



EVOLUTIONARY SPHERES THAT CONDITION THE TECHNOLOGICAL CAPABILITIES ACCUMULATION IN LATIN AMERICA

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Justification

- Broad literature on technological capability accumulation (TCA) for developing countries at country and firm level
 - Failed policies to overcome middle-income trap
 - No consensus on possibilities for developing countries to achieve economic and social objectives
 - Inputs and outputs of domestic capabilities are not enough to understand the problems of TCA

Different approaches to TCA

- Extensive literature recognizing TC accumulation for technological and economic development (Katz, 1986; Lall, 1992; Kim, 1997)
 - Nature of TC: concept, process of domestic TCA, taxonomies
 - Level of analysis: country, sector, cluster, firms
 - Methodologies: case studies, CDM, different econometric models, composite index, etc.

Different approaches to TCA

- Freeman (2011): connection between social policy and inequality with technology and growth.
- Katz (1987)
 - Macro and micro levels are intertwined
 - Firms' economic and technology behaviour respond to changes in the macroeconomic context
- Multilevel analysis: a broader approach to the drivers of TCA: variables of the economic and social spheres

Different approaches to TCA

We do not know enough neither on the process of TCA at the firm level nor on the relationship between technical, economic, environmental, social and political indicators with TCA at firm level

- It is necessary to frame TCA processes at the firm and national levels in a broader context
 - **Including the techno-economic and environmental, and the socio-political spheres**
- Countries' evolutionary trajectory combines these spheres differently
- The absence of critical masses, the inequalities and systemic failures emerge from these spheres, which may affect the TCA.

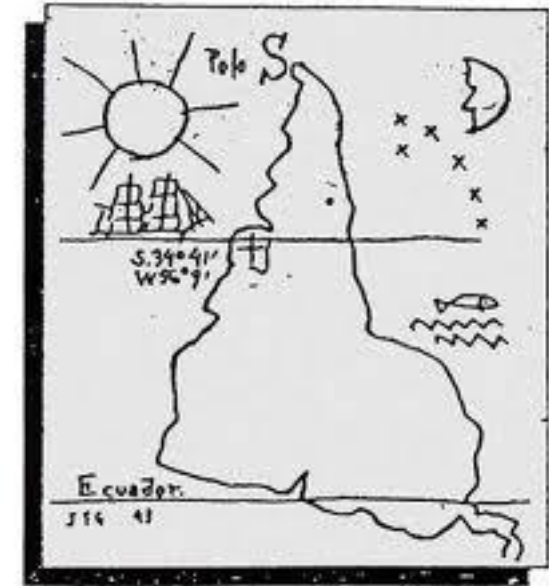
Objectives

1. to identify development profiles of Latin American countries (in terms of techno-economic and environmental, and the socio-political spheres)
2. to discuss their implications for TCA.

