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Innovation for Development in Latin America: where are we regarding the critical mass of STI capabilities

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Casa abierta al tiempo

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Agenda

- **Innovation, critical masses and development**
- **Structural characteristics of LA countries**
- **STI Profile of LA**
- **Innovation systems and development**
- **Heterogeneity of the countries**
- **How far regarding critical masses**
- **Implications for innovation policy**

Innovation, critical masses and development

Empirical bases: links between system of innovation, competitiveness, development an even social equity

➢**Accumulation of knowledge is a crucial factor for growth (List, 1841)**

➢**Science and growth (Schumpeter, 1942; Solow, 1956; Abramovitz, 1956 y 1986; Romer, 1990)**

➢**The evidence of Japan (Freeman, 1987), Korea (Kim, 1997), etc.**

➢**Links between R&D and rate of growth (Fagerberg & Srholec, 2008)**

- **Development economics:**

  - **Industrialization $\Rightarrow$ structural change $\Rightarrow$ development**

- **Evolutionary economics approach:**
  - **Structuralist and systems-evolutionary perspective Innovation affects economic growth and development if it triggers structural change (Schumpeter, 1934, 1939; Kuznets, 1971, 1973; Saviotti y Pyka, 2004; World Bank, 2008; Haussman and Klinger, 2007)**

  - **Learning, capability building and coevolution of technologies, institutions and key agents of the NIS $\Rightarrow$ emergence of HLO $\Rightarrow$ new sectors/market $\Rightarrow$ structural change $\Rightarrow$ development and social equity**

- **Connexions between both approaches**

- **Initial conditions (structural characteristics and STI profile) affect the potential trajectories**

- Critical masses and threshold
  - It refers to a certain level of accumulation of a capability that makes it possible to shoot a result that characterizes the process under study, and is maintained from there at a high rate of growth.
    - capability, capacity, stock

  - Largely used in relation to collective actions (Granovetter, 1978; Oliver, Marwell and Teixeira, 1985; Mahler and Rogers, 1999; Somasundaram, 2004; Booij and Helms, 2010)

  - In growth theory, it is linked with another two concepts used in development economics: the Poverty traps and the threshold effects (Azariadis and Drazen, 1990)
    - "the 'preconditions' that an economy must satisfy to move from low to sustained high growth"
    - *threshold effects* generating self-sustaining processes
- Critical masses can be defined as the level of capabilities at which the system is able to generate endogenous processes and thus became self-sustaining.

- Role of STI policies to foster:

  - Changes in agents' behaviours
  - Articulation of demand and supply of knowledge
  - Strategic sectors
  - New areas of competitiveness

  ➔ Take into account the initial conditions and the achievement of critical masses

Structural characteristics of Latin American countries
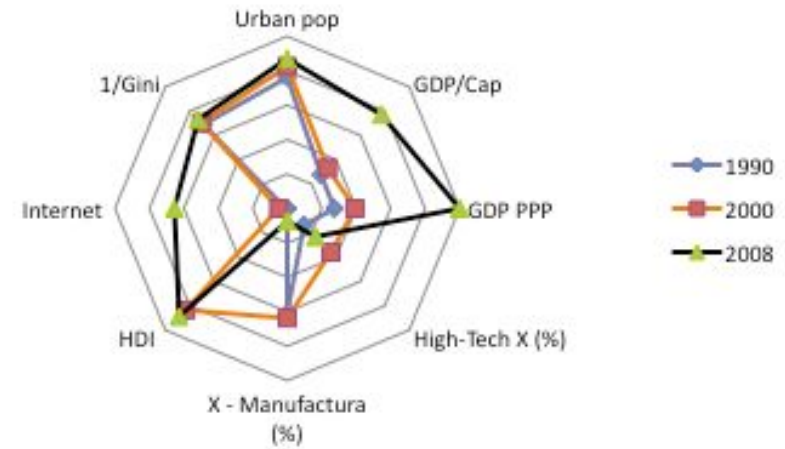
Differences in structural characteristics

Indicators:

- **Relative size of the economies**
  - **GDP PPP (Brazil)**

- **Basis for developing the capabilities of the systems:**
  - **health, education and income:**
    - **Human Development Index (HDI, Chile)**
    - **% of urban population (Puerto Rico)**
  - **diffusion of information technologies (Internet users, Jamaica)**

