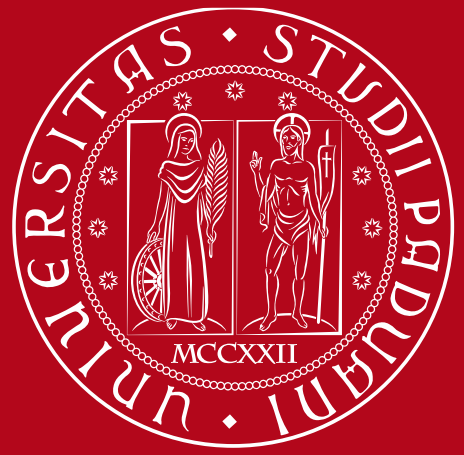

UNIVERSITÀ
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DI PADOVA

Systems of Innovation: National and Regional perspectives

AA 2022/23

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The origin of economic growth in the knowledge era

Economic growth of countries, regions and cities emerges as the aggregate results of a set of preconditions, resources and actors that transform knowledge into economic useful knowledge

From linear models to complex systems

- linear model of innovation, where knowledge flows are modelled as the straightforward result of a production function made by scientific and economic inputs → unrealistic approach
- Innovation can take many forms, originate from different sources and diffuse in many ways, it is more a process than a single event
- Innovation is therefore the result of a complex interaction between productive actors and institutions that is influenced by the cultural context
- What exactly is a complex system? Martin and Sunley (2007, p. 577) define it as: "*a systems is complex when it comprises non-linear interactions between its parts, such that an understanding of the system is not possible through a simple reduction to its component elements*".

Properties of a complex system

1. ***Distributed nature***. Complex systems are multi-scalar diffused with the entrenchment of actors and relationships
2. ***Openness***. Complex systems have blurred boundaries that continuously interact with the external environment
3. ***Non-linear dynamics***. Complex systems do not follow the same script and show feedback and interactions among their sub-systems.
4. ***Limited functional decomposability***. Complex systems can be decomposed into sub-systems, but the temporal validity is uncertain and dynamic.
5. ***Emergence and Self Organisations.*** New orders emerge from the interaction of agents and structures that autonomously interact in many different ways.
6. ***Adaptive behavior and adaptation***. Complex systems and their components critically re-act to the changing condition of the same system and of the external environment.
7. ***Non-Determinism and non-tractability***. Complex systems cannot be pre-determined ex-ante in all their future functions and morphs.

The introduction of National Innovation Systems

Box 1

National innovation systems: definitions

A national system of innovation has been defined as follows:

- " .. *the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies*." (Freeman, 1987)
- " .. *the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state*." (Lundvall, 1992)
- "... *a set of institutions whose interactions determine the innovative performance ... of national firms*." (Nelson, 1993)
- " .. *the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country*." (Patel and Pavitt, 1994)
- ".. *that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies.*" (Metcalfe, 1995)

The rational of unit of analysis (National level)

- State supports **learning mechanisms** of innovation

a) Preconditions → education
b) R&D facilities
c) Norms and laws that enable and/or hinder innovation
d) Many working mechanisms in the public sector contribute (directly or indirectly) to the innovation development process (e.g. finance, cultural environment, Infrastructure, Vision)

A brief focus on Institutions

- Institutions are "the rules of the game in a society" (Douglass North)
- Institutions are "a set of humanly devised behavioral rules that govern and shape the interactions of human beings, in part by helping them to form expectations of what other people will do." (Lin and Nugent)
- Can be *formal* (laws, regulations) or *informal* (norms, patterns of behavior, conventions, moral codes)

Source: Rodrick, 2016

Typologies of institutions

- Market-creating institutions
  - property rights (incl. corporate governance)
  - contract enforcement
- Market-regulating institutions
  - anti-trust, prudential regulation, environmental and safety regulations, etc
  - labor market institutions
  - correction of market and coordination failures
    - "Industrial policies"
- Market-stabilizing institutions (macroeconomic management)
  - monetary, fiscal and currency arrangements
- Market-legitimizing institutions
  - redistribution
  - social insurance
  - political democracy

Source: Rodrick, 2016

An Entrepreneurial State?

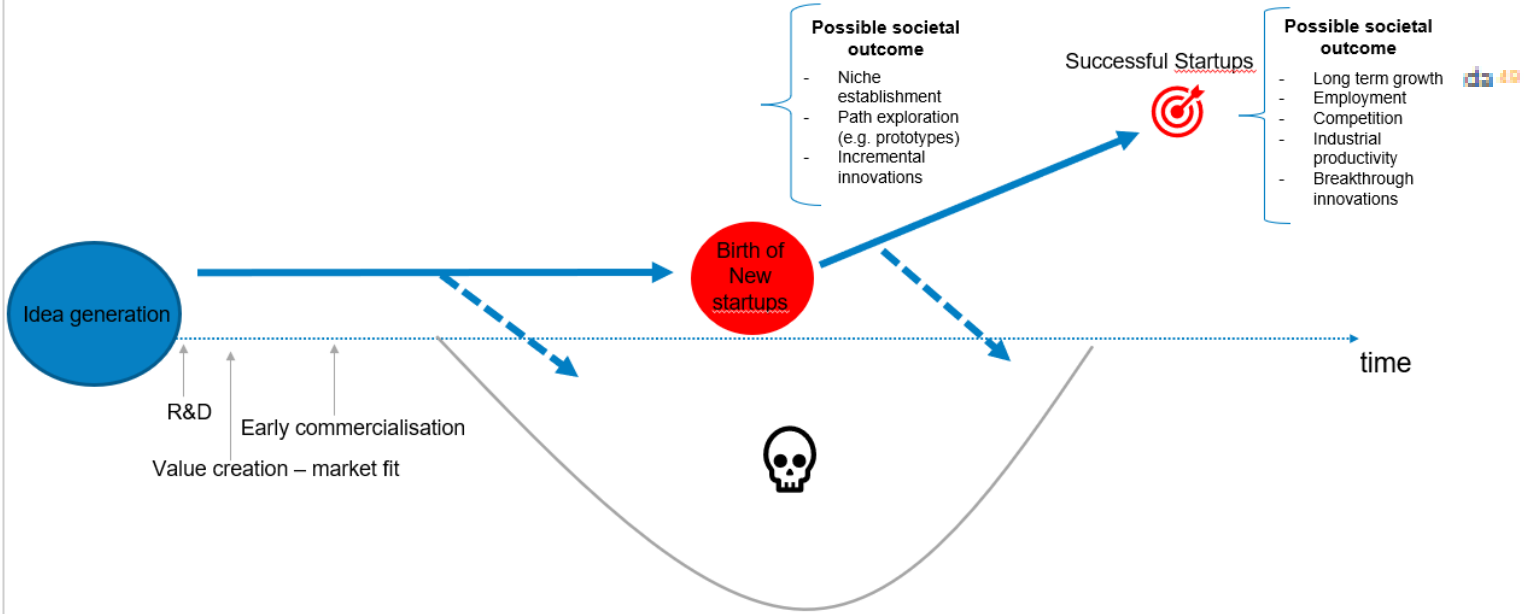
- R&D is not enough → need to build a fertile absorptive capabilities system to transform R&D expenditure in a productive asset (network of alliances, internal competencies)
- A high number of startups do not contribute to long term growth in terms of productivity and employment
- Venture Capital finance too focused on short term commercialisation → tendency to not invest in more risky emergent sectors with a damage for scientific exploration

VC impact

Figure 2 **Stages of venture capital investment**

Startups impact

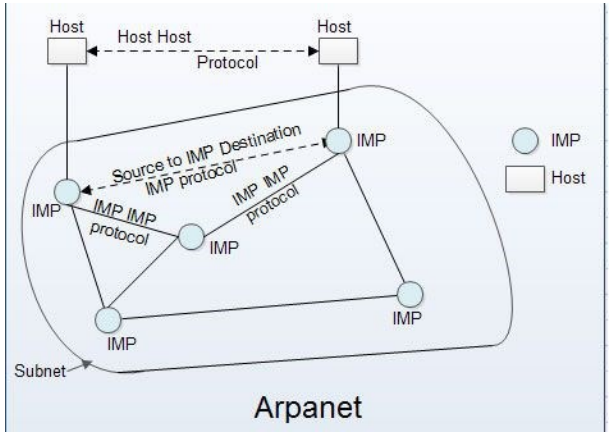
Intro: The long path from ideas to possible societal outcome



The US Entrepreneurial State – the case of DARPA

- The **Defense Advanced Research Projects Agency** agency was created on February 7, 1958 one year after the Soviet Union launched the world's first satellite, Sputnik 1
- The goal was to avoid falling behind the Soviets, and to ensure that the United States remained a world leader in technology development
- RPA was repurposed to do "high-risk", "high-gain", "far out" basic research, a posture that was enthusiastically embraced by the nation's scientists and research universities
- Pivotal investment in breakthrough technologies for national security to expand technological frontier BEYOND the immediate requirement of the Military Services.
- Small units managed by leading scientists with budget autonomy , deeply intertwining between basic and applied research

Innovations originated from the contribution of DARPA



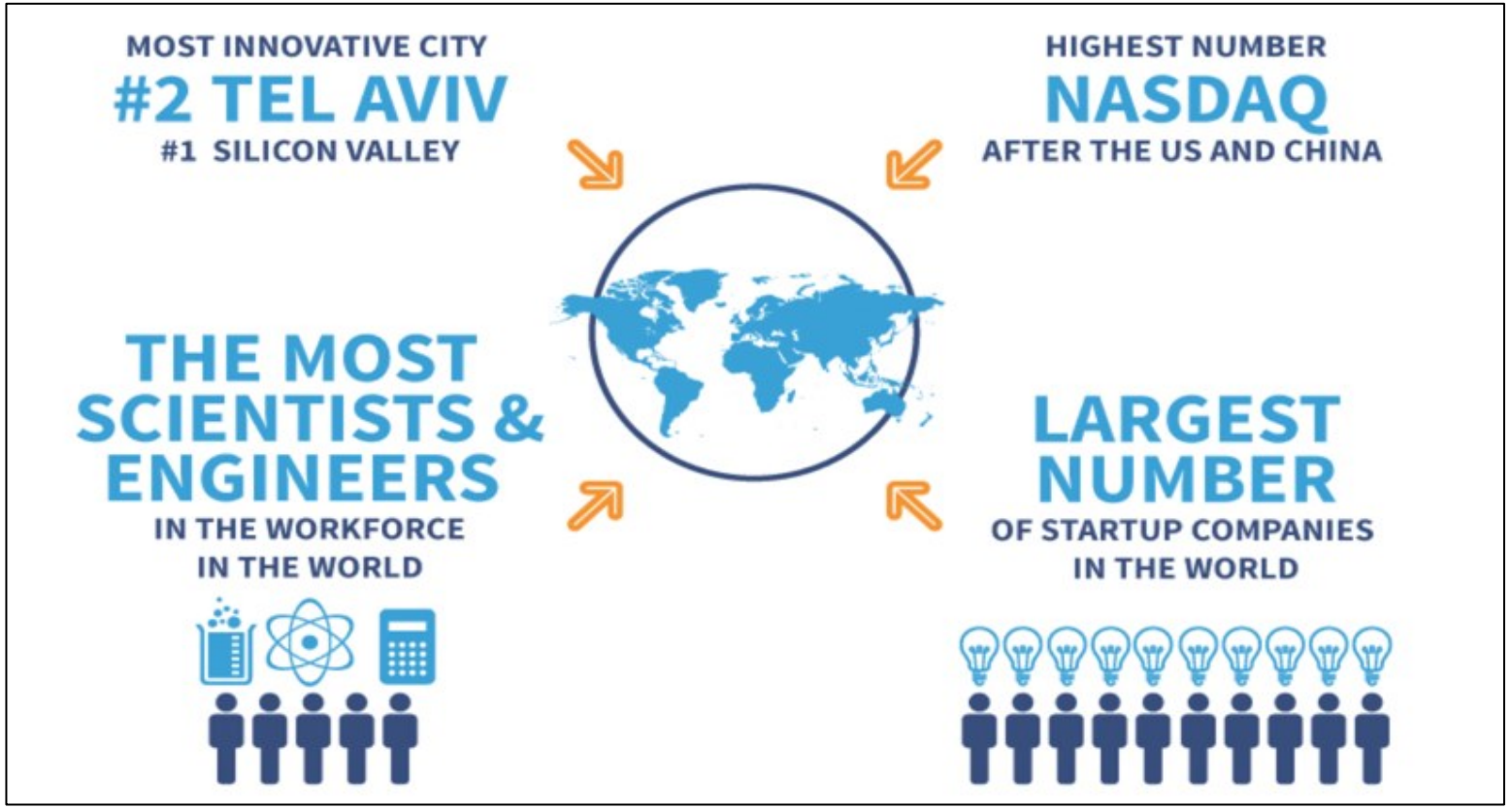
TWO CASES FROM THE WORLD

ISRAEL

- Year of foundation:1948
- Population: 9,3 million (2021)
- 22,070 km² (153 worldwide), more than half desert
- Most important cities: Tel Aviv, Jerusalem, Haifa