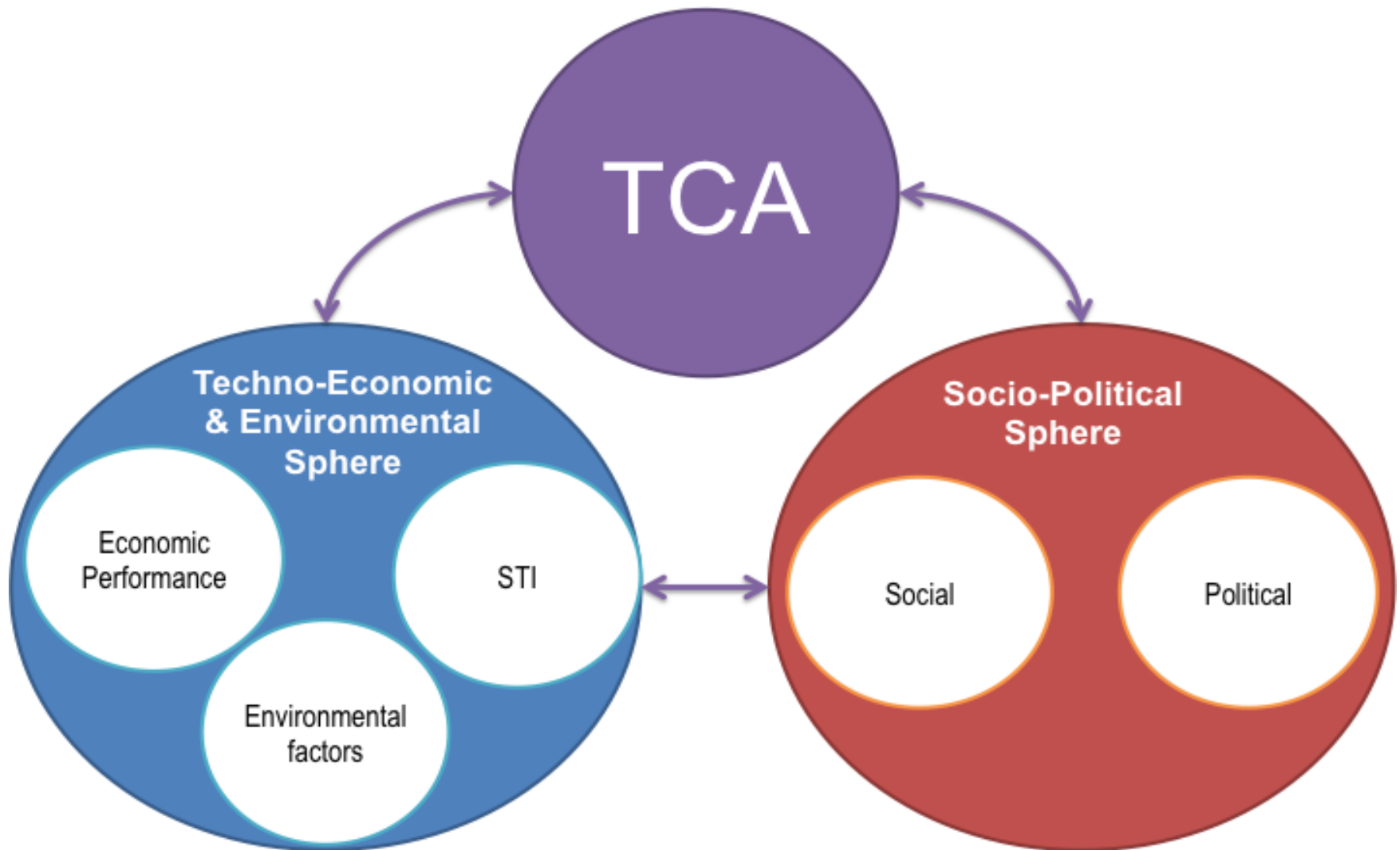
The context of the Latin American NSI

- The Latin America NSI
 - small according to the size of their main agents,
 - the structure of linkages is incipient
 - the financial resources dedicated by the public and private sectors to STI are scarce,
- The level of inequality and immaturity of the political system are stylised features of the region.
- The regulation system concerning the environment is still weak

Hence, techno-economic, environmental and socio-political dimensions are relevant to analyse both the TCA and the development process.



A conceptual model to characterize the co-evolution of TEES and SPS with the TCA



Research Design

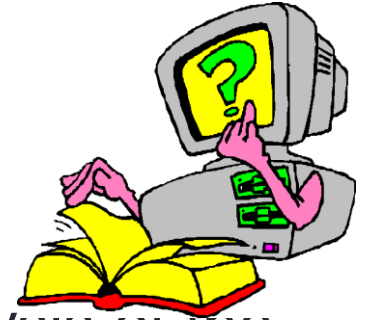
Data that is needed

- TEES and STS result from long-term processes
- For the analysis of TEES and STS, and their impact on TCA, robust long-term indicators, measuring dimensions at the micro, mezzo and macro levels are needed

The challenges of the data: a dilemma

- Studies usually focus on a small sample of countries over a long period of time (mostly advanced and middle-income)
- Studies focus on a larger sample of economies (including developing ones) but using a static approach.

Finding adequate and available data is a difficult task



- Indicator selection comes from a detailed analysis of the literature of innovation systems.
- Lack of long-term indicators
 - STI which would allow us to better characterize the STI performance
 - Appropriate indicators to measure the performance of economies
 - Appropriate indicators to measure the environmental dimension
 - Multidimensional measures for socio-political sphere of the countries
 - In addition, lack of reliable indicators on firm-level TCA in the long term is even more serious

