9%	4	France	163	5.2%	4	France	1678	5.5%
5	France	219	5.5%	5	UK	162	5.1%	5	UK	1427	4.7%
6	India	131	3.3%	6	Switzerland	119	3.8%	6	Italy	1055	3.5%
7	Switzerland	114	2.9%	7	China	97	3.1%	7	Switzerland	1031	3.4%
8	Netherlands	84	2.1%	8	South Korea	79	2.5%	8	South Korea	939	3.1%
9	Canada	77	1.9%	9	Netherlands	75	2.4%	9	Netherlands	799	2.6%
10	Sweden	51	1.3%	10	Canada	70	2.2%	10	Taiwan	717	2.3%
11	China	50	1.3%	11	India	65	2.1%	11	Canada	708	2.3%
12	Spain	48	1.2%	12	Sweden	57	1.8%	12	Spain	699	2.3%
13	Finland	46	1.2%	13	Finland	40	1.3%	13	China	635	2.1%
14	South Korea	44	1.1%	14	Italy	38	1.2%	14	Sweden	632	2.1%
15	Denmark	36	0.9%	15	Denmark	38	1.2%	15	India	605	2.0%
	Other countries	338	8.50%		Other countries	268	8.40%		Other countries	605	2.0%
	<b>Total</b>	<b>3980</b>	<b>100%</b>		<b>Total</b>	<b>3162</b>	<b>100%</b>		<b>Total</b>	<b>30554</b>	<b>100%</b>