Source: World bank

ISRAEL: AN INNOVATION HOTBED



monday.com

waze

Source: SKEMA

https://finder.startupnationcentral.org/

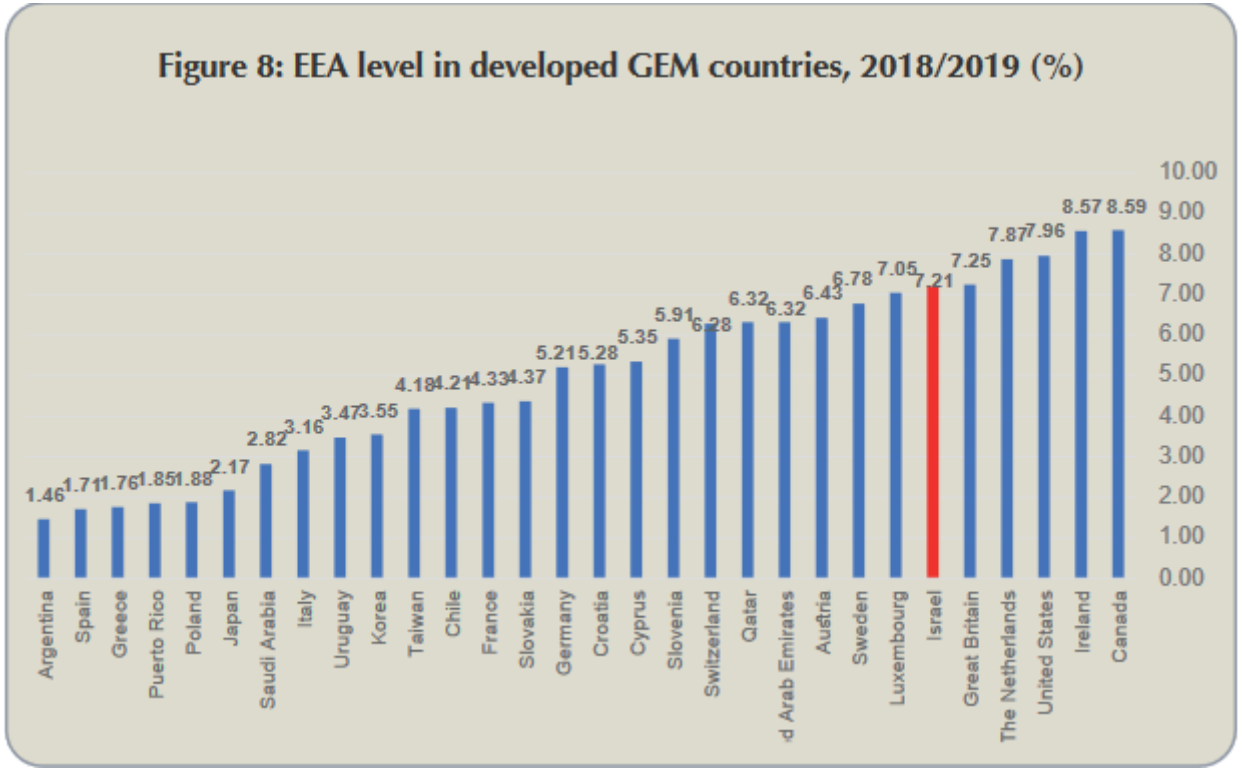
ENTREPRENEURIAL FACTSHEET

Total Early Stage Entrepreneurial Activity Rate (TEA):
The percentage of entrepreneurs among the adult population, ages 18-64, who are at one of the first two stages of forming a business:

a. The Creation and Formation stage, during which the new enterprise has not paid out wages of any kind for over three months (Nascent).

b. The Young Business stage – salary or wages have been paid out for between 3-42 months (Baby Business).

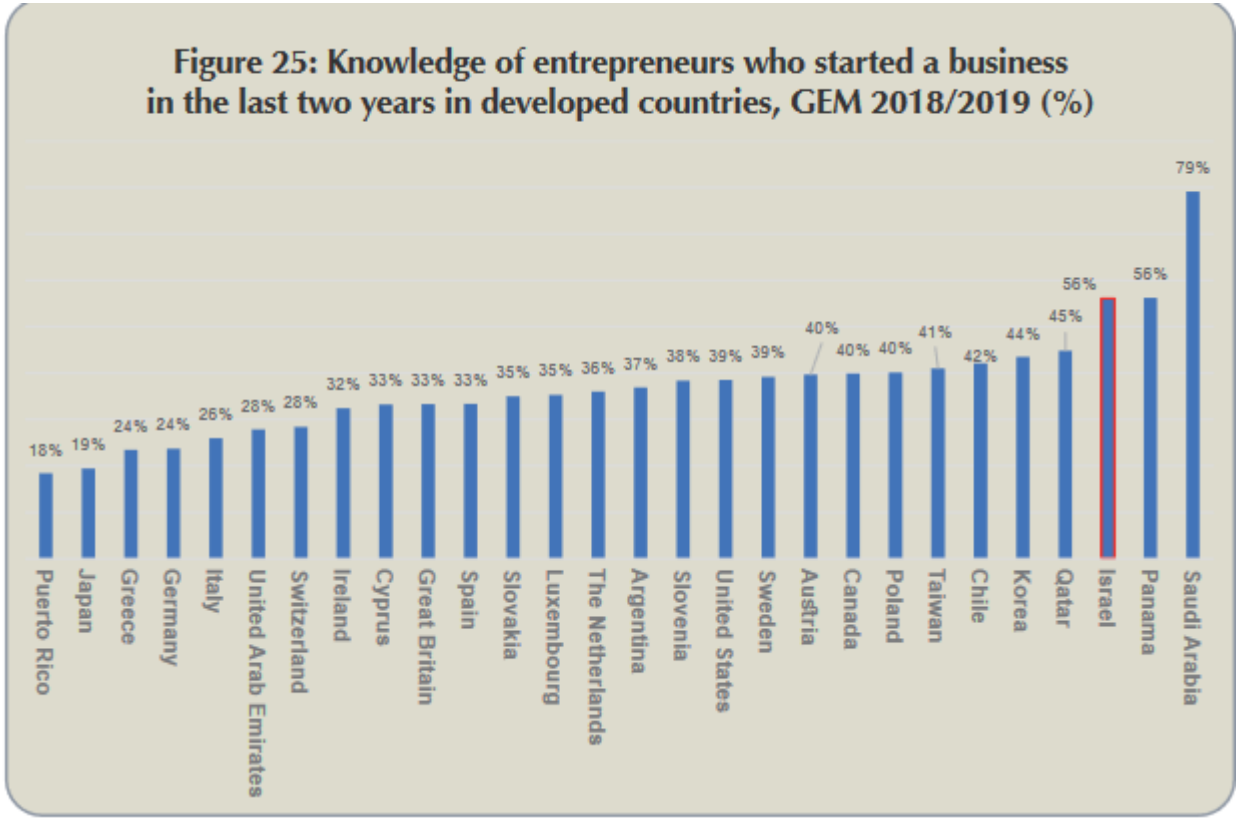
ENTREPRENEURIAL FACTSHEET



Entrepreneurial Employee Activity (EEA):

The rate of individuals ages 18-64 in the population that are currently employed leading new developments or business ideas, or implementing new activities for the employer. This includes developing or launching new goods or services, or setting up a new subsidiary.

