

# The Dynamics of National Innovation Systems

A Panel Cointegration Analysis of the Coevolution between  
Innovative Capability and Absorptive Capacity



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# Agenda



- Motivations
- NIS dynamic analysis: challenges, requirements and econometrics
- NIS in panel:
  - 1 Model, 3 propositions
  - Empirical results
- (In Process) Conclusions
- Next steps



# Motivations



- 2) It is not hard to find empirical analysis about generating economic growth from innovation...  
... but it is not that easy to find studies about how to generate innovation

**If you want to win the race, you better feed your horse**

- 3) Most of the empirical studies are focused on cross-country comparisons (“why growth rates differ across countries?”)

**Pictures are OK, but we want to see the movie**

# NIS dynamic analysis: challenges



## Challenges

- 1) Time series perspective
- 2) The dynamics and determinants of innovative capabilities
- 3) The dynamics and multifaceted nature of absorptive capacity
- 4) The coevolution between innovative capability and absorptive capacity

# NIS dynamic analysis: requirements

## What do we need?

- 1) CANA Dataset: 134 Countries, 42 Indicators, 1980 - 2008

<http://cana.grinei.es>

Freely  
available!!

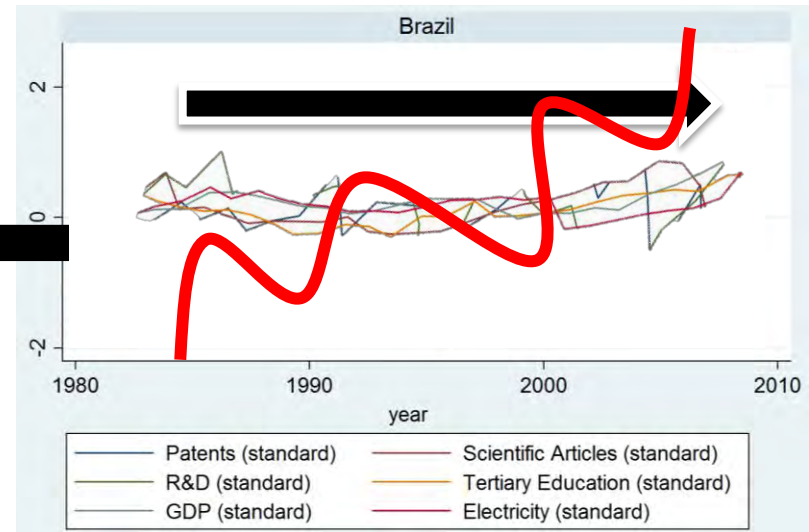
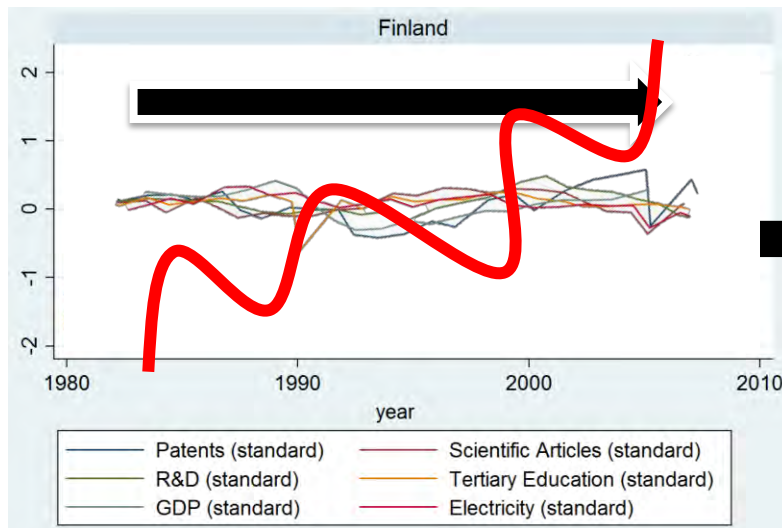
- 2) Analytical and methodological orientation to complex evolving systems **over time**:
  - Panel Unit Root Test
  - Panel Cointegration Analysis
  - VECM
  - Granger Causality Tests