- **Achievement of economies:**
  - **GDP per capita (Trinidad Tobago)**
  - **Inequality (1/GINI, Venezuela)**
  - **participation of manufacturing in export (% manufacture, México)**
  - **export capacity of high technology goods (% High Tech X, Costa Rica)**

Structural Characteristics Argentina
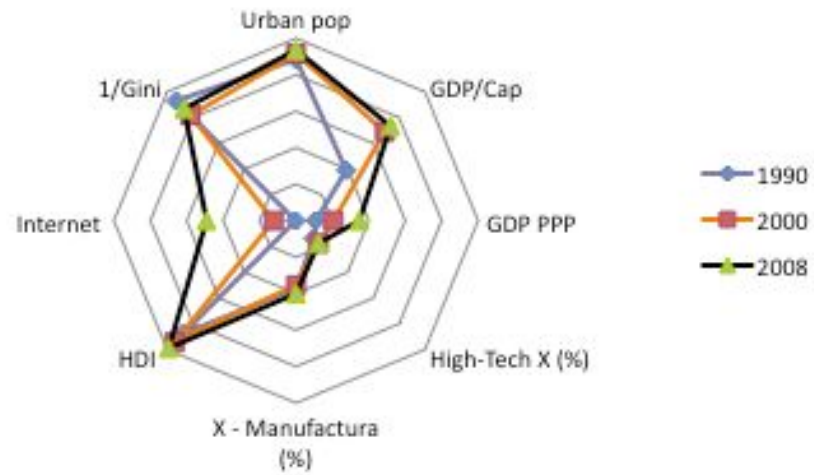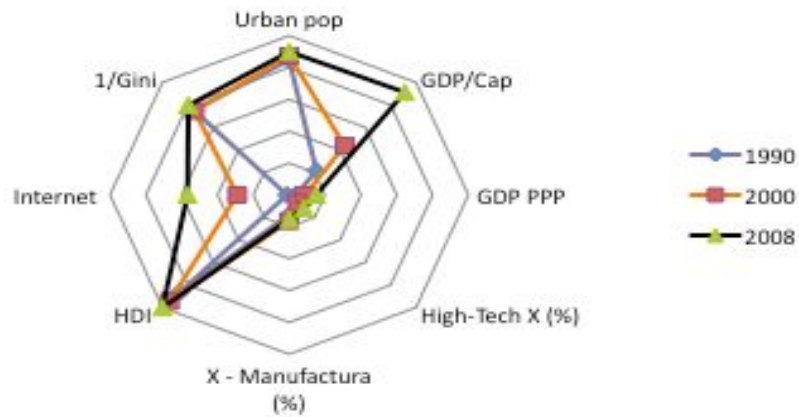
Structural Characteristics Brasil
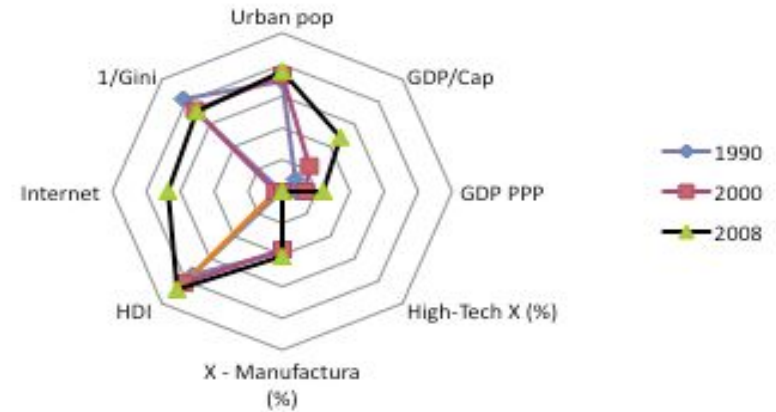
Structural Characteristics México
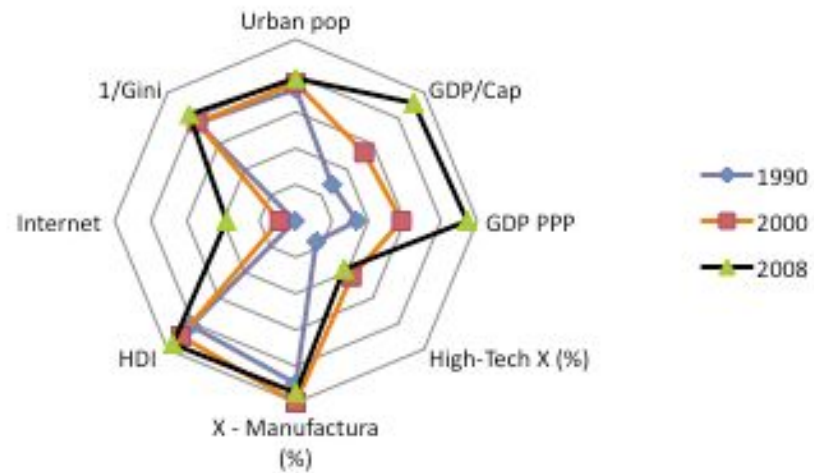
Large countries, more balanced