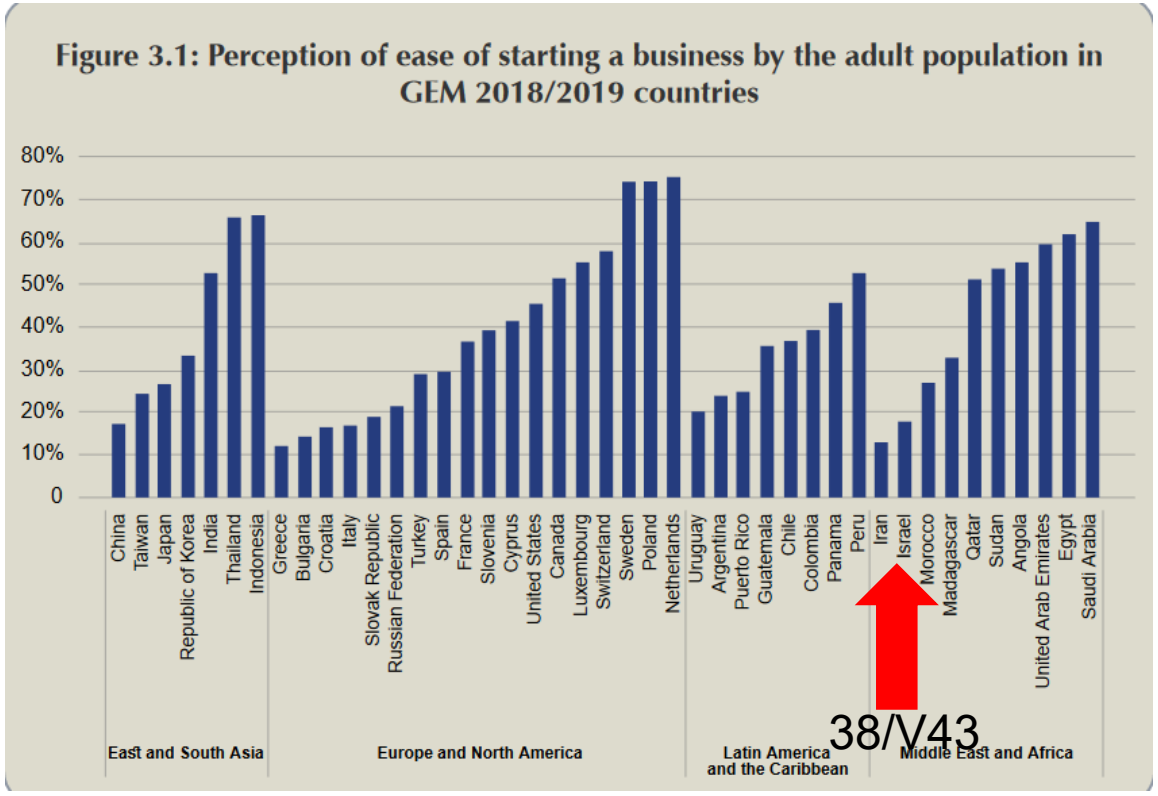
ENTREPRENEURIAL FACTSHEET



Level of knowledge of entrepreneurs

External Evaluation

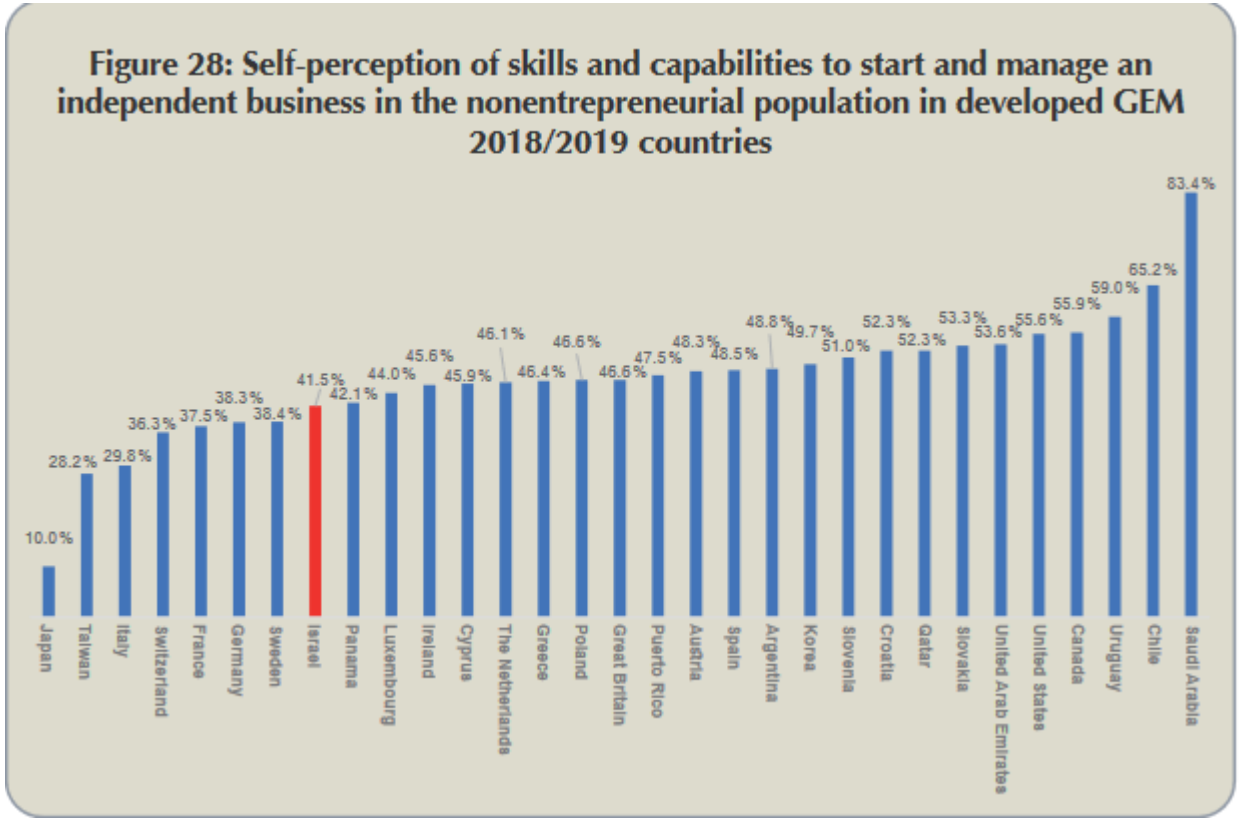
ENTREPRENEURIAL FACTSHEET



Easiness of start a new business (perception)

Percentage of 18-64 population who see good opportunities to start a firm in the area where they live

ENTREPRENEURIAL FACTSHEET



Self Perception

Percentage of 18-64 population who believe they have the required skills and knowledge to start a business

Chance or rational explanation?

ISRAEL INNOVATION ECOSYSTEM (peculiar traits)

A culture of doubt and argument and assertiveness (*chutzpah)*

The Israeli military serves as an incubator for high-tech start-ups and prepares its cadets for business environments

Strong sense of community

Immigration (to and from Israel)

Geopolitical dangerous and adverse natural conditions as incentive for "creativity"

Culture of doubt

- Culture of dissatisfaction → stubbornness and tendency towards a continuous improvement of existing things
- Attitude towards radicalness and challenge towards established rules (with strong argumentation)

Military service as a source of innovation

- IDF (Israel Defense Force) instilled a nonhierarchical culture that allowed soldiers to challenge superiors and organizational procedures (leadership by example versus power by status)

- Technological training during military service to design and lead innovation project

Geopolitical threats and climate adversity

- Geographical bounded by adversaries better equipped in terms of resources, population and territorial size
- Shortage of water pushed Israel to become a global leader in desert agriculture (drip irrigation and desalination)

Sense of community and value of culture

- A state officially built from scratch in 1948 with the will to build up a strong community
- Culture is considered a milestone for socio-economic development

Immigration and international links

FROM THE WORLD TO ISRAEL

- New argonauts from US in the 1970s
- Former Soviet Union in the 1990s
- Major part scientists, doctors, engineers, teachers, writers, journalists, musician and other profession with high level of HC

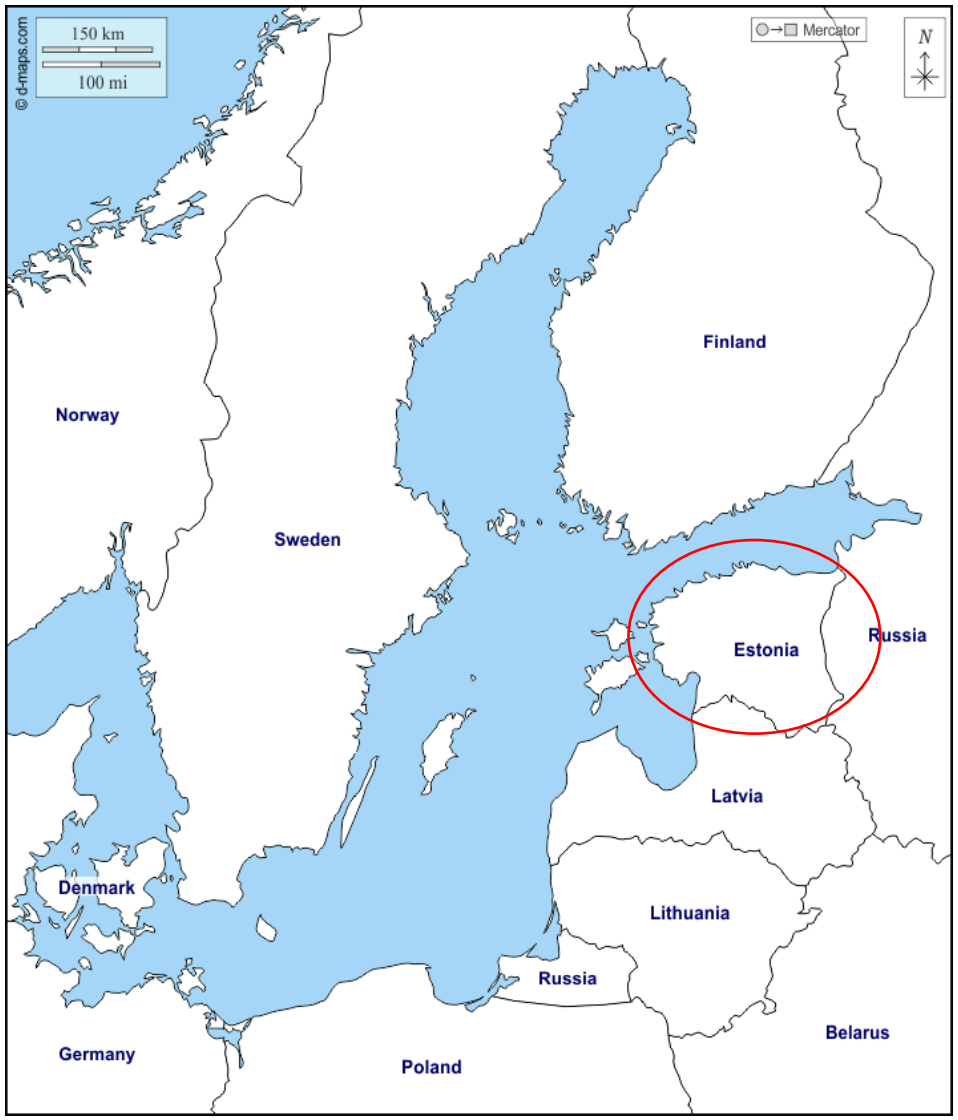
FROM ISRAEL TO THE WORLD

- From 2000s Israel entrepreneurs moved to California (Silicon Valley), New York, Boston and London

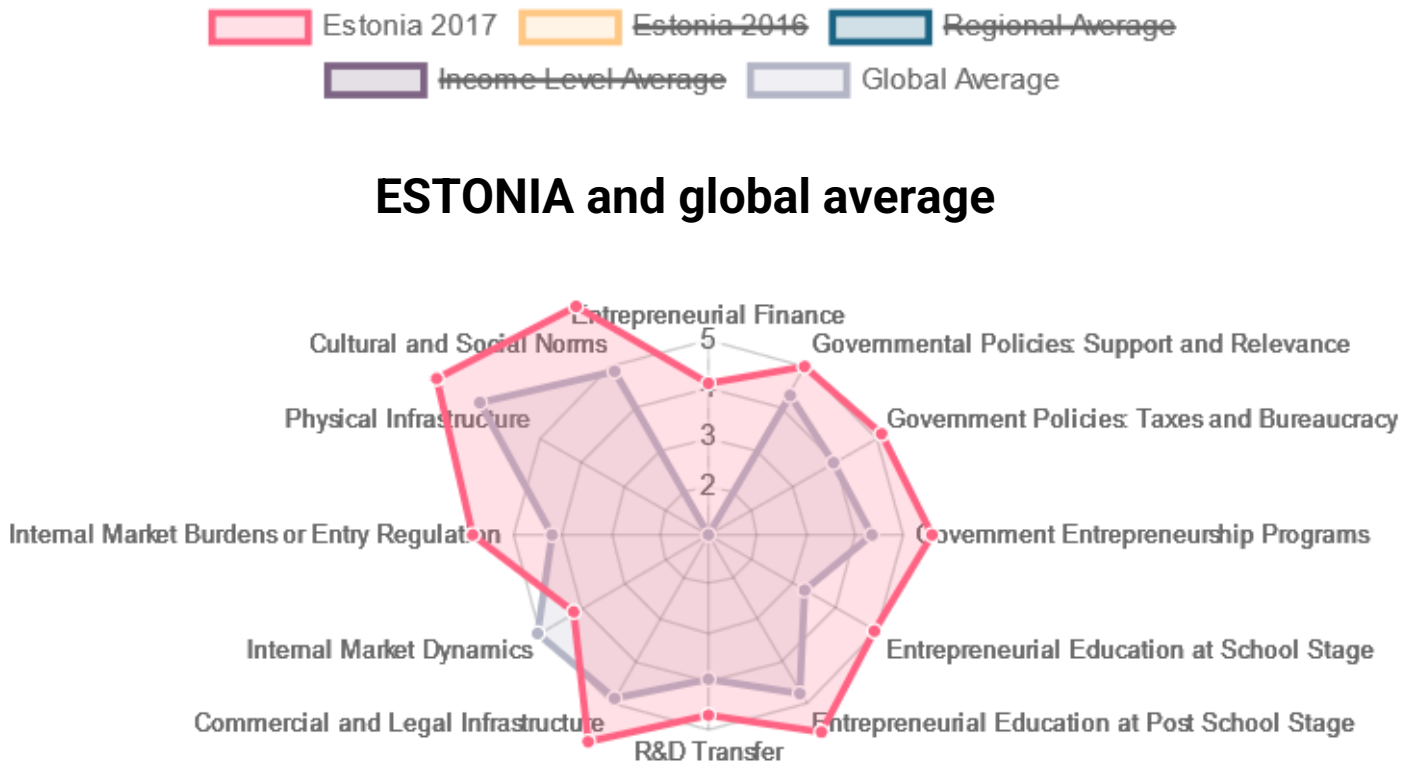
- Frequent travel between western countries and Israel → Not only transfer of entrepreneurial spirit but also management capabilities, who people that come back in Israel were usually to report in dedicated workshops

