Innovation Indicators in the Adriatic Region

Methodological explanations

Aim

The aim of gathering and presentation of Innovation Indicators within the PACINNO project is to complement and extend existing evidence on Innovation Systems (e.g. as presented by the European Commission in the Innovation Union Scoreboard), including all countries in the Adriatic area. In particular, data gathering for countries as Albania, Bosnia and Herzegovina, Serbia and Montenegro is of particular interest for the project.

Methodology and timing

In summer 2014, the University of Trieste provided PACINNO partners with methodological explanations on data gathering for the Innovation Systems Maps.

Within this activity, PACINNO partners have collected data on their Innovation Systems, according to the Innovation System conceptual framework. In particular, within WP5 the partners collected data in the form of both *variables* or *indicators*, meaning:

• Variables are the raw data collected from different data sources (e.g. R&D expenditure in million euros in country X in year T; or GDP in million euros in country X in year T);

• Indicators are ratios calculated using two or more variables, either within these maps (e.g. dividing R&D expenditure and GDP, as above) or by external data sources (e.g. data sources already showing the R&D/GDP ratio for country X in year T).

These variables and indicators have been grouped by *dimensions* which are the building blocks coming from the Innovation System literature. 10 dimensions were identified:

1. *General indicators*: general economic figures of the countries.
2. *Human resources*: variables on researchers, R&D personnel, PhD holders.
3. *Education system*: variables on universities, higher education R&D, quality of education.
4. *Public sector*: governmental R&D actors, expenditures.

5   *Private sector*: business R&D actors, expenditures.
6   *Funding of innovation*: innovation and R&D sources of funding.
7   *Innovation linkages*: variables on co-patenting, co-publications, collaborations.
8   *Entrepreneurship*: variables on entrepreneurial dynamics.
9   *Scientific output*: variables on patents, trademarks, publications.
10 *Institutions*: variables on business, political, regulatory environments.

Data sources
Data have been collected using multiple secondary data sources. Main ones have been:
• EUROSTAT
• EU ERAWATCH
• GLOBAL INNOVATION INDEX
• OECD
• SCIMAGO
• WIPO
• WORLD BANK

These data sources have been used as a *benchmark*, as in many cases no data on some countries do exist. Partners have therefore looked for similar data on other (often national) data sources: the Ministry of Research, the National Statistical Office etc., directly contacting them when needed.

Outcome
Raw Excel files with national data have been collected until February 2015, when a collection of most reliable data has been sent as project deliverable. The online visualisation of these data on a dedicated webpage was initially presented during the PACINNO Corfu Innovation summit at the beginning of October 2015.

Preliminary definitions
Innovation system: "all important economic, social, political, organizational, and other factors that influence the development, diffusion, and use of innovations" (Edquist 1997).

National innovation system definitions (from OECD, 1997):

- "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).

Description of variables and glossary

Dimension 1 – General indicators

1.1 GDP per capita
The Gross Domestic Product "is the standard measure of the value of final goods and services produced by a country during a period minus the value of imports. While GDP is the single most important indicator to capture these economic activities, it is not a good measure of societies' well-being and only a limited measure of people's material living standards" (OECD).

The *relative value* shows the GDP per capita, that is divided by total population in each country, and in Purchasing Power Standard. PPS "is the technical term used by Eurostat for the common currency in which national accounts aggregates are expressed when adjusted for price level differences using PPPs. Thus, PPPs can be interpreted as the exchange rate of the PPS against the euro" (EUROSTAT).

The *absolute value* shows the GDP in billions of euro.

1.2 GDP growth
The *relative value* shows the annual growth rate of the GDP.

1.3 Inflation
The inflation rate is the "annual percentage increase of the cost of living as
measured by the consumer price index. Consumer price indices are based on a representative basket of goods and services purchased by consumers in an economy. Composition and relative weights of the basket are reviewed periodically" (United Nations).

The *relative value* shows the annual inflation rate of each country.

1.4 Unemployment
Unemployment comprises all persons above a specified age who during the reference period were: without work, that is, were not in paid employment or self employment during the reference period; currently available for work, that is, were available for paid employment or self-

employment during the reference period; and seeking work, that is, had taken specific steps in a specified recent period to seek paid employment or self-employment (ILO).

The *relative value* shows the annual unemployment rate for each country.

1.5   Current account deficit

The current account deficit "can be expressed as the difference between national (both public and private) savings and investment. A current account deficit may therefore reflect a low level of national savings relative to investment or a high rate of investment—or both" (IMF).

The *relative value* shows the current account deficit as percentage of GDP.
The *absolute value* shows it in billions of euro.

Dimension 2 – Human resources

2.1   R&D personnel

The R&D personnel is the amount of public and private employees involved in Research and Development. "Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD, Frascati Manual).

The *relative value* shows the percentage of R&D employees on active population ("all persons of either sex who furnish the supply of labour for the production of goods and services during a specified time-reference period", ILO. In this case, it comprises people aged between 15 and 64).
The *absolute value* shows R&D employees in total number.