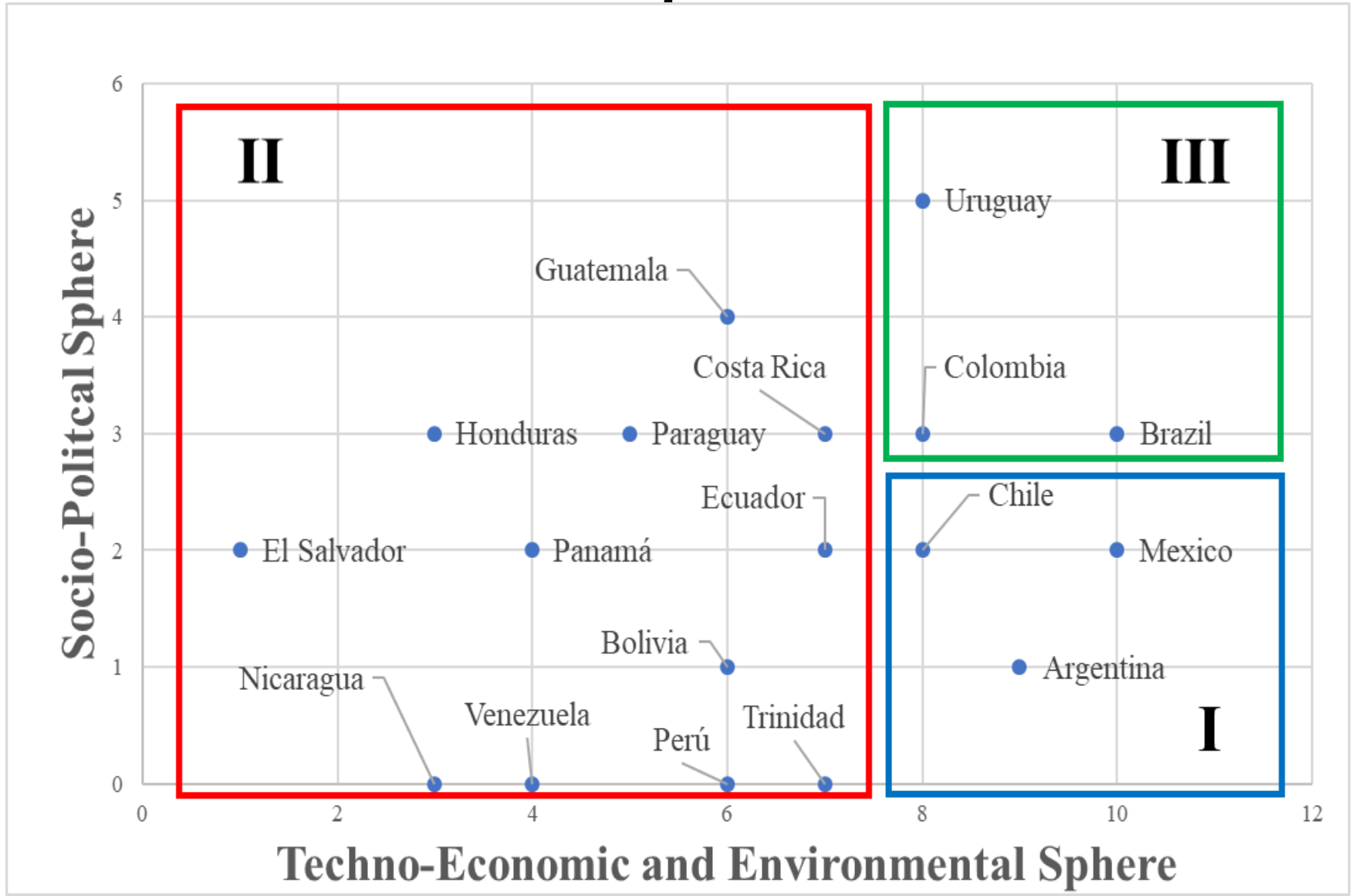
Indicators

TEES indicators:

- Indicators of economic performance:
 - **Gross fixed capital formation (% of GDP), Openness Indicator (Import+Export)/GDP, PPP** (Current US\$), Imports Current US\$, Exports Current US\$, Labour productivity per person employed in 2010 US\$ (converted to 2010 price level with updated 2005 EKS PPPs), Total natural resources rents (% of GDP), **Industry value added (% of GDP), FDI Inward Flow (% of GDP)**.
- Indicators of STI inputs and outputs:
 - **Research and development expenditure (GERD as % GDP), School life expectancy (years) Primary to Tertiary**, Total Researchers per million inhabitants (FTE), Scientific and technical journal articles (per million people), Patent applications, residents (per capita), **High-technology exports (% of manufactured exports)**, Fixed telephone subscriptions (per 100 people).
- Indicators of Environmental impact of economic activities:
 - **Renewable energy consumption (% of total final energy consumption), CO2 intensity (kg per kg of oil equivalent energy use), Total greenhouse gas emissions (kt of CO2 equivalent)**, Water productivity, total (constant 2010 US\$ GDP per cubic meter of total freshwater withdrawal) , CO2 emissions (metric tons per capita), Fossil fuel energy consumption (% of total), Combustible renewables and waste (% of total energy), Urban population (% of total).