ESTONIA

- Year of foundation:1918 (independence from URSS 1991)
- Population: 1,3 million (2021)
- 45,228 km², more than half forest (24th smallest country in Europe out of 27)
- Most important city: Tallinn (almost 50% of the total population)

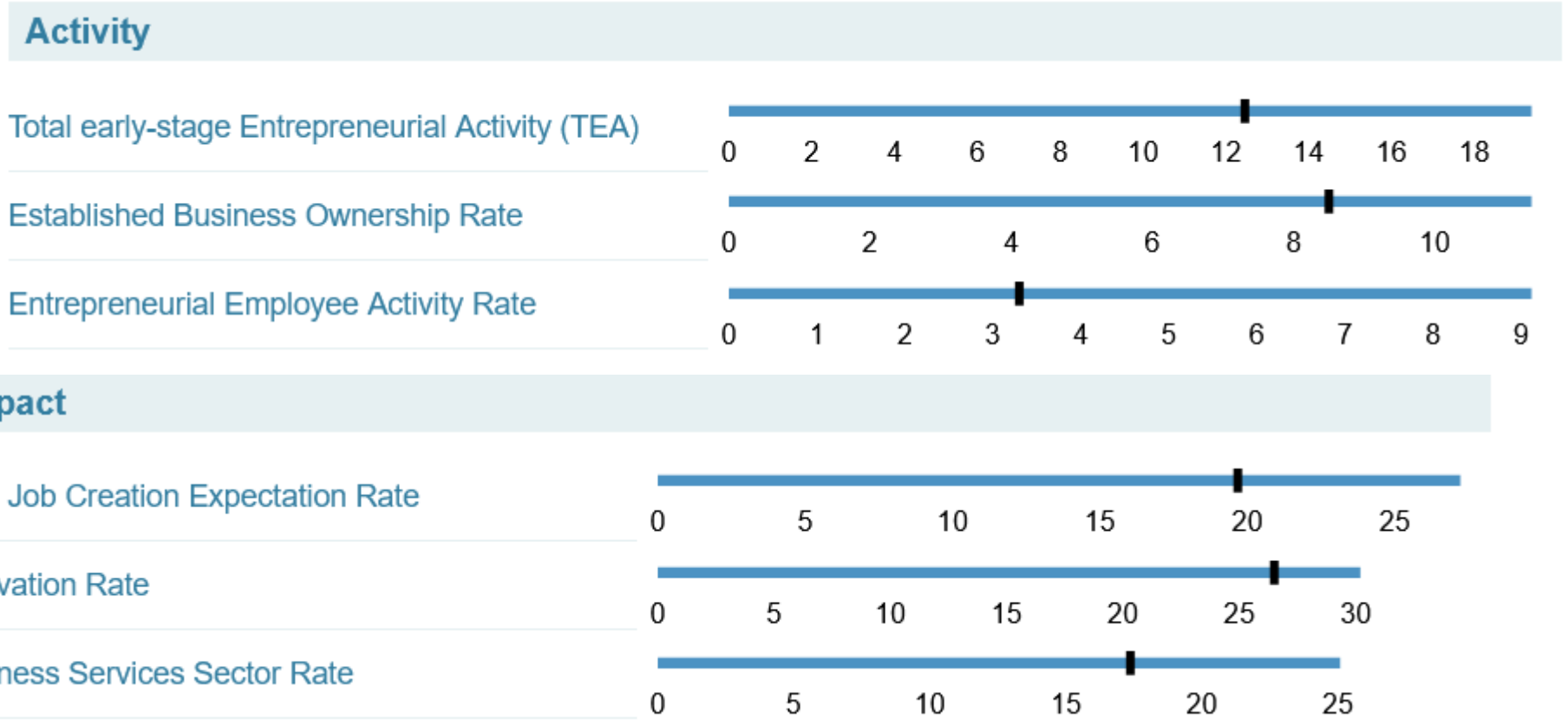


Framework conditions



Framework conditions

ESTONIA and global average



Some well-knonwn cases

playtech
SOURCE OF SUCCESS

GRABCAD

TransferWise

ERPLY

Path dependency of Estonia

LONG TECHNOLOGICAL TRADITION

- In 1960 Tallinn was chosen by the Soviet regime to host technical universities focusing on computer technology
- Legacy with Ericsson, which in 1900 was an emerging Swedish telecommunication company, setting up manufacturing facilities

GENERAL SHOCK

- After URSS dissolution in 1990-1994 the economy contracted by an estimated 36% → export collapsed, domestic demand fall

SMALL COUNTRY WITH LIMITED NATURAL RESOURCES

ESTABLISHMENT OF A FAVORABLE ENVIRONMENT

- Business friendly environment in terms of market trade policies, privatisation of state owned firms, tax system with zero tax on reinvested profits

The birth of «E-Estonia»

Pioneer in the concept of digital society

Estonia exploited internet and the IT capabilities accumulated to connect people, business and government, in 2000 Estonia become the first country to adopt a system of e-governance

In 2002 a digital national ID was introduced and free wi-fi contributing to define digital human rights

By 2000 telecommunications accounted for the largest share of Estonia's export revenues

Specialisation in service platform and electronic payment systems

From KaZaA to Skype

KaZaA a file sharing programme that leveraged P2P networks across the internet

Developing the technology platform to enable voice call by sharing data similar to the way KaZaA did music files

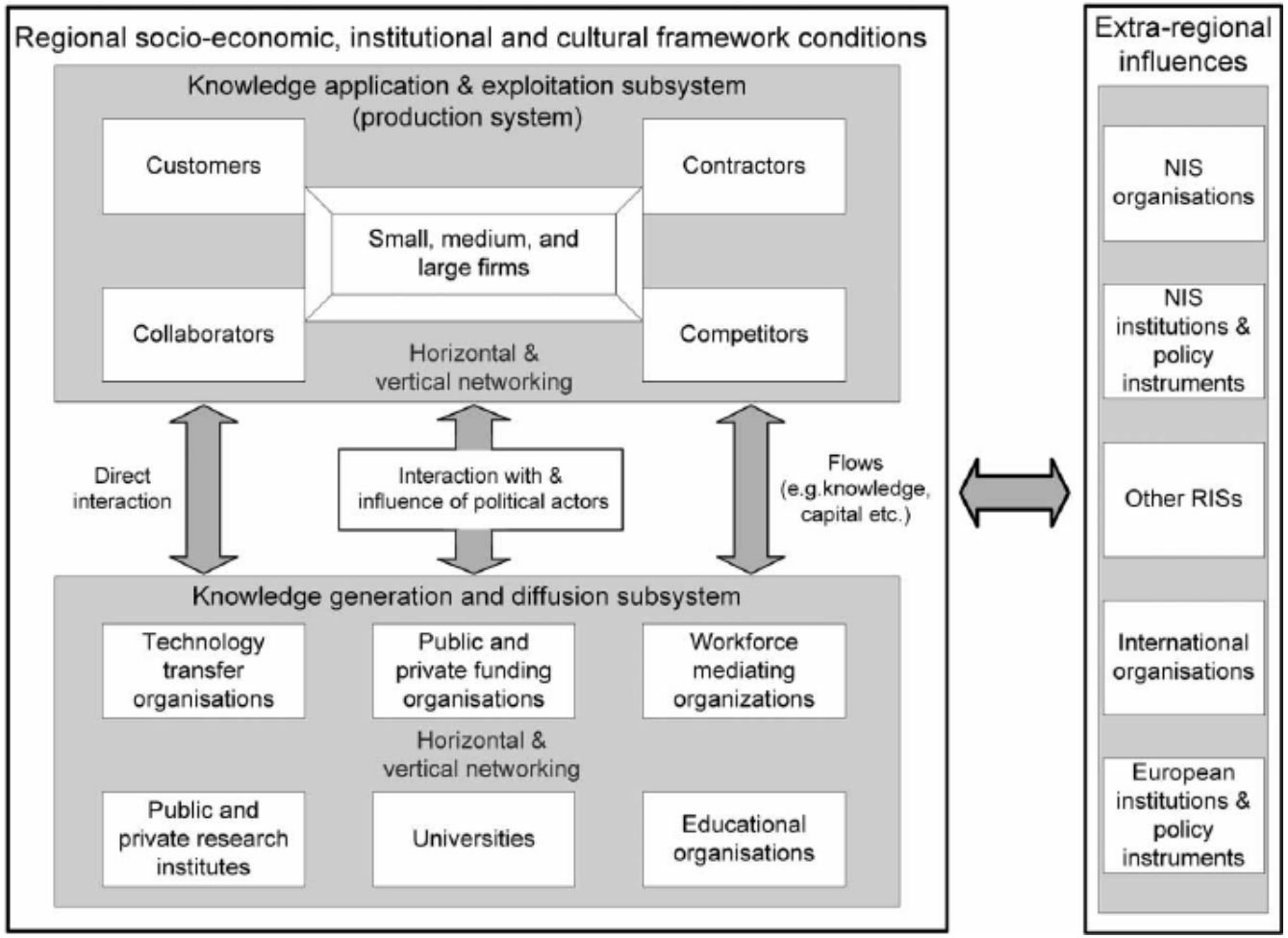
Business experts analyse the strategic technological impact of this P2P technology and they find out telephony market as the ideal test bed

In the early 2000s the other enabling technologies such as broadband level were ready to complement the potential of exchange voice instead of pictures and text

While competition in the VOIP market increased business experts decide to adopt a blue ocean strategy, revolutionising the traditional telephone revenue model (zero cost of getting new users and running traffic; cost based on business development and software development)

Moving to the regional level

Challenging «national homogeneity»: the notion of Regional Innovation Systems

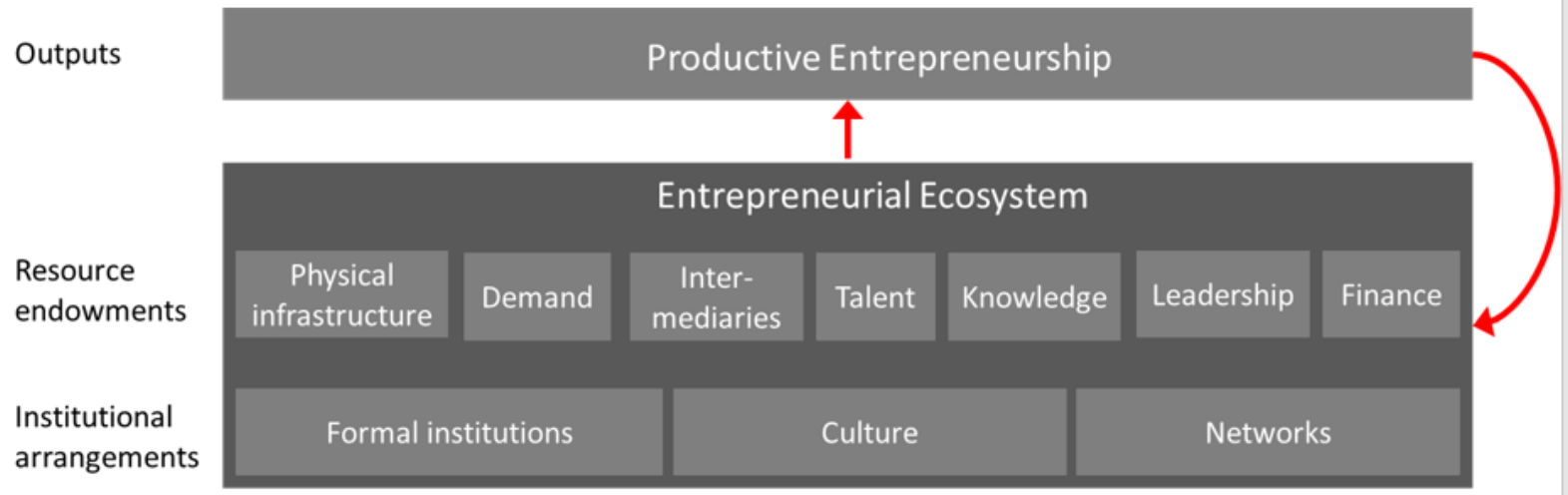


Source: Stuck et al. 2015

- All the same conditions within big nations?
- Spatial Variety matters? (e.g. local clusters?)
- 3 key arguments (Cooke, 1997)