2.2   Researchers

Researchers are "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned" (OECD, Frascati Manual).

The *relative value* shows the percentage of Researchers Full Time Equivalent (FTE) on active population. FTE measures the equivalent of one person working full-time: "a person who normally spends 30% of his/her time on R&D and the rest on other activities (such as teaching, university administration and student counselling) should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this results in an FTE of 0.5" (OECD, Frascati Manual).

The *absolute value* shows Researchers FTE in total number.

2.3   New PhDs
New PhDs are people who got the doctorate degree, that is the highest degree in tertiary education (mainly, but not limited to, university education).

The *relative value* shows the percentage of each country new PhD graduates on active population.
The *absolute value* shows new PhD graduates in total number.

Dimension 3 – Education system

3.1   Tertiary education
"Tertiary education broadly refers to all post-secondary education, including but not limited to universities. Universities are clearly a key part of all tertiary systems, but the diverse and growing set of public and private tertiary institutions in every country—colleges, technical training institutes, community colleges, nursing schools, research laboratories, centres of excellence, distance learning centres, and many more—forms a network of institutions that support the production of the higher-order capacity necessary for development" (World Bank).

The *relative value* shows the percentage of population with completed tertiary education in each country on active population.
The *absolute value* shows population with completed tertiary education in thousands of people.

3.2   Students

Students reflect the current tertiary education participation, in each country.

The *relative value* shows the percentage of population currently enrolled in a tertiary education programme on active population.

The *absolute value* shows population currently enrolled in a tertiary education programme in thousands of people.

Dimension 4 – Public sector

4.1   GOVERD

GOVERD (Government R&D) represents the R&D <u>performed</u> by the Government sector, that is "all departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community" (OECD, Frascati Manual).

The *relative value* shows total R&D expenditure <u>performed</u> by the Government sector as percentage of GDP.

The *absolute value* shows total R&D expenditure <u>performed</u> by the Government sector in millions of euro.

Dimension 5 – Private sector

5.1   Product innovation

"A technological product innovation is the implementation/commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer. A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these" (OECD, Oslo Manual).

The *relative value* shows the percentage of Small and Medium Enterprises (SMEs) with product innovation on total firms in each country. SMEs are firms respecting the following criteria (EUROSTAT):

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

5.2   BERD

BERD (Business R&D) represents the R&D <u>performed</u> by the Business sector, that is "all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price" (OECD, Frascati Manual).

The *relative value* shows total R&D expenditure <u>performed</u> by the Business sector as percentage of GDP.
The *absolute value* shows total R&D expenditure <u>performed</u> by the Business sector in millions of euro.

Dimension 6 – Funding of Innovation

6.1   Private-funded GERD

GERD (Gross domestic expenditure on R&D) is "total intramural expenditure on R&D performed on the national territory during a given period […] R&D expenditures can be reported either by the agency providing the money (funding) or by the agency actually performing the R&D" (OECD, Frascati Manual).
The <u>funding</u> of GERD can be undertaken by 5 sources of funding: the Business sector, the Government sector, the Higher education sector, the Non-Profit institutions and actors from Abroad. In this innovation dimension, figures on Business (private) and Government (public)

sectors as sources of funding are reported.

The *relative value* shows total R&D expenditure <u>funded</u> by the Business sector as percentage of GDP.
The *absolute value* shows total R&D expenditure <u>funded</u> by the Business sector in millions of euro.

6.2 Private-funded GERD (%)
See explanation on GERD at point 6.1.

The values show the share of total GERD <u>funded</u> by the Business sector.

6.3 Public-funded GERD
See explanation on GERD at point 6.1.

The *relative value* shows total R&D expenditure <u>funded</u> by the Government sector as percentage of GDP.
The *absolute value* shows total R&D expenditure <u>funded</u> by the Government sector in millions of euro.

6.4 Public-funded GERD (%)
See explanation on GERD at point 6.1.

The values show the share of total GERD <u>funded</u> by the Government sector.

6.5 Total FP7 grants
"FP7 is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe run from 2007 to 2013" (European Commission).

The *relative value* shows the EU financial contribution to signed FP7 grant agreements as percentage of GDP.
The *absolute value* shows the EU financial contribution to signed FP7 grant agreements in millions of euro.

6.6 FP7 grants per participant
The values show the average EU financial contribution to signed FP7

grant agreements, per participant in millions of euro.

Dimension 7 – Innovation linkages

7.1   International co-publications
The *relative value* shows the share of scientific publications with at least one foreign co-author. The percentage is calculated on total scientific publications on Scopus.

7.2   National collaboration
The *relative value* shows the share of innovative SMEs with only National collaborations for innovation, as identified in the PACINNO survey.

7.3   International collaboration
The *relative value* shows the share of innovative SMEs with National and International collaborations for innovation, as identified in the PACINNO survey.