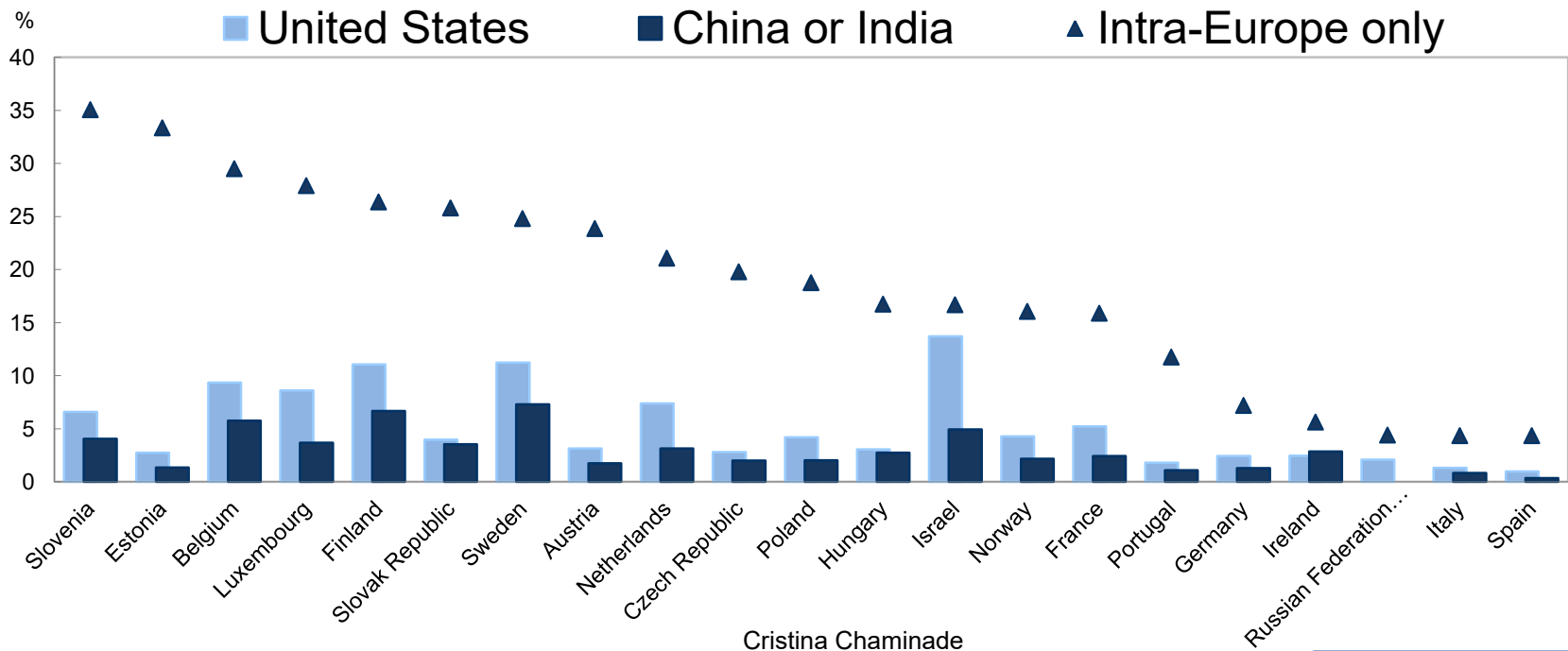


# 3. Overview of changes

## Changing geography

## Research collaboration

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



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Concepts

Changes

Challenges

Research

Sum up





# 3. Overview of changes

## Changing nature

In which sectors are the following destinations important for R&D investments & type? (+10% total cross-border goes to those countries)

	China	India	USA	France	UK	Canada
Construction	<b>Basic&amp; Applied</b>	Applied	<b>Basic&amp; Applied</b>	--	--	--
Consumer Goods	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	Applied	--	--	--
Creative Industries	<b>Basic</b>	<b>Basic&amp; Applied</b>	Applied	--	Applied	Applied
Energy	--	--	--	--	Applied	<b>Basic</b>
Environmental Technology	<b>Basic</b>	--	<b>Basic&amp; Applied</b>	--	--	--
Financial Services	--	Applied	--	--	Applied	--
Food, Beverages & Tobacco	<b>Basic&amp; Applied</b>	--	<b>Basic&amp; Applied</b>	--	--	--
ICT & Electronics	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	--	--	--	--
Industrial	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	Applied	--	--	--
Life sciences	Applied	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	--	<b>Basic</b>	--
Physical Sciences	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	--	--	--	--
Professional Services	--	<b>Basic&amp; Applied</b>	--	--	--	--
Retail Trade	--	--	Applied	<b>Basic</b>	--	--
Tourism	--	<b>Basic&amp; Applied</b>	--	--	--	--
Transport Equipment	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	<b>Basic&amp; Applied</b>	--	--	--
Transportation, Warehousing & Storage	Applied	--	<b>Basic</b>	<b>Basic</b>	--	--
Wood, Apparel & Related Products	<b>Basic&amp; Applied</b>	Applied	--	--	--	--

Basic: R&D  
Applied: DDT

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Concepts

**Changes**

Challenges

Research

Sum up





## 2. Overview of changes

### Changing actors

What has changed is (at least):

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







## 2. Overview of changes

### Changing actors

- And this is not only a "large firm" phenomenon... In Sweden 16% of the innovative firms with less than 50 employees collaborate with Chinese and Indian partners for innovation

	Total	Sweden	Other Europe	USA	China and India	Other
10-49 employees	37	94	58	28	16	21
50-249 employees	43	96	69	29	18	23
More than 250 employees	65	95	83	43	31	28





## 2. Overview of changes

### Changing actors

### Some characteristics of balanced GINs

Barnard and Chaminade (2012) –  
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!





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4. Empirical research
5. Summing up





# 3. Globalization of innovation as a research field- Theoretical and empirical challenges

- Most of our (innovation) theories are based on empirical evidence from the “North”, for example....
  - Innovation systems
    - Functions of innovation systems
    - Importance of local interactions (RIS)
  - International business
    - Offshoring of R&D, driven by large MNEs, for exploration (in the North) and exploitation (in the South)





# 3. Globalization of innovation as a research field

- Limitations of existing literature
  - Generally not capturing sectoral and regional differences – Too aggregated data or studies in just one industry or region (eg. Morrisson, Rabellotti- wine)–
  - Limited to the use of certain indicators for which there is international comparable data – Are these the right ones?
  - Not capturing interrelations between macro and other levels of analysis – need for multilevel models
  - Not taking into account firms' strategies





# 3. Globalization of innovation as a research field

## CURRENT CHALLENGES

- Qualify existing theories and develop new theories and concepts when necessary - GINs
- Capturing industrial differences
- Capturing regional differences across the globe
- Systematic comparative analysis across the globe
- Beyond the cases: Quantitative analysis – New indicators!