1)Regional budget and adequate capabilities
2) Different learning pace made by sectorial specialization and entrepreneurial culture
3) Different productivity level

Measuring regional preconditions to innovative output



Stam and Van de Ven, 2021

Measuring precondition for Innovation: a focus on Italy

ARTICOLI

GLI ECOSISTEMI IMPRENDITORIALI ITALIANI: UN'ANALISI COMPARATIVA A LIVELLO PROVINCIALE

News ed eventi, attualità

Gli ecosistemi imprenditoriali Italiani: Un'analisi comparativa a livello provinciale

17 gen, 2022

Siamo lieti di segnalarvi il report che il **Macronodo IMT** di **ARTES 4.0** ha prodotto in collaborazione con **l'Università di Utrecht:** *un'analisi molto dettagliata sui fattori collegati e distintivi di un'imprenditorialità di successo e relativi all'ecosistema d'appartenenza* (ad esempio: apparato istituzionale, livello di connessioni, cultura d'impresa, capitali pazienti, servizi dedicati alle imprese e talento).

Sei interessato a saperne di più sull'ecosistema imprenditoriale dove opera la tua impresa? Vuoi conoscere lo stato di salute di possibili target territoriali per lo sviluppo del tuo business? Vuoi sapere quali territori Italiani hanno le migliori condizioni di partenza per creare una nuova opportunità di business?

Entrepreneurial Ecosystems metrics

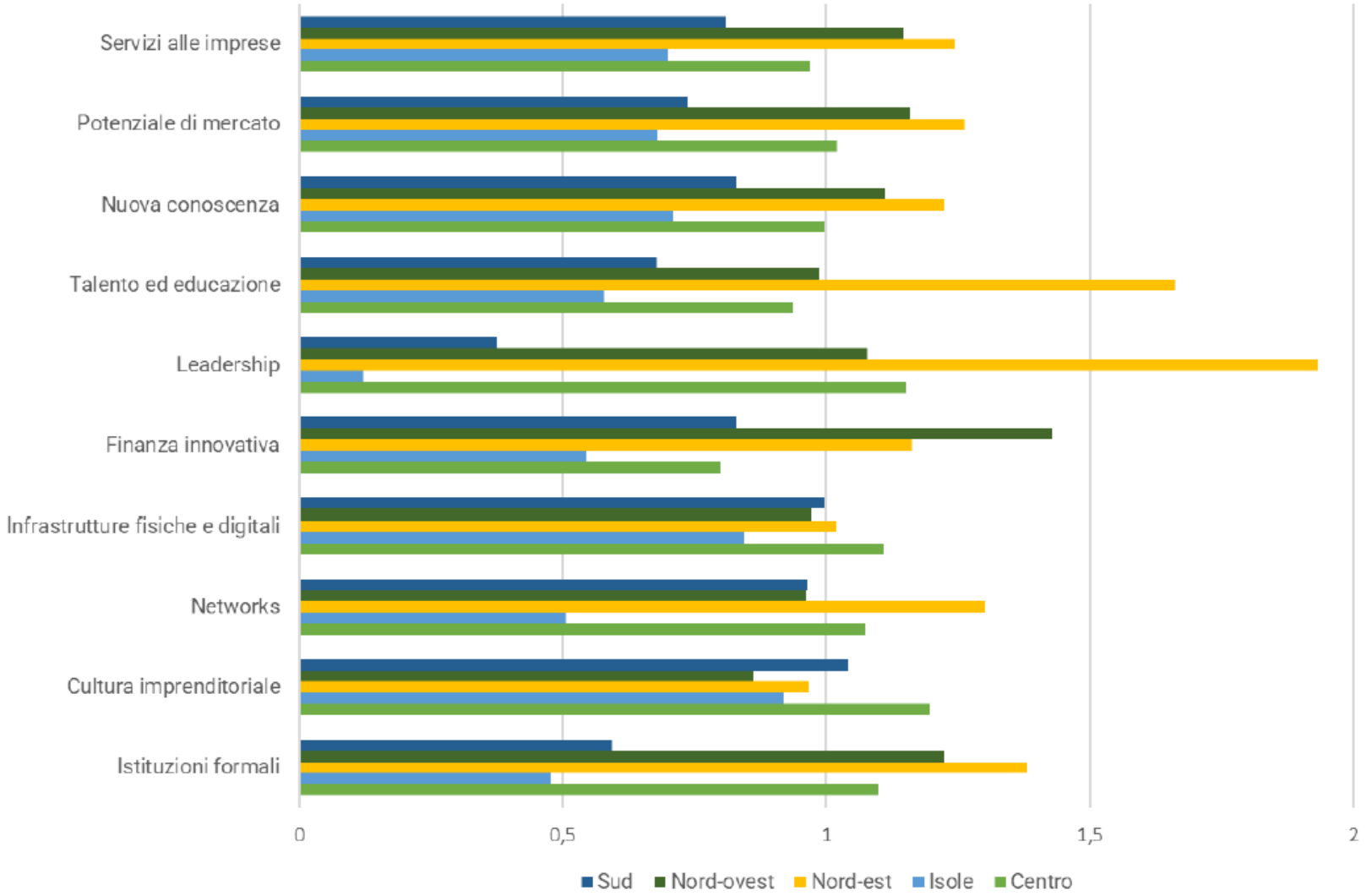
Institutional arrangement	Measures
Formal Institutions	The institutional quality index developed by Nifo and Vecchione (2014) based on 5 groups of elements (corruption, governance, regulation, law enforcement, and social participation).
Culture	New firm formation rate (excluding the sole proprietorship firms) (Stam, 2013).
Networks	The number of Network Contracts between firms ("Rete Contratto"), established by Italian Law 33/2009 that represent an agreement tool that gives the possibility to firms to share one or more objectives and a common program, without creating a new legal entity (Leoncini et al., 2020). This policy tool has been mainly adopted by SMEs and therefore can be used as a proxy of connectedness degree within provinces.

Resources	Measures
Physical Infrastructure	A composite indicator of three measures: Accessibility (travel time to urban centres and average speed in the provincial capital), and Digital infrastructure (percentage of the population with a broadband subscription)
Finance	Information on the innovative source of financing (Venture capitalist, Project Finance and Crowdfunding) as a proxy for the local financial development (cf. Michelacci and Silva, 2007).
Leadership	The number of Horizon2020 project coordinators. In this way we measure the capacity of the territories to coordinate and attract sources of innovation, measuring territorial leadership (Grillitsch and Sotarauta, 2019).
Talent	human capital measure. Composite indicator: level of education of people (percentage of graduated and Ph.D.) and the engagement of firms in training activities to acquire new skills and competencies.
New Knowledge	Intramural R&D activities
Demand	The potential internal market of the ecosystems, measured with GDP per capita
Intermediate Service	the availability of business services that can nurture the activity of startups, sustaining them in consulting activities across different levels (e.g., legal, financial, strategical). As a proxy, we use the percentage of firms in knowledge-intensive market services in line with Leendertse et al. (2022).

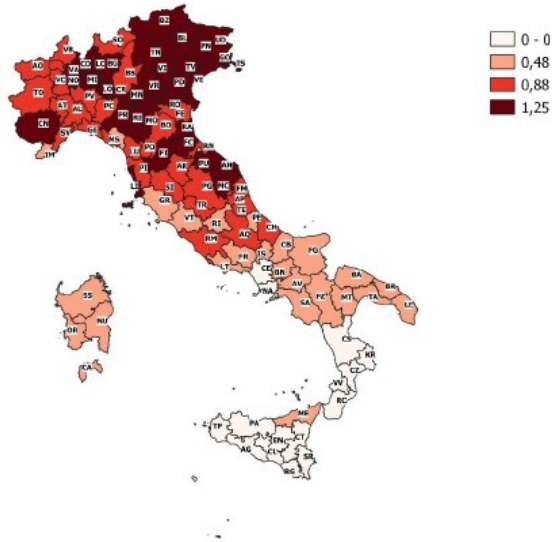
Diagnosis of the EE elements

Provincia	Regione	Istituzioni Formali	Cultura Imprenditoriale	Networks	Infrastrutture Fisiche e Digitali	Finanza Innovativa	Leadership	Talento e formazione	Nuova Conoscenza	Potenziale di Mercato	Servizi alle Imprese	Indice Ecosistema
Milano	LOMBARDIA	1,28	1,92	5,30	1,63	10,10	4,76	6,31	1,50	2,06	2,35	37,20
Roma	LAZIO	1,16	1,76	5,30	1,44	10,10	4,68	4,78	1,21	1,42	1,54	33,39
Bologna	EMILIA-ROMAGNA	1,24	1,08	2,58	1,26	2,15	5,73	6,46	1,33	1,53	1,56	24,93
Torino	PIEMONTE	1,10	0,94	2,39	1,09	6,64	2,65	1,87	1,30	1,23	1,66	20,86
Trento	TRENTINO-ALTO ADIGE/SÜDTIROL	1,68	0,92	1,10	1,47	3,27	6,55	1,79	1,23	1,41	1,08	20,49
Trieste	FRIULI-VENEZIA GIULIA	1,59	0,71	0,74	0,95	0,00	5,83	5,95	0,90	1,30	1,53	19,50
Firenze	TOSCANA	1,42	2,93	2,11	1,06	2,15	3,09	2,53	1,43	1,41	1,29	19,42
Bolzano/Bozen	TRENTINO-ALTO ADIGE/SÜDTIROL	1,33	1,07	0,62	1,13	7,93	2,05	1,10	0,91	1,73	1,31	19,16
Brescia	LOMBARDIA	1,25	1,08	2,14	1,27	7,15	0,57	0,58	1,44	1,27	1,56	18,29
Genova	LIGURIA	1,09	0,89	0,94	1,02	0,60	6,69	1,87	0,99	1,33	1,33	16,74
Bergamo	LOMBARDIA	1,35	0,96	1,68	0,76	6,72	0,61	0,81	1,22	1,24	1,38	16,73
Venezia	VENETO	1,46	0,96	2,03	1,05	1,64	4,26	1,14	1,04	1,18	1,69	16,46
Pisa	TOSCANA	1,22	1,13	1,04	0,82	0,00	6,89	1,30	1,26	1,18	1,09	15,93
Padova	VENETO	1,47	1,15	2,10	0,47	1,12	3,67	1,80	1,22	1,28	1,42	15,70
Parma	EMILIA-ROMAGNA	1,40	1,12	1,00	1,21	0,69	3,15	2,59	1,27	1,41	1,45	15,29
Bari	PUGLIA	0,78	1,24	3,57	0,84	4,65	0,44	0,89	1,14	0,80	0,91	15,25
Modena	EMILIA-ROMAGNA	1,28	1,23	1,49	1,69	0,52	2,01	1,50	1,78	1,47	1,45	14,43
Verona	VENETO	1,41	1,17	2,08	0,86	0,78	1,25	1,78	1,19	1,29	1,26	13,08
Reggio nell'Emilia	EMILIA-ROMAGNA	1,29	1,10	0,97	1,25	0,43	2,75	0,67	1,53	1,35	1,18	12,53
Monza e della Brianza	LOMBARDIA	1,38	0,98	1,24	0,48	1,64	0,94	1,68	1,22	1,16	1,64	12,35
Siena	TOSCANA	1,13	1,12	0,99	1,13	0,26	2,80	1,77	1,07	1,19	0,86	12,33
Vicenza	VENETO	1,45	0,99	1,73	0,51	1,55	0,47	0,96	1,70	1,28	1,32	11,96