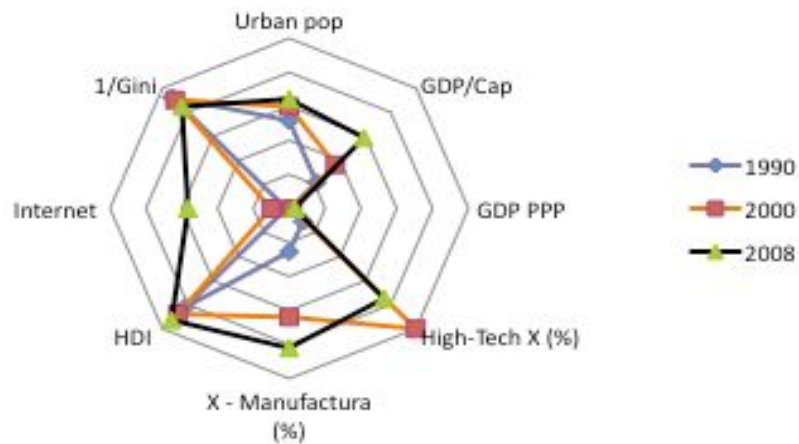Medium size countries, better life conditions
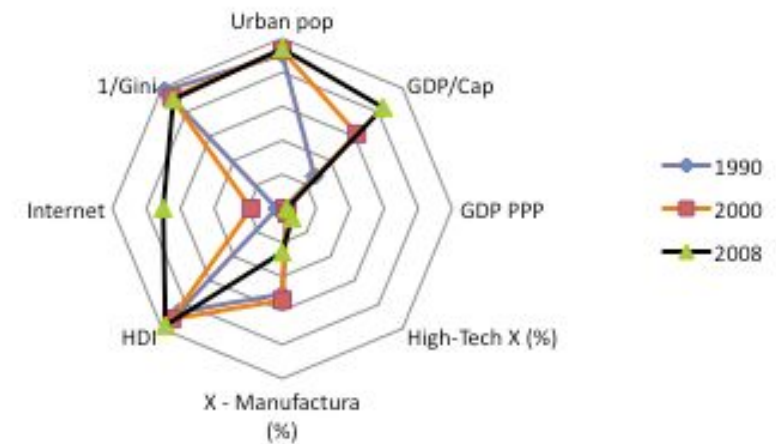
Structural Characteristics Chile

Structural Characteristics Colombia
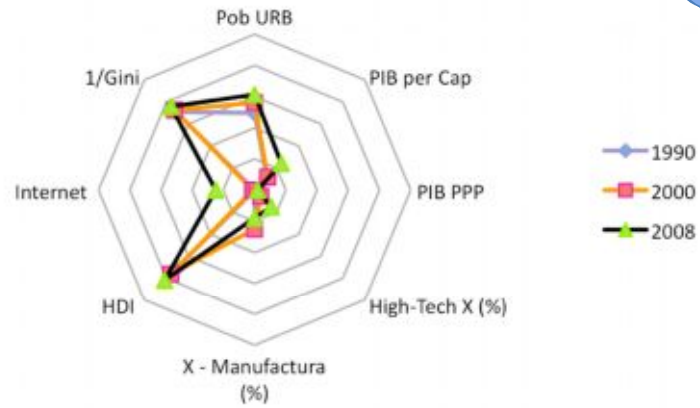
Structural Characteristics Costa Rica