# NIS dynamic analysis: econometrics

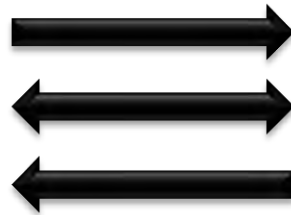
**1** Panel Unit Root  
Panel Cointegration

**2** VECM

**3** Granger Causality Test



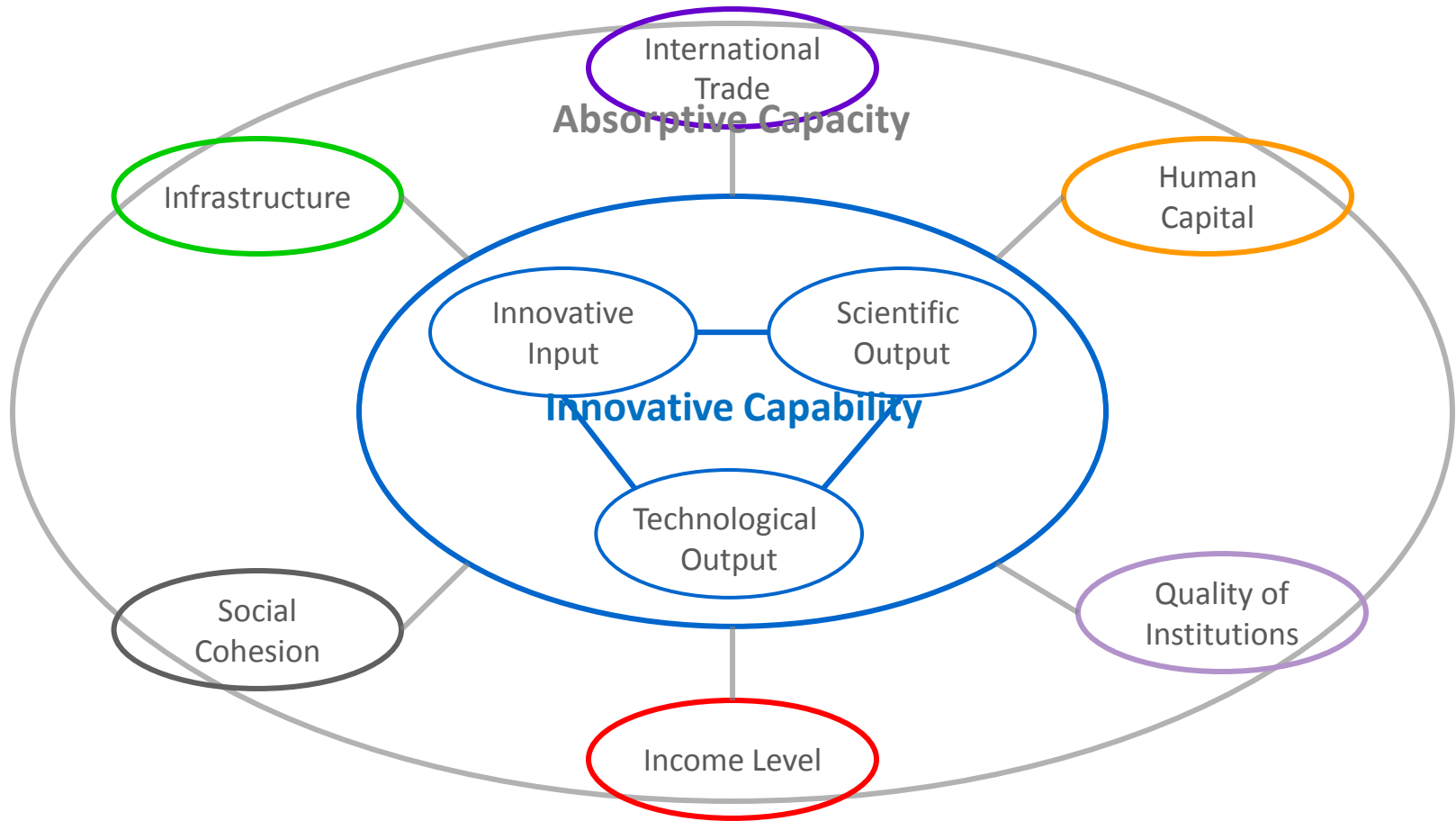
X



Y

# NIS in panel: 1 Model

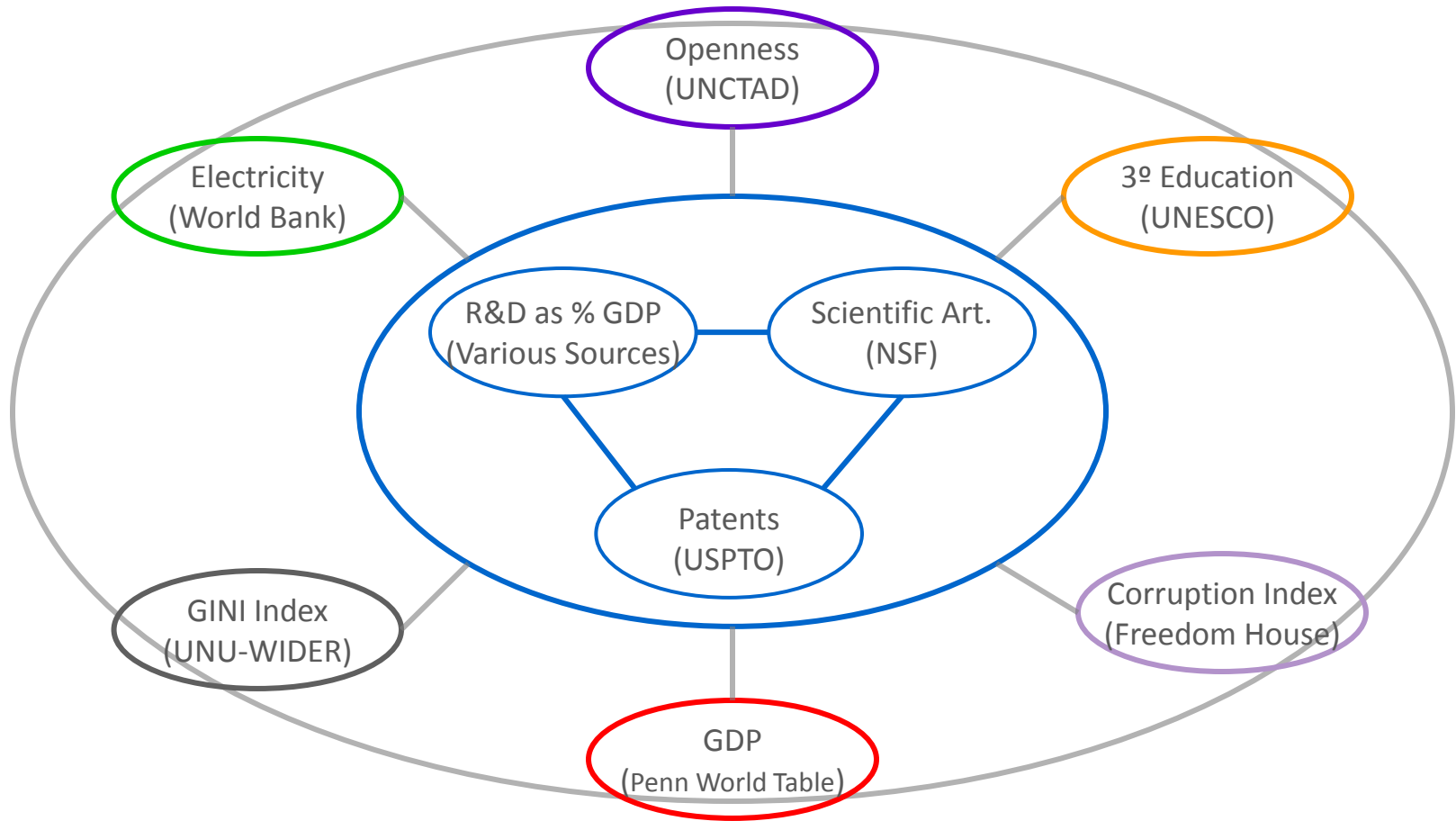
## The theoretical model





# NIS in panel: 1 Model

## The Indicators (and Sources)



# NIS in panel: 3 propositions



## The 3 propositions

- 1) The dynamics of the *innovative capability* is driven by the coevolution the three factors that define it: innovative input, scientific output and technological output.