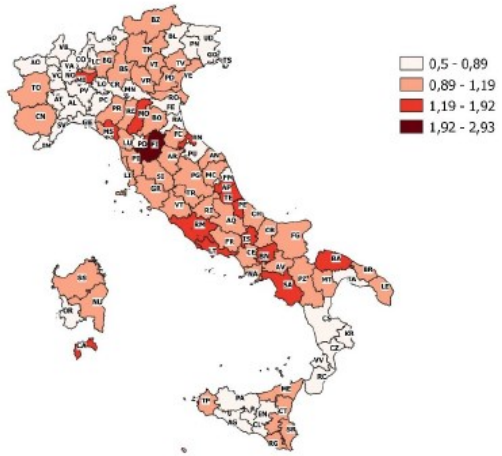
Regional average



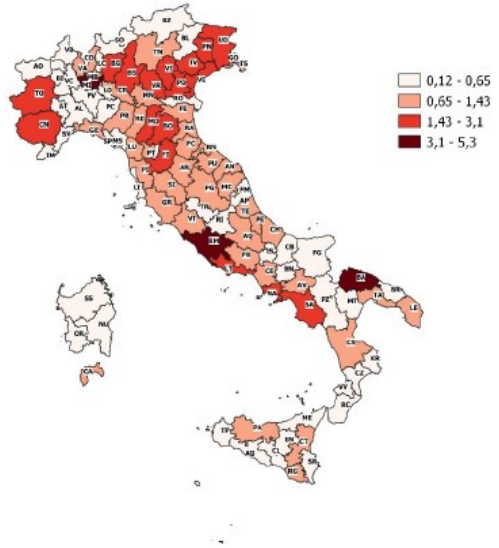
Istituzioni formali



Cultura imprenditoriale

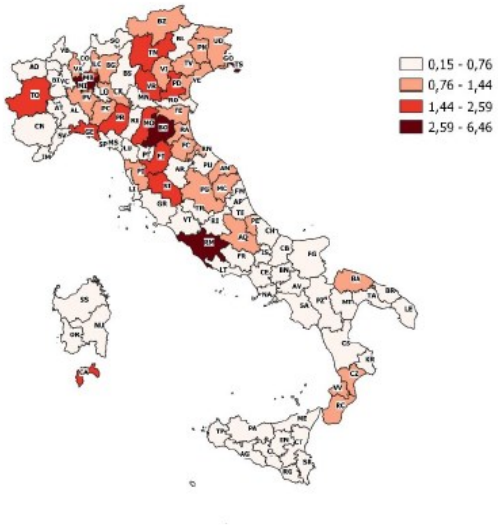


Networks

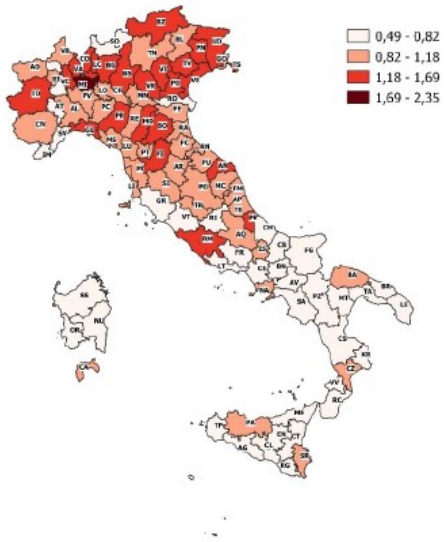


Spatial Distribution

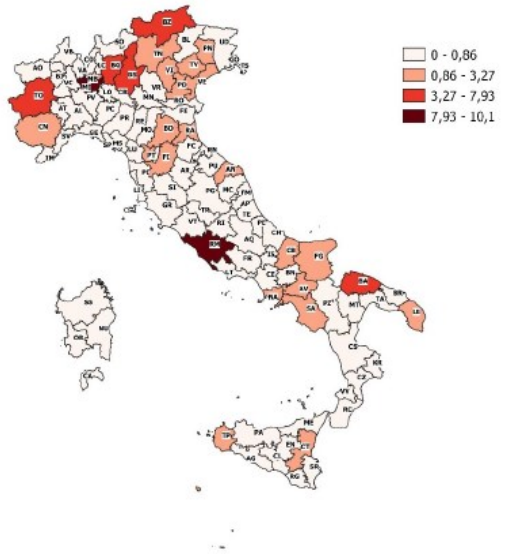
Talento e formazione



Servizi alle imprese

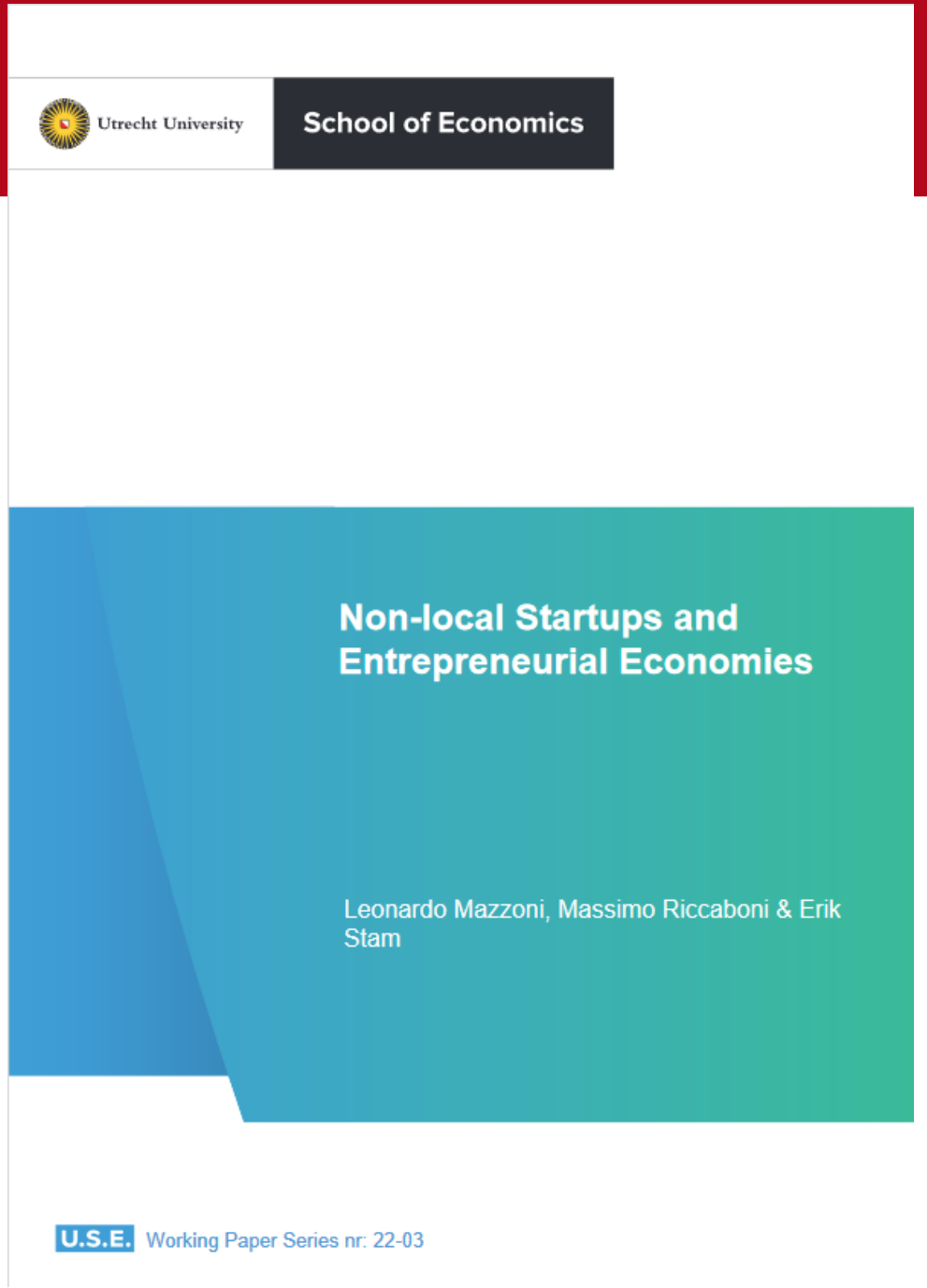


Finanza innovativa

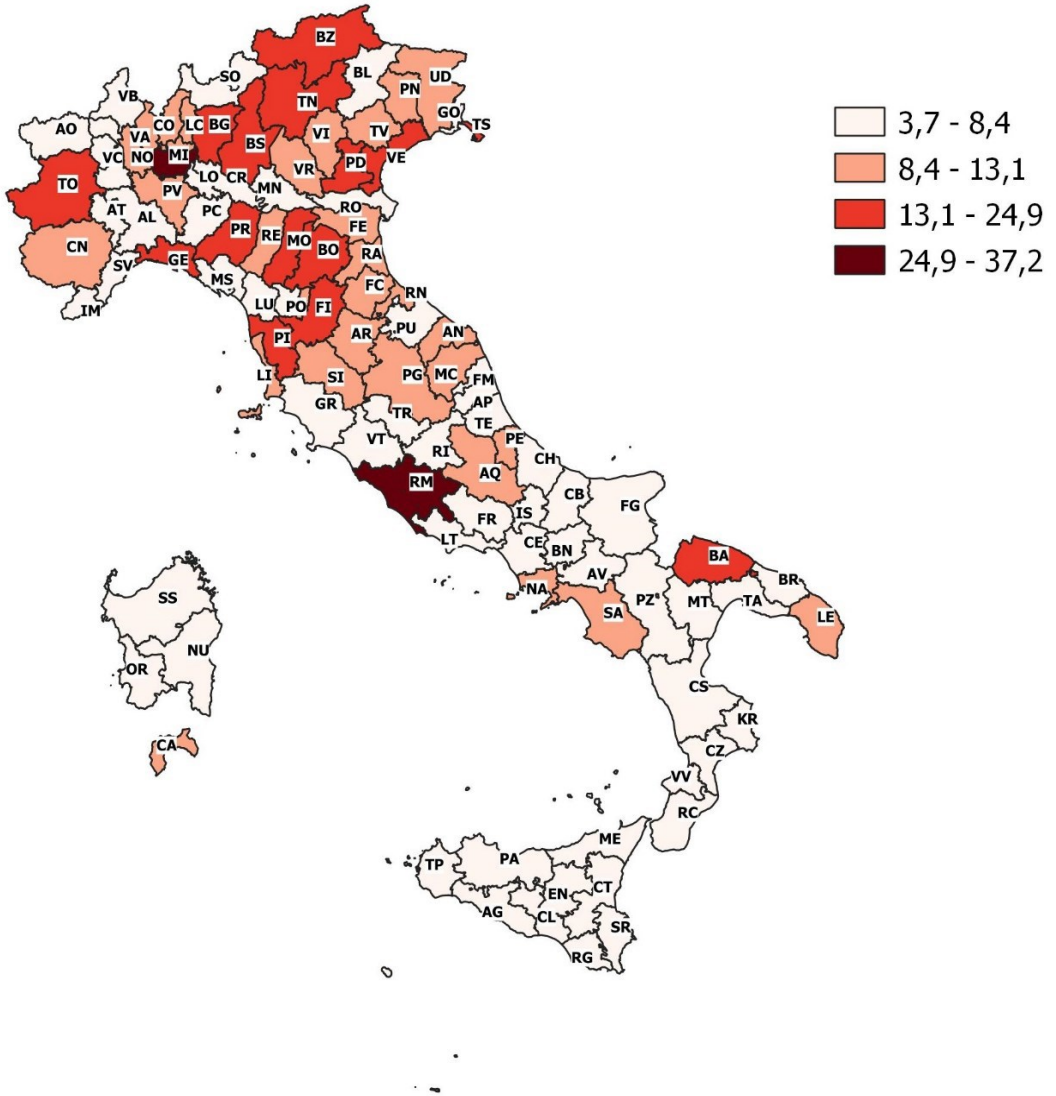