Structural Characteristics Uruguay

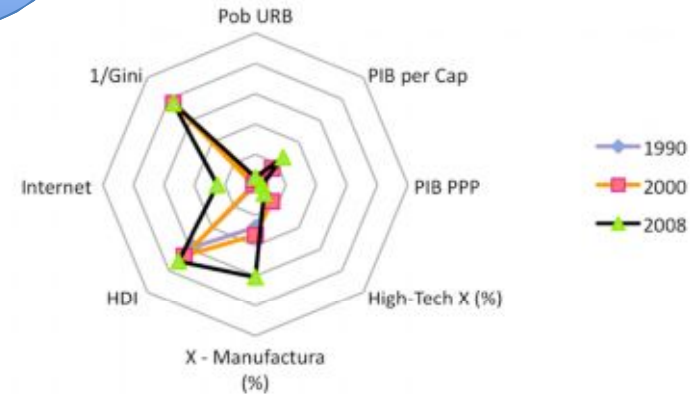Small countries
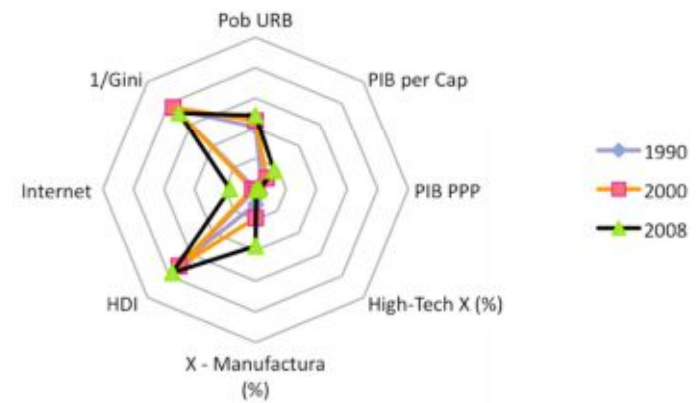
In general

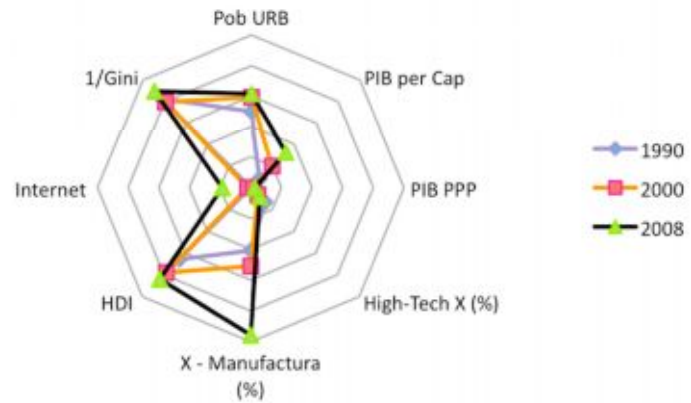- – **Improvement overtime**
- – **Persistence of high inequality**
- – **The largest countries: better economic performance but high inequality**

Different profiles:

- – **Large countries: a more balanced structure**
- – **Medium size countries: a satisfactory performance in life conditions**
- – **Small countries: the worst performance**

➔ **Different structural characteristics reveal different levels of development**

STI profile of Latin American countries

Different profiles of STI: capacities and outputs

Indicators

- Percentages and Amounts of ST and Innovation
- Inputs and Outputs

Science

– Scientific articles per/ 100.000 Hab. (Chile)

– Share of the world's publications (Brazil)

– Total PhD awarded (Brazil)

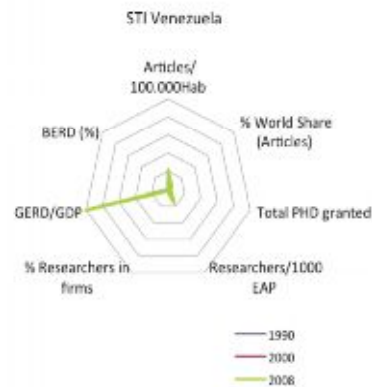– Researchers per /1,000 employees (Argentina)