- 2) The dynamics of the *absorptive capacity* is driven by the coevolution of the various dimensions that define it.
- 3) There is a coevolution between *innovative capability* and *absorptive capacity*, these two dimensions are linked together by a set of dynamic relationships.

# NIS in panel: Empirical Results



## Panel Unit Root Test & Panel Cointegration Test

- Panel Unit Root tests (Levin, Lin & Chu; Breitung; Im, Pesaran and Shin; ADF and PP) confirmed that all **variables are I(1)**.
- Pedroni Cointegration Test (ADF and PP) confirmed that **there is a cointegration relationship**.
- For robustness check, **lags from 1 to 10 were tried**. All of them showed consistent results.

# NIS in panel: Empirical Results

## Vector Error Correction Model

	Long Run Cointegration Equation	Short Run Adjustment Coefficients	R <sup>2</sup>
Technological output	1	-0.002601 ***	0.20306
Scientific output	386541.1***	-1.21E-08 ***	0.22112
Innovative input	-65.9453**	0.0000472 ***	0.09114
Human capital	-4.76499***	-0.000558	0.09089
Infrastructures	-0.013706**	-0.079792**	0.18925
Income level	-0.031801***	-0.701127***	0.55615
International trade	-129.5993***	-0.0000508***	0.07938

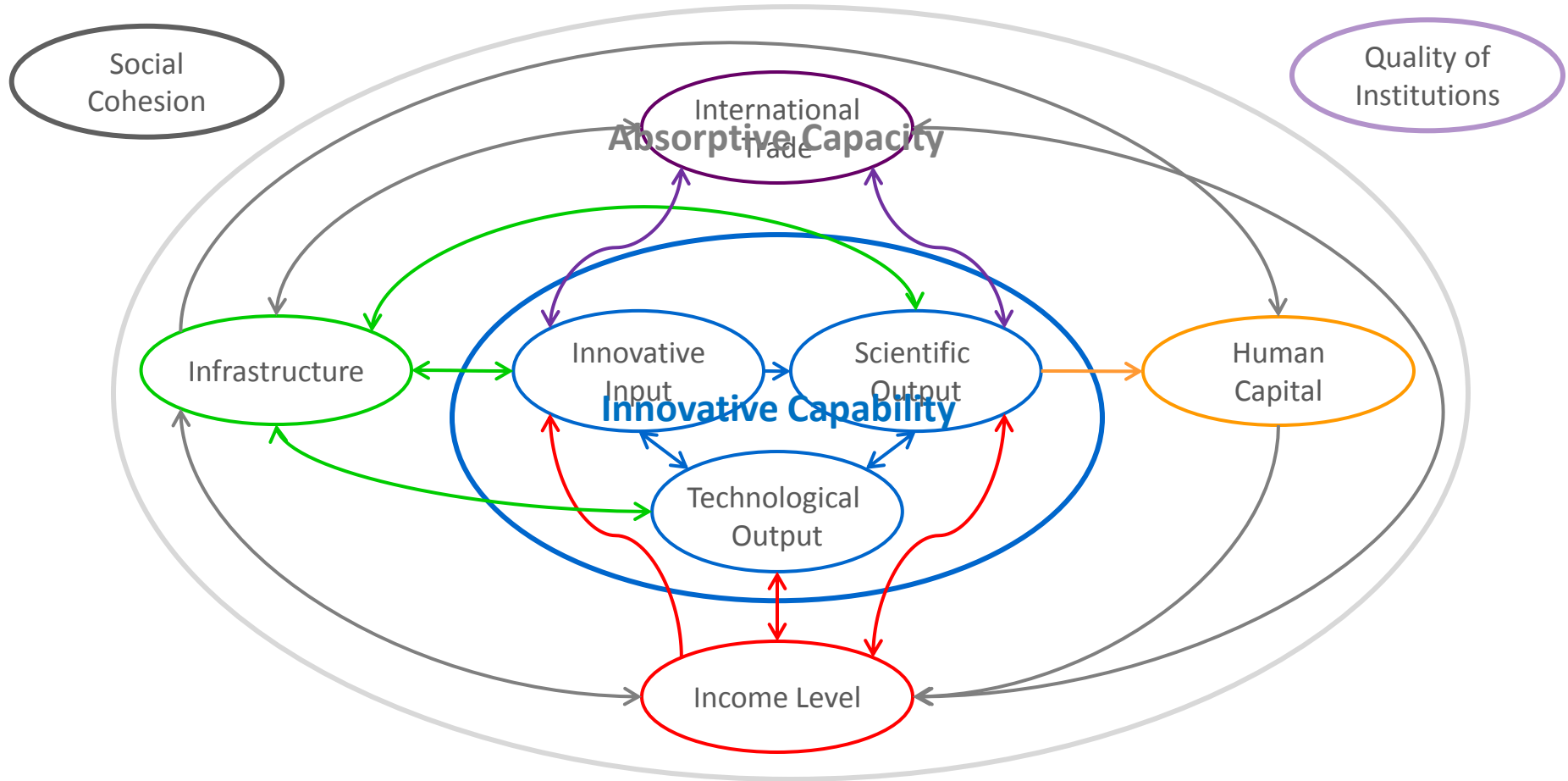
Exogenous variables: **Social Cohesion; Quality of Institutions**