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## 4. Empirical research

### Our work on GINs at CIRCLE

- Focus on the interplay between firm characteristics, regional characteristics and global innovation networks
- Integrating:
  - Development economics: Global value chain & upgrading
  - Ec. Geography&Innovation studies: RIS
  - International business: firms strategies
- Truly global project- systematic comparison







## 4. Empirical research

### Our work on GINs at CIRCLE - AIM

Understand the extent of the global distribution of innovation activities and its impact in the developed and developing world through **systematic comparative analysis** of different **industries** and **regions across the globe**

Challenge existing theories on internationalization of R&D, importance of local linkages for innovation (economic geography), innovation systems



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Concepts

Changes

Challenges

Research

Sum up





# 4. Empirical research

## Our work on GINs at CIRCLE - ALM



### Latin America



### Europe



### Asia



### Several projects...

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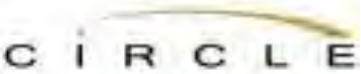
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Changes

Challenges

Research

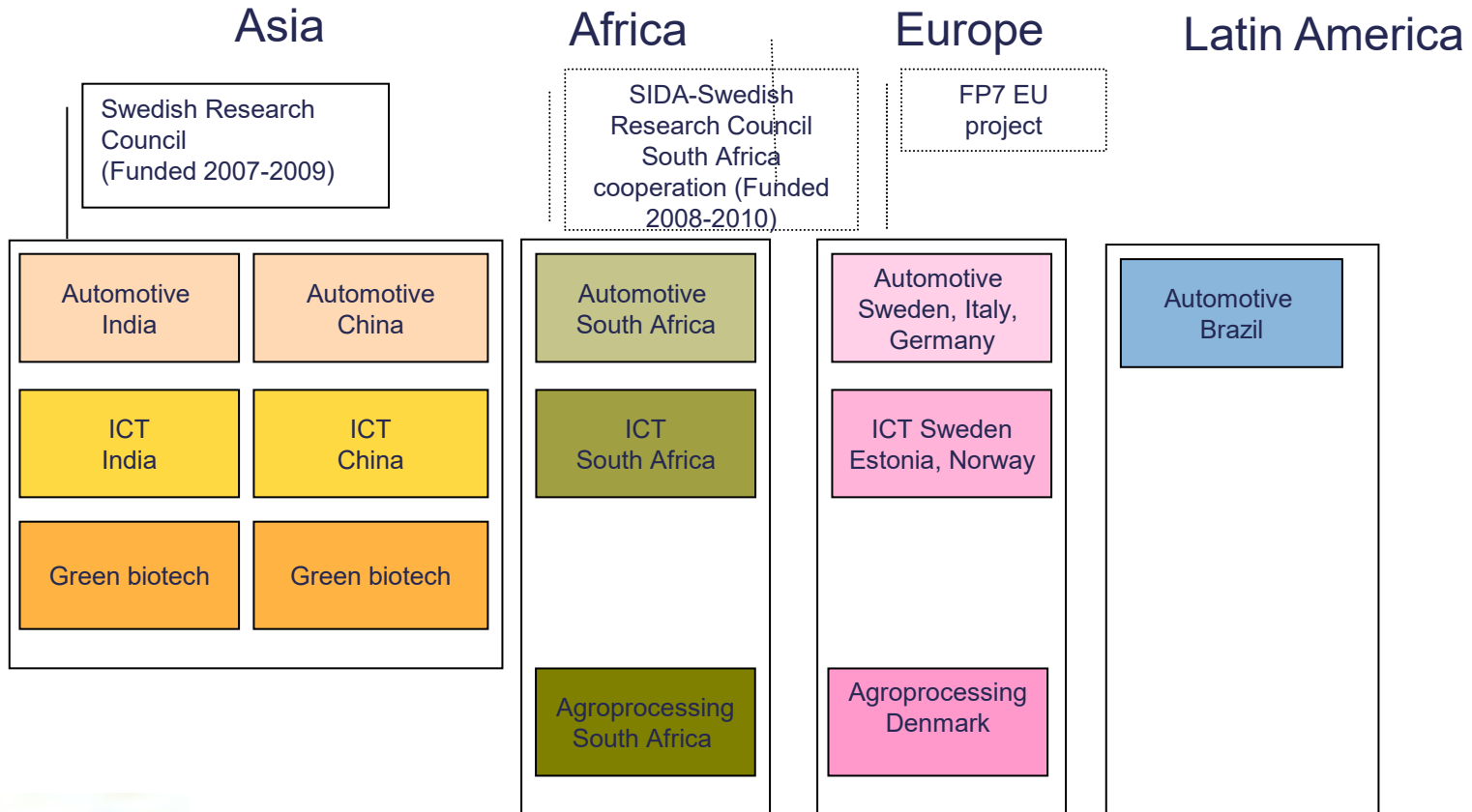
Sum up





# 4. Empirical research

## Our work on GINs at CIRCLE – The GLOBINN data sets



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Concepts

Changes

Challenges

Research

Sum up





# 4. Empirical research

## The GLOBINN data sets

- Survey on innovation and internationalization of firms in Pune and Beijing (regional focus) and South Africa (Cape Town and Johannesburg), 3 industries
- Survey on engagement in global innovation networks of firms in 5 countries in Europe plus BICS (Ingenueus survey)





## 4. Empirical research – some results

### On importance of regions for globalization of innovation

- Plechero and Chaminade (Forthcoming) “Do regions make a difference? Regional innovation systems and global innovation networks in the ICT industry”  
European Planning Studies