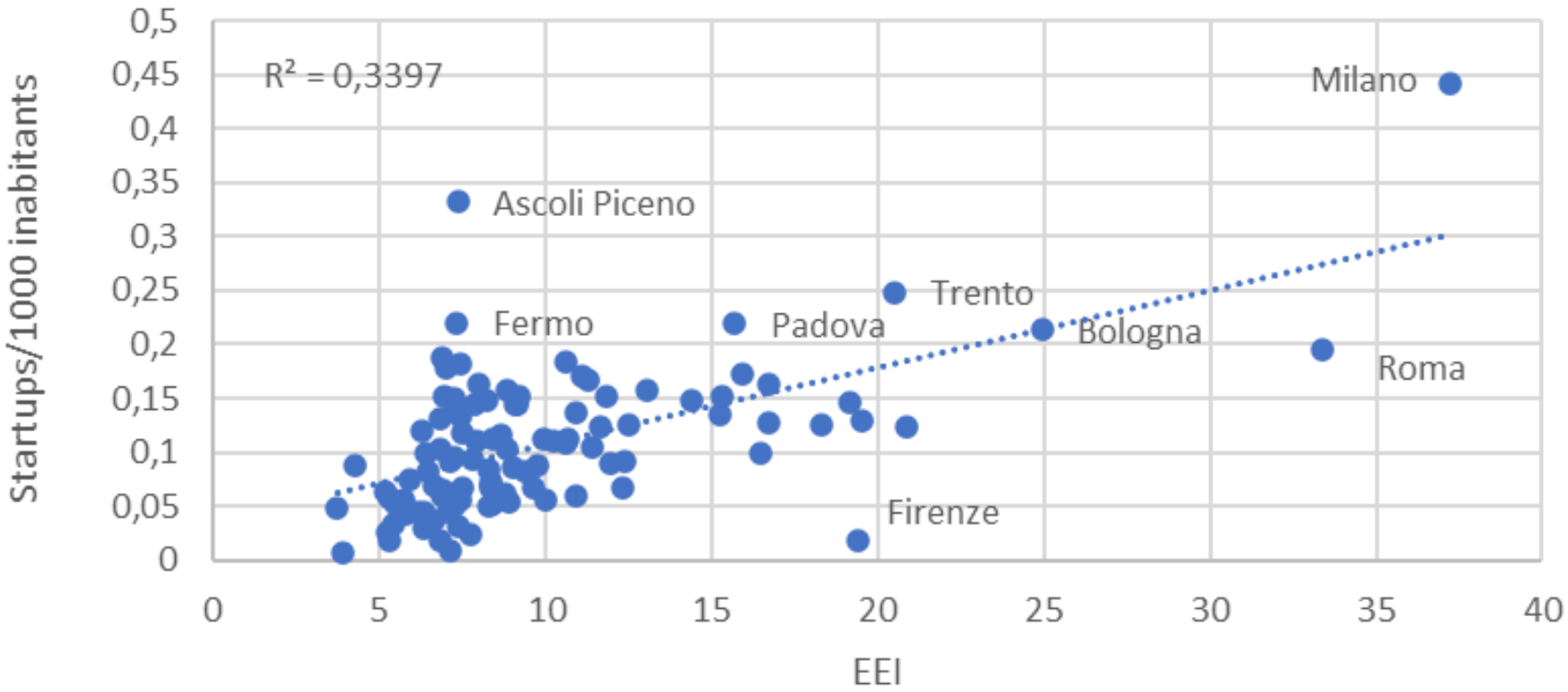
Spatial Distribution

Interregional connection between entrepreneurial systems

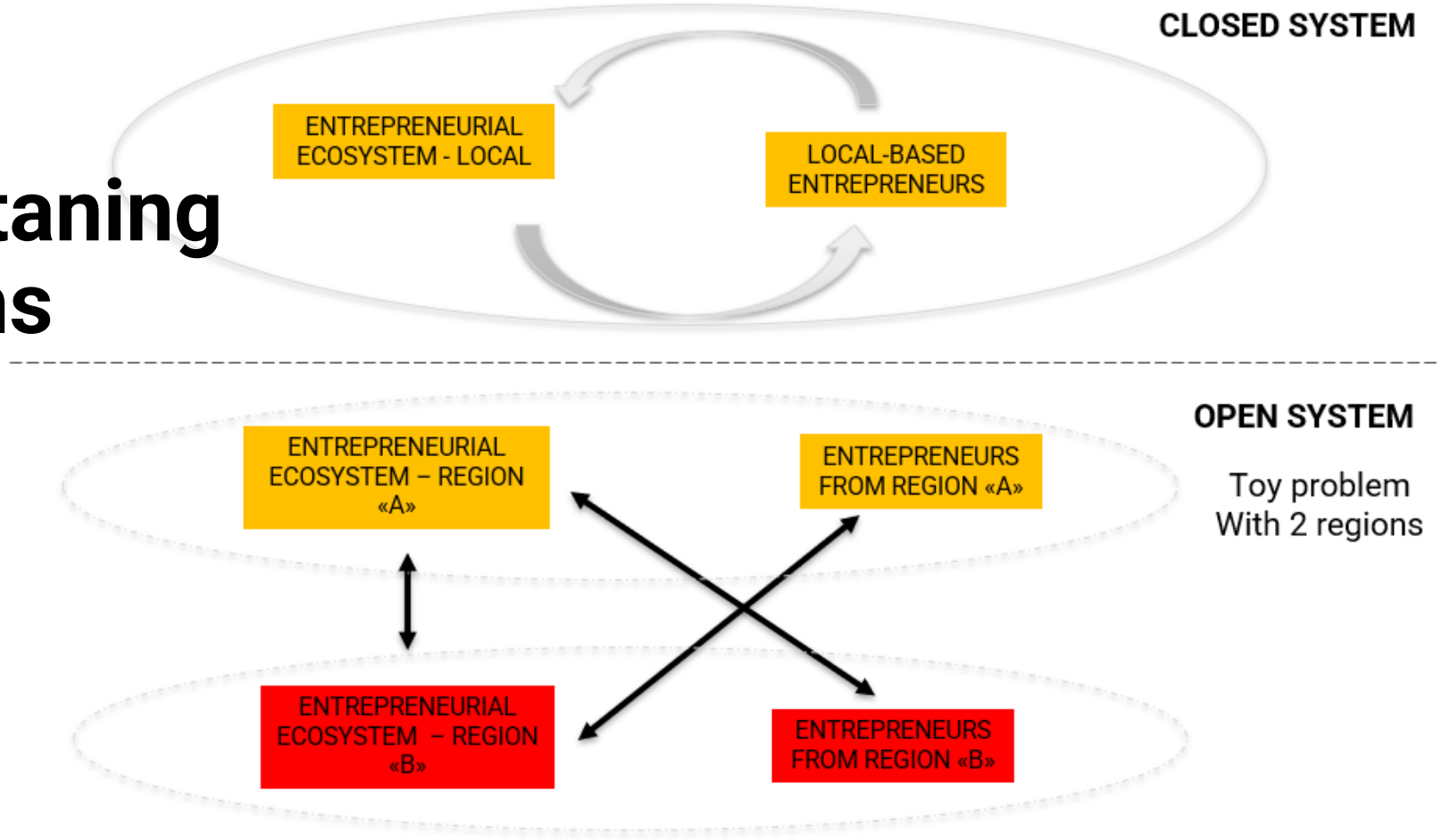


Entrepreneurial Ecosystem at the local level – 105 Italian NUTS-3 regions

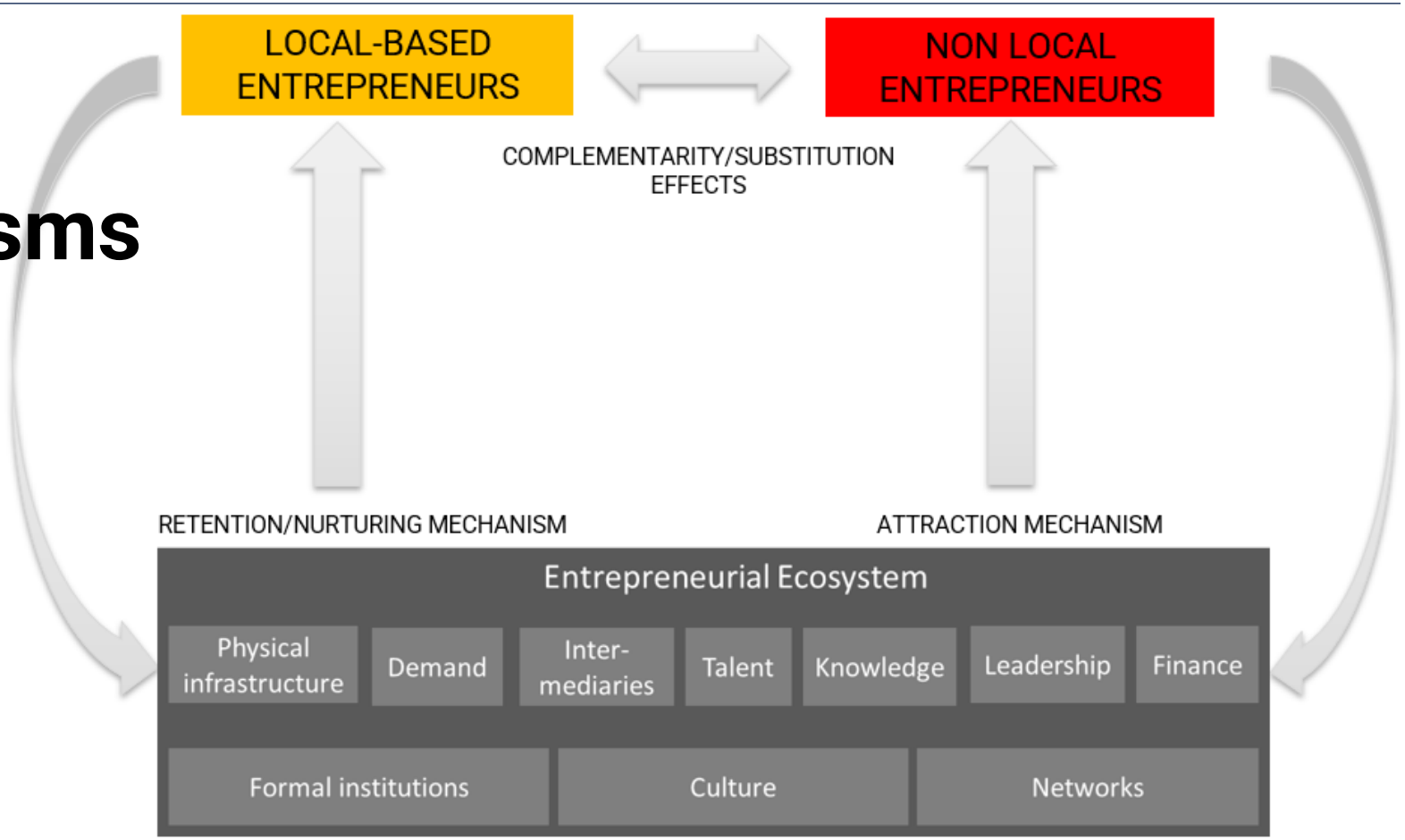



Startups/1000 inabitants
0,5
0,45
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
R² = 0,3397
Milano
Ascoli Piceno
Trento
Fermo
Padova
Bologna
Roma
Firenze
0
5
10
15
20
25
30
35
40
EEI