Innovation

– Gross Domestic Expenditure on R&D as % of the GDP (GERD/GDP, Venezuela)

– Business Expenditure on R&D as % of the GERD (BERD %, Uruguay)

– % Researchers in the private sector (Chile)

Two groups:

- **Group A: countries with higher investment in STI**
- **Group B: countries with lower investment in STI**

➔**Different STI profiles reveal different maturity of the NIS**

STI Argentina

STI Brazil STI

STI Mexico

STI Chile

STI Colombia

STI Uruguay

STI Costa Rica

STI Venezuela
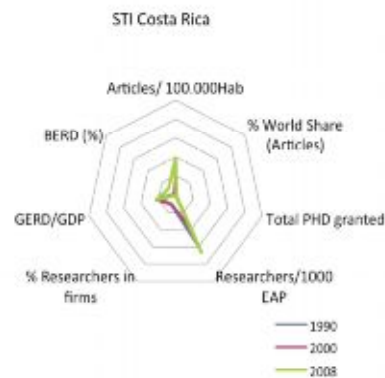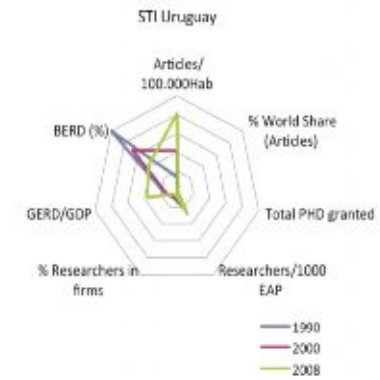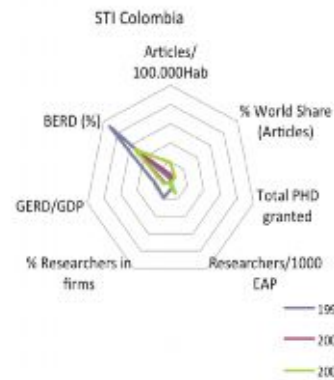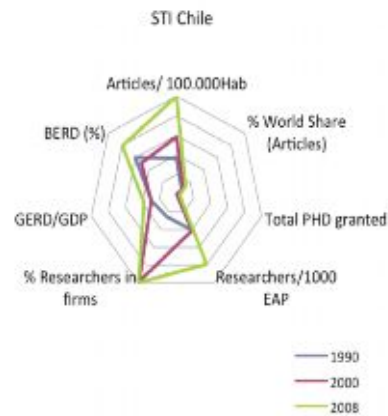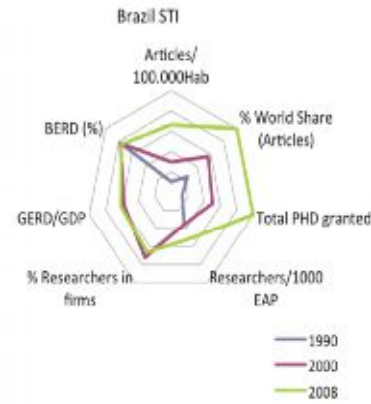
Group A: highest effort
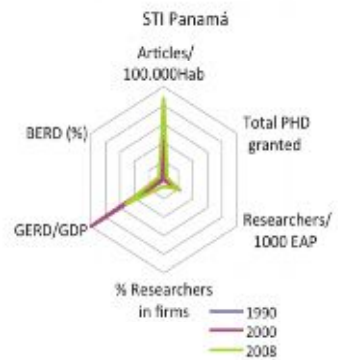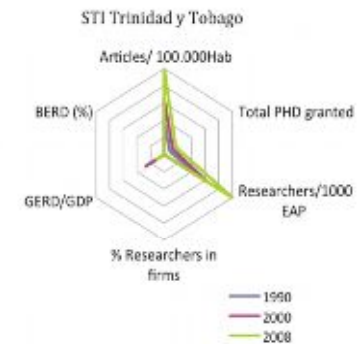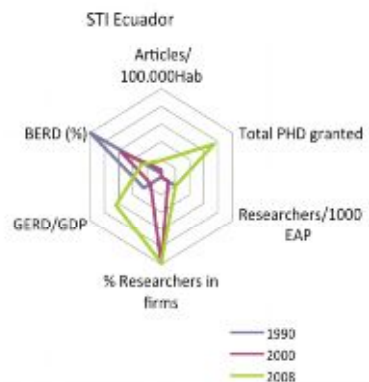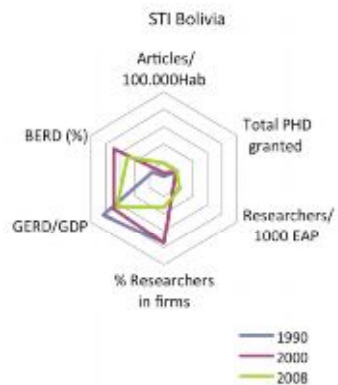
Group B: lower effort
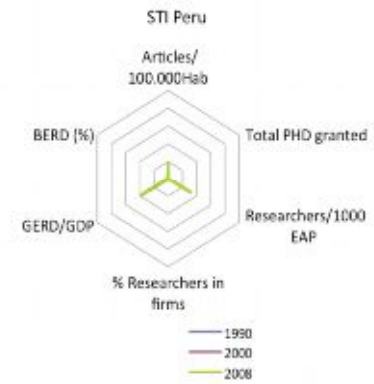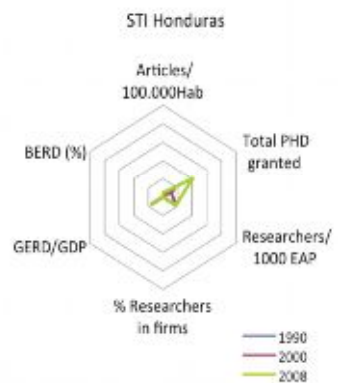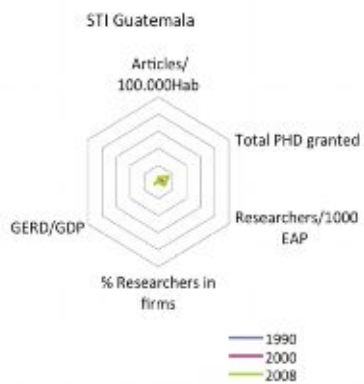
In general:

- An increase of the values overtime in both groups
- High value of BERD
- Imbalance between the indicators of the science and innovation capacities

3 profiles:

1. High value of STI indicators and a more balaced profile (large countries)
2. High values and bias toward one arena: science (Argentina) or innovation (Mexico)
3. Low values of the STI indicators and strong biases towards some indicators but without articulation

➔ Still very limited effots in countries of Group B

Heterogeneity of countries in terms of structural characteristics and STI capacities

…. there are many Latin Americas

National innovation systems and development in Latin America

Emergent NIS with still reduced national STI capacities and limited articulation

- Scarce financial resources and allocation problems, small government financial effort (low GERD)
- Scientific community
    - Small with level of excelence in some scientific fields
    - Mostly curiosity driven and limited incentives to carry out problem oriented research
    - Experience in the solution of local problems (e.g. health, environment and food)
- Public sector is the main source of funding
- High geographical and institutional concentration of STI capacities
- Firms
    - A set of multilatinas
    - Low expenditure in R&D and other innovation activities (small BERD)
    - Little innovation culture
- Still limited links between the agents

- **Distortion in the incentives structure, combining new and old programs and institutions**
- **There are many economic and social issues that transcend specific aspects of STI**
  - **How to articulate the modern and traditional sectors to reduce poverty, inequality and other social gaps?**
  - **In a context of scarce resources, what are the challenges for the governance of the system under new institutional designs, new agents and new leadership?**

    - **The relationship between inputs and outputs provides evidence that the way the system is operating can not provide the expected results**

How far from critical masses?

How far off is Mexico, Brazil and India from Korea?