  - Role of institutional thickness of a region on the propensity to engage in GINs
- Chaminade and Plechero “Exploring the relation between regional innovation systems and global research collaboration in developed and emerging economies”
  - Differences between developed and emerging economies in their propensity to engage in GINs





## 4. Empirical research – some results

### On importance of regions for globalization of innovation

- data

- o **Firm level primary data** (INGINEUS project): <http://ingineus.eu> collected during 2009-2010
- o 9 countries: Brazil, India, China, South Africa, Norway, Sweden, Germany, Estonia and Denmark in 3 sectors (Agroprocessing, Automotive and ICT)
- o **Sample 707 firms (out of 1215): only ICT sector** and regions in India, China, Norway, Sweden and Estonia
- o **Quantitative analysis:** econometric analysis  
generalized ordered logit model;  $\chi^2$  test





## 4. Data and methodology

- All cases in the survey were codified as belonging to regions Tier 1, Tier 2 and Tier 3 (national statistics and local expertise)
  - Tier 1 = Institutionally thick regions, metropolitan and strong specialization in industry (e.g. Bangalore in India for ICT)
  - Tier 2 = significant number of firms specialized in that industry, presence of support institutions, not so well networked, not so many MNCs (e.g. Skåne in Sweden)
  - Tier 3 = institutionally thin regions, marginal, not specialized.





## 4. Data and methodology

Resulting classification:

- Tier 1 (343), Tier 2 (301) and Tier 3 (63)
- Tier 1: more HQ of MNCs, but also highest proportion of SMEs
- Tier 2: highest proportion of large companies and highest proportion of subsidiaries
- Tier 3: dominated by standalone and SMEs







## 4. Data and methodology

- Independent variables
  - Research collaboration in the development of the most important innovation by partner
    - By geographical reach (regional, national, international, global)
    - By breath of the partners
  - Offshoring of innovation activities
  - Networks (combining sourcing of technology, research collaboration and offshoring)
- Control: size, organizational form, innovation performance