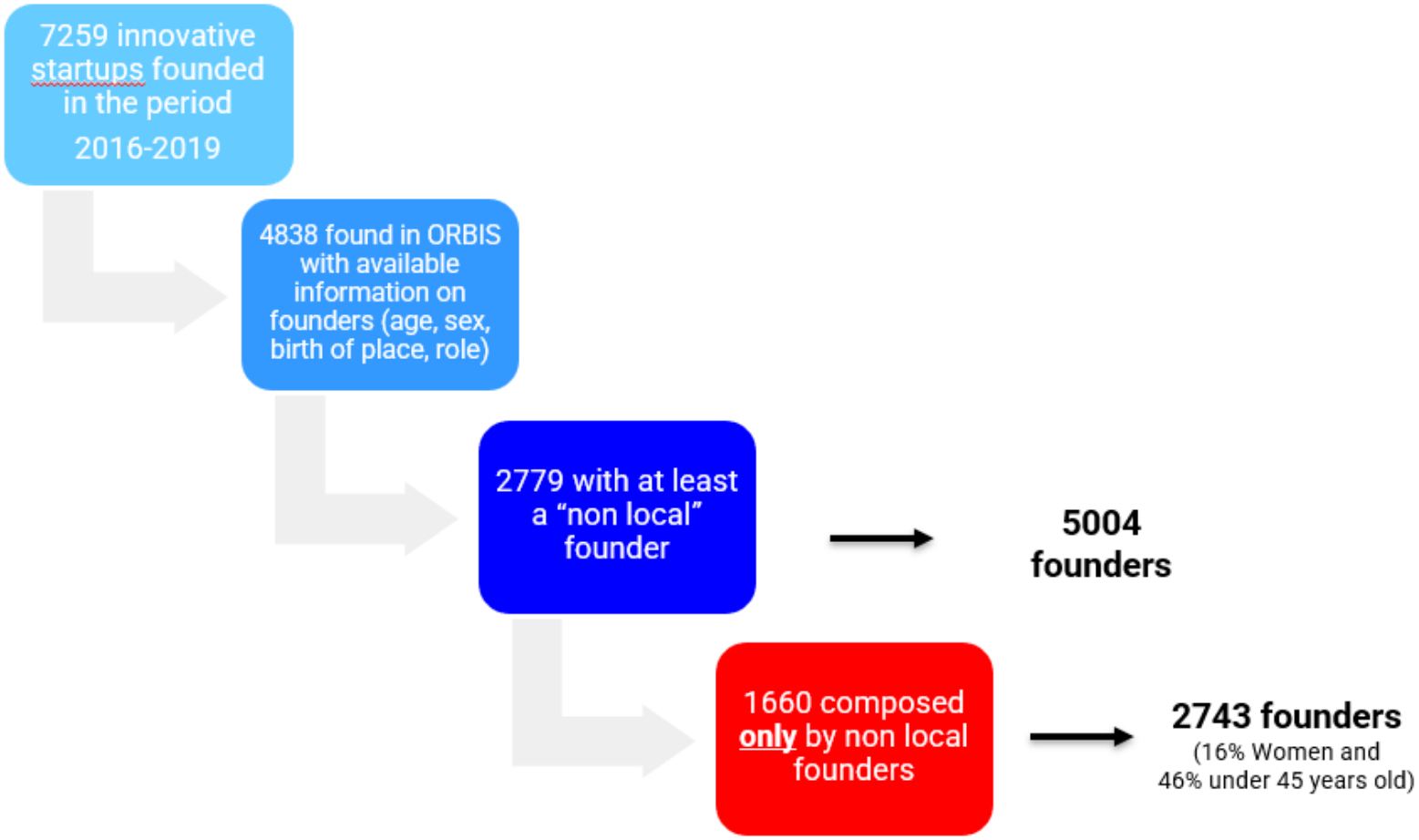
From self-cointaning to open systems



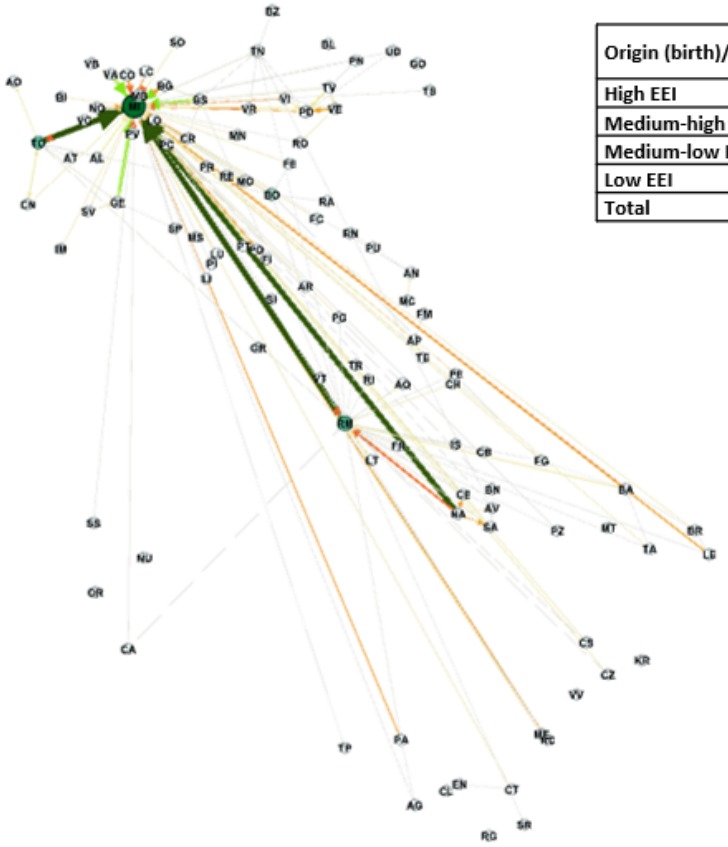
Working mechanisms



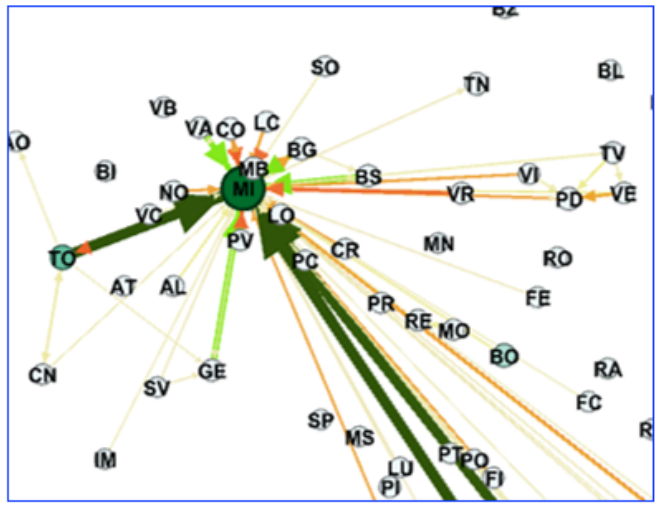
Data collection



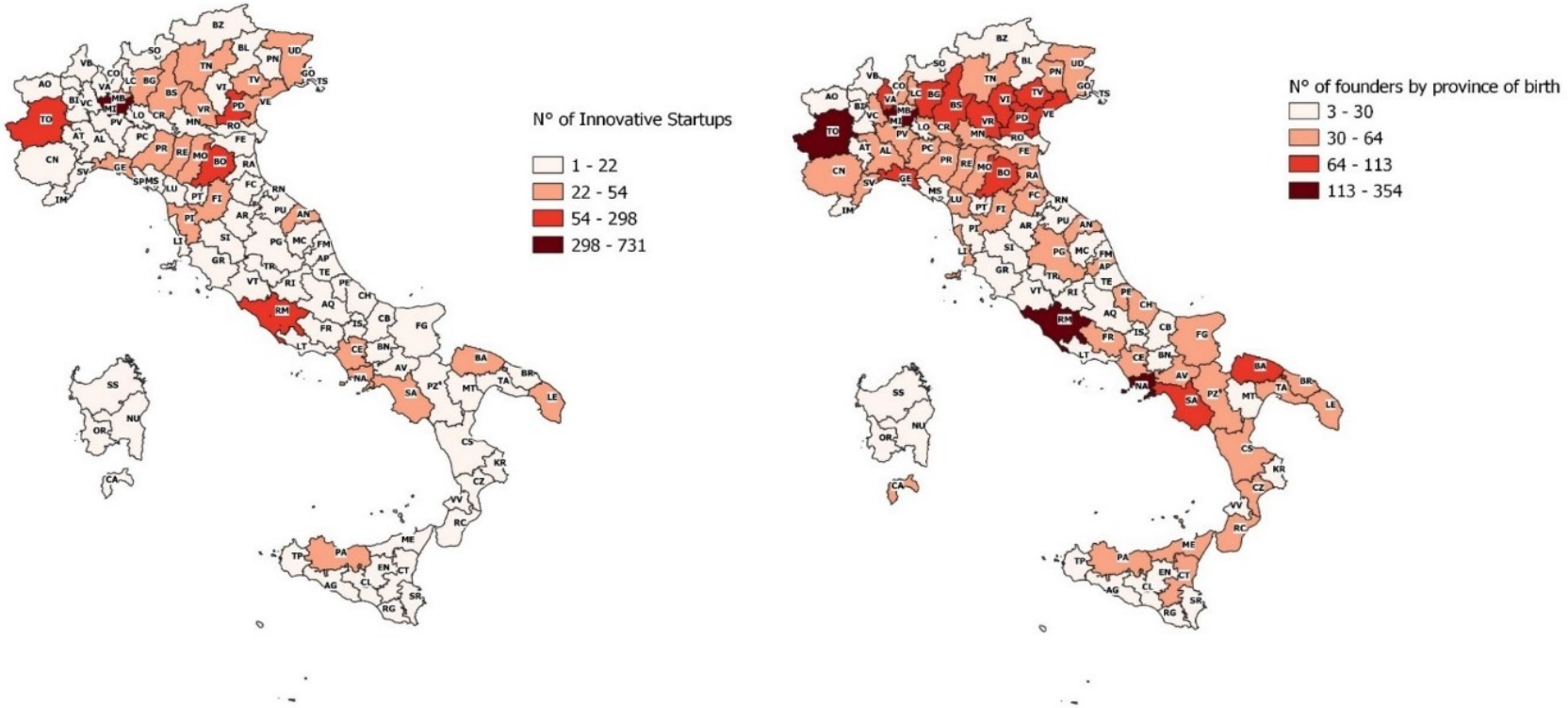
Network of non-local founders mobility



Origin (birth)/destination	High EEI	Medium-high EEI	Medium-low EEI	Low EEI	Total
High EEI	1865	362	141	137	2505
Medium-high EEI	860	134	64	35	1093
Medium-low EEI	486	99	68	43	696
Low EEI	519	84	44	63	710
Total	3730	679	317	278	5004



Innovative startups and non-local founders by Italian NUTS-3 regions of 105 Italian NUTS-3 regions



DISCUSSION TIME

What are the main challenges for the future development of the two systems of innovation? Specify different mechanisms for the two countries.

DISCUSSION TIME

Could you provide and (briefly) describe other examples of innovation systems with peculiar characteristics? (national or regional level)?

For Further insights…

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