Lags included: 5. Observations: 1914 / \*\*\* 1% sig. level; \*\* 5% sig. level

Technological output = **-386541,1 (scientific output)** + 65,94 (innovative input) + 4,76 (human capital) + 0,01 (infrastructures) + 0,03 (income level) + 129,6 (international trade).

# NIS in panel: Empirical Results

## Summary of Granger Causal relationships\*



\* We assumed Granger Causality when 5 out of 10 lags are significant at least at 5% of confidence level.

# (In Process) Conclusions



## The 3 propositions

- 1) The dynamics of the *innovative capability* is driven by the coevolution the three factors that define it: innovative input, scientific output and technological output.
  - **Confirmed!**
  - Interactions explain the cumulateness of technological progress.
  - Scientific Output negative. How come?
    - Non linear relationship with Technological Output
    - One single Techno – Scientific System: Patents and Scientific Articles are substitutes outcomes.


# (In Process) Conclusions



## The 3 propositions

- 2) The dynamics of the *absorptive capacity* is driven by the coevolution of the various dimensions that define it.
  - **Confirmed!**
  - Interactions represent systemic relationships.
  - Human Capital, however, shows an indirect effect on the absorptive capacity, since it has a direct impact only on Income Level.

# (In Process) Conclusions



## The 3 propositions

1) There is a coevolution between *innovative capability* and *absorptive capacity*, these two dimensions are link together by a set of dynamic relationships.

- **Confirmed!**

- Technological output is not directly linked with Human Capital and Openness.
- Scientific Output coevolve with the absorptive capacity. It is the only innovative factor affecting Human Capital.
- Innovative Input is caused by Income Level and has a two ways relationship with the others, but not with Human Capital.
- Why is Human Capital behaving in a counterintuitive way?



# Next Steps



- 1) **Classifying**. The world is too big for one single equation:
  - Different development & technological levels.
  - Different industrial sectors might have different interactions.
  - Social Cohesion and Quality of Institutions might have an important role in different clusters.
  - Human Capital should be further assessed.
  
- 2) Incorporating **other components of Innovative Capability**.
  - Patents, R&D and Scientific Articles are not the best indicators for developing countries.
  - Innovation Surveys could provide insightful information.
  
- 3) **International Spillovers are underrepresented** (only measured by International trade).
  - FDI and MNE activities should also be incorporated.

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## Questions?

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