Critical mass in ST (2008)

Country	Population, millions (2010)	Inputs			Outputs		
		Basic Research Expenditure as % of GDP	Researchers (per 1000 employed)	Researchers in universities and research centres	PhD awarded (per 100.000 population)	Scientific Articles (per million population)	World Share of Scientific Publications (%)
Mexico	112,3	0.09*	0.9*	20,891*	3.2*	73.3	0.8
Korea	49.0	0.50	9.5*	53,274*	19.8	762.2	3.3
Brazil	190,7	0.06	2.2*	158,314	5.2*	141.4	2.7
India	1,210,2	NA	0.4**	NA	NA	35.5	3.7

Critical mass in Innovation (2008)

Country	GDP world position (millions dollars, IMF)	Inputs			Outputs		
		GERD (million dollars)	GERD/ GDP (%)	BER D/G ERD (%)	Researchers in the Business Sector (%)	Innovative manufacturing firms in total firms (%)	Triadic patents granted (per million habitants)
Mexico (2007)	14 (1,004,042)	5,856	0.38	44,6	52.7	29.8	0.14
Korea	15 (986,256)	44,026	3.37	73.7	65.6	42.0	43.9
Brazil	8 (2,023,528)	11,269	1.13	47.5	19.8	33.3	0.34
India	11 (1,430,020)	29,021	0.88	29.6*	31.0	NA	0.14

- The threshold is movable
- There are different initial conditions in LA, different trajectories and hence different critical masses
- If we focus on sectors: Which the strategic sectors should be?
  - Where we are strong: economic sectors that have shown revealed advantages or acquired
  - Preparing for the future: economic sectors related to cutting-edge technologies, nanotechnology, biotechnology, information and communications technologies, electronic micromachines, genetics (sectors where we need skills for the future)
  - Economic sectors that generate identities, or are linked to biodiversity or cultural diversity (water, forests, energy, biodiversity and other natural resources, crafts, traditional food),
  - Economic sectors associated with the production of goods and services for basic needs of the population.
    sectors in which we have lost advantages but are job generators
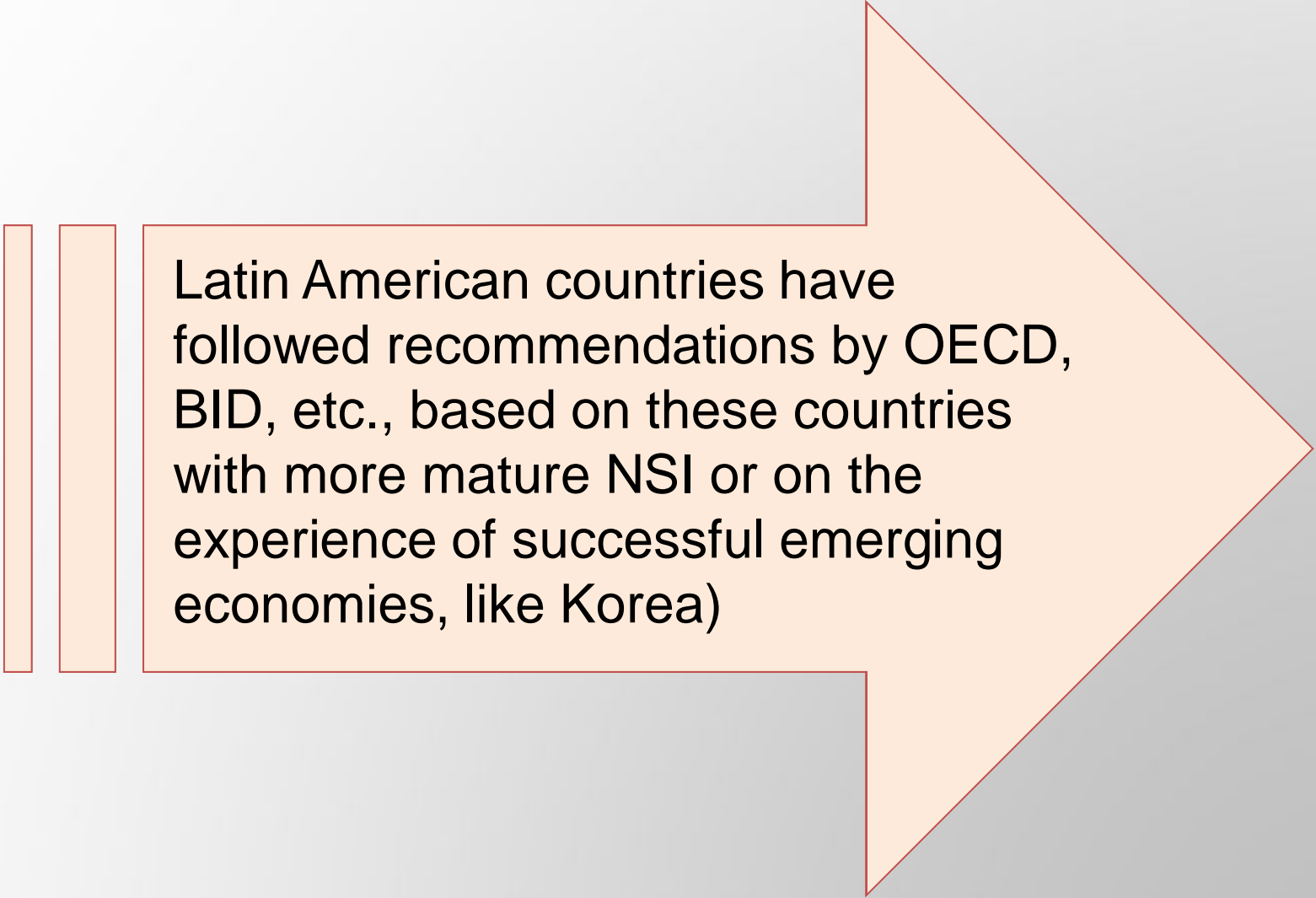
Innovation policy: initial conditions, existing analytical frameworks and some reflexions