- SPS indicators
- Indicators of quality of life:
 - **GINI index, School life expectancy (years)**, Government expenditure on education (% of GDP), Primary School enrolment (% gross).
- Indicator of socio political environment:
 - **Corruption Perception Index, Index Democracy and Autocracy, Legislative Index Electoral Competitiveness, Executive Electoral Competitiveness.**

Identification and estimation of countries' long-run paths



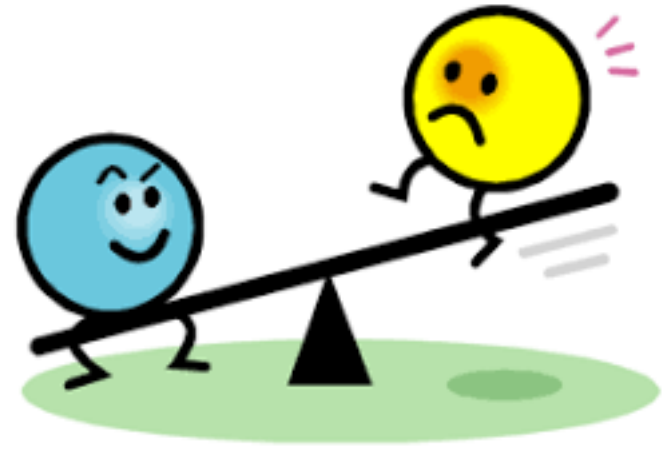
Development profiles based on long-run paths

- **Profile I.** Biased towards the TEES, and lacking in the SPS: Argentina, Chile and Mexico.
 - labour productivity has a positive impact on GDP/capita
 - Lack of a favourable presence of the SPS (little positive impact of these indicators on GDP/capita).
- **Profile II.** Biased towards the SPS and lacking in the TEES: Bolivia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panamá, Paraguay, Peru, Trinidad y Venezuela.
 - a positive influence of the SPS,
 - still with low impact of these indicators on GDP/capita, and lacking a favourable presence of the TEES.
- **Profile III.** More balanced systems: Brazil, Colombia and Uruguay.
 - A more balanced systems between both spheres.
 - the better impact of SPS on GDP/capita

The three profiles also suggest a reflection:

- there seems to be a trade-off between techno-economic-environmental performance and socio-political performance.
 - it seems that the economy continues to extract resources that it does not distribute, and for that it uses political mechanisms that privilege its extractors.

→ more research is needed



Lessons Learned




from this model

1. There are causal sequences between variables. This must be verified by evidence. This is a difficult task.
 - data on key variables are concentrated on indicators designed for other purposes.
 - the spheres work through networks of internal relationships and interrelationships between them, and this is captured in a weak, and probably biased way.
 - the available data for existing indicators are scarce in many countries.
2. There are limitations in the methodology that transcend the state of knowledge.
 - The panel data co-integration method relies on specification and long-term trend detection tests that make the model extremely robust.
 - The way in which this model incorporates the dynamics of the processes for determining the variables explained is consistent with an evolutionary view.
 - But, the notion of equilibrium underlying co-integration is too lineal

Lessons learned on the countries profiles for STI policy

1. Three Development Profiles were identified. But countries still confront, in different degrees, a set of problems that undermine the processes of capacity building (limitations in the demand, supply constraints, low private sector investment, shortage of private and public venture capital, rupture of domestic productive chains, among others)
 - The design of STI policy should take into account these particularities of the TEES, the SPS and their connexion, as well as the specificities of the NSI.
2. A weak balance between the TEES and SPS; this may have impact on TCA
 - The need to pay more attention to other societal needs, such as poverty, food production, diabetes, renewable energy sources, water supply, amongst others.

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3. We need different types of STI policy strategies to strengthen the firms' TCA process in accordance with the countries' development profiles