# 4. Empirical research – some results

## On importance of regions for globalization of innovation

### Generalized ordered logit model

From First_Tier to Second Tier		From Second Tier to Third Tier	
Networks	0.288*** [0.092]	Networks	-0.458*** [0.169]
Inno_Perform	-0.352*** [0.098]	Inno_Perform	-0.015 [0.160]
Medium	0.712*** [0.218]	Medium	-0.055 [0.349]
Large	1.186*** [0.258]	Large	-0.357 [0.421]
Headquarter	-1.133*** [0.278]	Headquarter	-1.743*** [0.551]
Standalone	-0.800*** [0.222]	Standalone	-1.472*** [0.335]
Constant	0.205 [0.223]	Constant	-1.297*** [0.305]

N	579	579
LI	-482.706	-482.706
LR $\chi^2$ (12)	108.69	108.69
P	0	0
Pseudo R2	0.1012	0.1012

\*p<0.10, \*\*p<0.05, \*\*\*p<0.01. Standard errors in parenthesis



# Results

## Maximum geographical spread of collaboration for innovation by Tiers

	First Tier	Second Tier	Third Tier	Total
<b>collaborationNo n</b>				
No. firms	61	79	26	166
% row	37.75	47.59	15.66	100
% column	17.78	26.25	41.27	23.48
<b>Regional collaboration</b>				
No. firms	33	25	5	63
% row	52.38	39.68	7.94	100
% column	9.62	8.31	7.94	8.91
<b>Domestic collaboration</b>				
No. firms	104	43	8	157
% row	66.24	27.39	6.37	100
% column	30.32	14.29	15.87	22.21
<b>Global collaboration</b>				
No. firms	145	154	19	321
% row	45.17	47.98	6.85	100
% column	42.27	51.16	34.92	45.40
<b>Total</b>				
No. firms	343	301	63	707
% row	48.51	42.57	8.91	100
% column	100	100	100	100

Pearson  $\chi^2$  (6) = 38.8719 Pr = 0.000 ; Source: own elaboration Ingeinus data



## 4. Empirical research – some results

### On importance of regions for globalization of innovation

- There is a significant relationship between the type of region in which the firm is located and the engagement in GINs
- Regions that are institutionally too thick or too thin are not so conducive to globalization of innovation. Firms located in "middle" regions engage more in different forms of globalization of innovation (Plechero and Chaminade, Forthcoming)
  - Tier 1: gIN
  - Tier 2: GIN and GiN.
  - Tier 3: gin
- GINs as a compensatory mechanism

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Concepts

Changes

Challenges

Research

Sum up





## 4. Empirical research – some results

### Differences between developed and emerging economies in their propensity to engage in global research collaboration

- In general firms located in emerging economies (innovation systems in formation) collaborate less but, when they do, the breath and spread of their research network is higher (more global linkages)
- However, when we introduce the degree of ICT specialization of the region, then the pattern changes....





## 4. Empirical research – some results

### Differences between developed and emerging economies in their propensity to engage in global research collaboration

- Firms located in ICT specialized emerging countries mirror firms located in ICT specialized regions in developed countries (more regional and domestic)
- So, when a region in an emerging economy reaches a high degree of specialization (organizational thickness), it can counterbalance the fact that is in an emerging economy
- EXCEPT: for new to the world -> Global networks needed





## 4. Empirical research – some results

### Differences between developed and emerging economies in their propensity to engage in global research collaboration

- What matters is the institutional thickness of the region
- Engaging in GIN is costly and hard to maintain:
  - Firms engage in different forms of GINs when they cannot find the resources they need to innovate in their close proximity
  - Absorptive capacity is needed engage in GIN





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## 5. Summing up

- Innovation is becoming truly global in Dickens sense
- This is challenging existing theories in innovation studies, economic geography and international business
- As well as posing new empirical challenges – new data is needed, comparable at global scale
- Novel and challenging research area
- Input from young researchers is needed!!!





# Thanks!

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