Initial conditions of developed countries:

- **There is a consolidated scientific base**
- **Predominance of quality and excelencia criteria that were built according to their experience and needs**
- **Critical mass of firms that carry out R&D activities**
  - **Focus on increasing private R&D and innovation based on new knowledge**
- **Social contract for S&T with the society**

They do have critical masses or at least an important amount of STI capacities

Focus on innovation policy (which include S&T)

Latin American countries have followed recommendations by OECD, BID, etc., based on these countries with more mature NSI or on the experience of successful emerging economies, like Korea)

Room for improving the innovation policy within the existing analytical framework

- **Articulation between the innovation policy and a national policy for development**
    - **Resource allocation within different national demands**

- **Strategic level of innovation policy**

    - **Definition of strategic priorities in key areas, and a 'vision' of the country and its growth, while performing higher level coordination**

    - **Targeting new industries/clusters**

    - **Internalization by policy makers of the need to continuously adjust capacity from a long-term**

    - **Evolution of the instruments *pari pasu* to the evolution of the sectors to attend new needs… policy learning:**
    1. Horizontal policies to foster variation and experimentation of new programs
    2. Design and implementation of new programs, more vertical/targeted policies, greater policy mix

- **Combine policies to cover all the innovation stages**
  - **By now the policy mix generally includes more programs/resources to foster R&D than to foster other innovation activities**

- **Attention to the building of critical masses of STI**

  - **a focus only on innovation is limited as ST capabilities are still below critical masses**
  - **ST for knowledge generation, technology transfer and human resources formation**
  - **the existent knowledge base may be enough today, but new knowledge is required for the next step on the building of capabilities**

- **Complement between different instruments…systemic focus**

✧**To what extend the existing policy models take into account the initial conditions of the Latin American and all the developing countries world?**

✧**To what extend we can copy the policy design of Germany, France or US, or even Korea and China?**

✧**To what extend these policy models can be articulated in a general strategy of sustainable and inclusive growth in developing countries or is it required another STI model for this?**

Some debates in the region

- **Followers of the international frameworks or look at initial conditions?**

- **Which innovation should be estimulated: radical or incremental?**

- **How to create critical masses of STI and how a balance of the masses look like?**

- **How much science in developing countries? What science? Priorities?**

- **Pick up the winners to generate sucessful cases to replicate or horizontal support to increase variety and generate critical masses of innovative firms**

- **Take-off and catching up are different stages:**
  - **Need for differential STI policy and productive development/industrial policy**
- **Due to the existing combination of growth and high inequality**
  - **What go first: Grow and then distribute, or Distribute to increase the internal market and then grow**
  - **Focus on economic development or on inclusive development**

We still do not know enough

• How to gradually build national and regional capabilities of design and implementation of policies?

• How gradually and consistently build national and regional policies?

• How to build the governance of more complex NIS?

• How innovation can make a contribution to inclusive development?