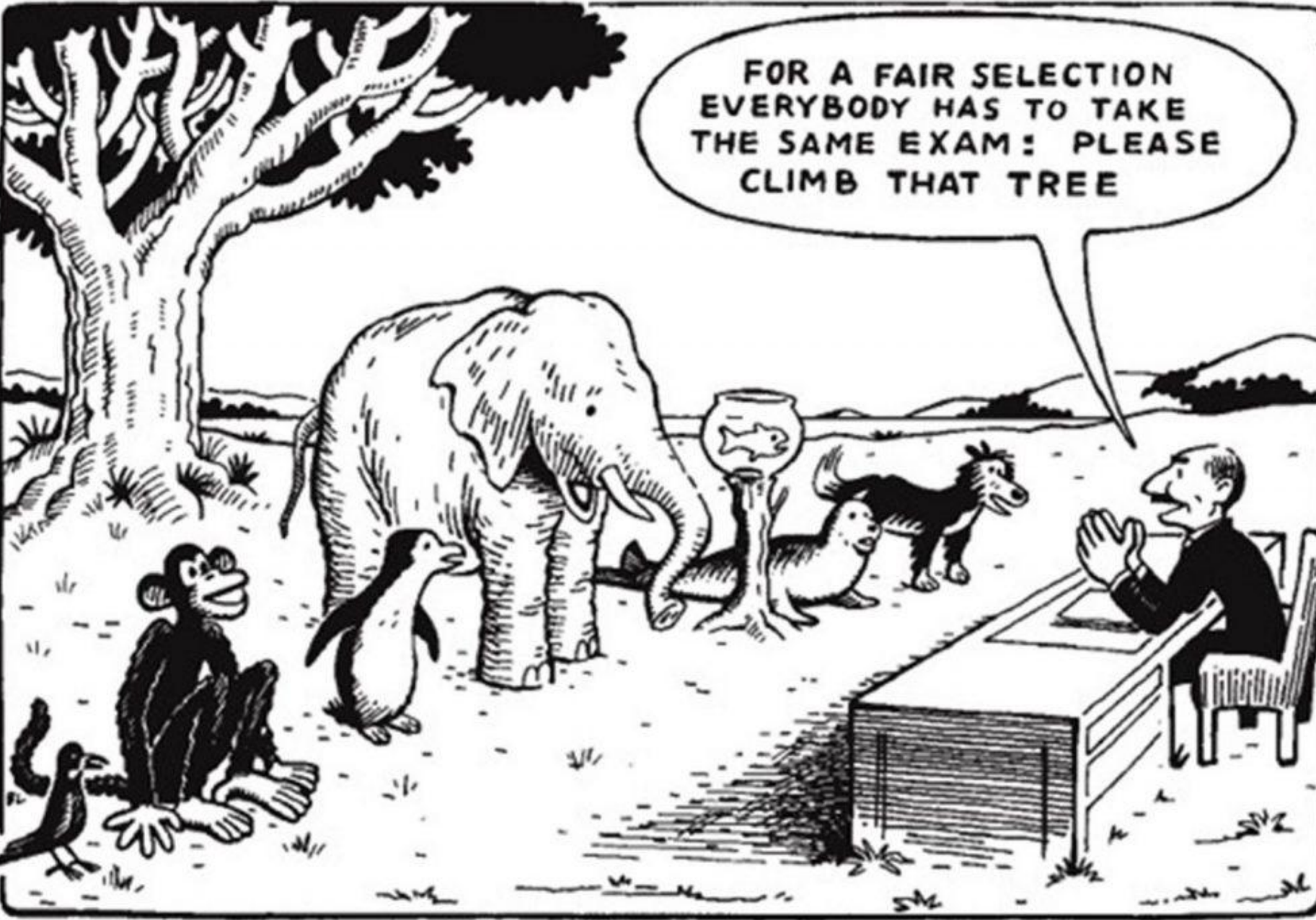
Final reflections

- Our knowledge about the factors that explain successful TCA, at the firm and national levels, is still limited.
- The evidence suggests that the STI policy oriented to strengthen TCA processes at the firms, and then country level, cannot centre only on technology related aspects, but also on the co-evolution between the TEES, the SPS and the TCA process.
- Countries differ in relation to the balance between the TEES and SPS: development profiles.
 - Profile I: countries with strong TEES
 - Profile II: countries with strong SPS
 - Profile III: countries with a more balanced TEES and SPS
- The middle-income trap is a blockage in the structural transformation; we argue that the particularities of the countries context, in terms of their TEES, SPS and their connexion, have an explanatory power of the restrictions.

In terms of policy implications:

- Profile III (more balanced systems between the TEES and SPS)
 - the focus should be on increasing productivity and improving innovation performance to approach the technological frontier;
 - at the same time, to keep the balance with the SPS;
 - policy also might include attention to the solution of national problems.
- Profile II (a bias towards the SPS and lacking in TEES)
 - the focus should be to promote learning, imitation, adaptation, and a variety of innovation activities,
 - at the same time, they may keep the balance with the SPS,
 - policy also may include attention to the solution of national problems.
- Profile I (high TEES performance but a weak SPS)
 - the attention to national problems should be at the centre of the STI policy,
 - the challenge is how to keep productivity increase with the solution of national problems and an improvement of the SPS.

→ “One does not fit all”



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