Dimension 8 – Entrepreneurship

8.1   New business density
The *relative value* shows the number of new firm registrations per thousand people aged 15-64.
The *absolute value* shows the total number of new firm registrations.

8.2   Bankruptcies
The *relative value* shows the number of bankruptcies per thousand people aged 15-64.
The *absolute value* shows the total number of bankruptcies.

8.3   VC investment
The *relative value* shows Venture Capital Investment (all stages of development: seed, start-up and later stage) as percentage of GDP.
The *absolute value* shows Venture Capital Investment (all stages of development: seed, start-up and later stage) in billions of euro.

Dimension 9 – Scientific output

9.1   Patents

A patent is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem. To get a patent, technical information about the invention must be disclosed to the public in a patent application.

World Intellectual Property Organization (WIPO) gathers data from Intellectual Property (IP) offices. A resident filing refers to an application filed in the country by its own resident; an abroad filing refers to an application filed by this country's resident at a foreign office; a regional filing refers to an application filed for jurisdiction over more than one country or territory.

The *relative value* shows the number of patent filings (Resident + Abroad, Including Regional) per million active population.
The *absolute value* shows the total number of patent filings (Resident + Abroad, Including Regional).

9.2   Scientific publications

Scientific publications refers to citable documents (articles, reviews and conferences papers) gathered in the Scopus database.

The *relative value* shows the number of citable documents (per million active population).
The *absolute value* shows the total number of citable documents.

9.3   H Index

H index refers to a country's cumber of articles (H) that have received at least H citations.
The values show the H index (1996-2014).

9.4   Trademarks

A trademark is a sign capable of distinguishing the goods or services of one enterprise from those of other enterprises. Trademarks are protected by intellectual property rights.

World Intellectual Property Organization (WIPO) gathers data from Intellectual Property (IP) offices. A resident filing refers to an application filed in the country by its own resident; an abroad filing refers to an application filed by this country's resident at a foreign office; a regional filing refers to an application filed for jurisdiction over more than one country or territory.

The *relative value* shows the number of trademark filings (Resident + Abroad, Including Regional) per million active population.
The *absolute value* shows the total number of trademark filings (Resident + Abroad, Including Regional).

Dimension 10 – Institutions[1]

10.1 Ease of starting a business

Doing Business records all procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures and the paid-in minimum capital requirement.

*Ease of starting a business i*s an index calculated based on: procedures (number); time (days); cost to complete each procedure (% of income per capita); and paid-in minimum capital (% of income per capita). The scores are the simple average of the distance to frontier scores for each of the component indicators[2].

The *relative value* shows the country's distance to frontier score for ease of starting a business.

10.2 Ease of resolving insolvency
To analyze the efficiency of insolvency frameworks across economies Doing Business studies the time, cost and outcome of insolvency

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[1] More detailed information can be retrieved from the Methodology Section of World Bank- Doing business http://www.doingbusiness.org/methodology

[2] The distance to frontier score shows the distance of an economy to the "frontier," which is derived from the most efficient practice or highest score achieved on each indicator.

proceedings involving domestic entities as well as the strength of the legal framework applicable to liquidation and reorganization proceedings.

The time for creditors to recover loans is recorded in calendar years. The cost of proceedings is recorded as a percentage of the value of the debtor's estate. The recovery rate for creditors depends on whether the distressed company emerges from the proceedings as a going concern or its assets are sold piecemeal. The rate is recorded as cents on the dollar recouped by secured creditors through reorganization, liquidation or debt collection (foreclosure or receivership) proceedings.

Ease of resolving insolvency is an index calculated based on recovery rate (cents on dollars). The score is the simple average of the distance to frontier scores for the recovery rate.

The *relative value* shows the country's distance to frontier score for ease of resolving insolvency.

10.3 Ease of paying taxes

Doing Business records the taxes and mandatory contributions that a standard medium-size company must pay in a given year as well as the administrative burden of paying taxes and contributions.

Ease of paying taxes is an index calculated based on payments (number per year); time (hours per year); and total tax rate (% profit). The scores are the simple average of the distance to frontier scores for each of the component indicators with a threshold applied to the total tax rate.

The number of payments indicates the frequency with which the company has to file and pay different types of taxes and contributions, adjusted for the manner in which those filings and payments are made. The time indicator captures the number of hours it takes to prepare, file and pay 3 major types of taxes: profit taxes, consumption taxes, and labor taxes and mandatory contributions. The total tax rate measures the amount of taxes and mandatory contributions borne by the standard firm (as a percentage of commercial profit).

The *relative value* shows the country's distance to frontier score for paying taxes.

10.4 Ease of protecting investors

Doing Business measures the protection of investors from conflicts of interest through one set of indicators and shareholders' rights in corporate governance through another.

Ease of protecting investors is an index calculated based on: the extent of conflict of interest regulation index (0–10) and the extent of shareholder governance index (0–10). These scores are the simple average of the distance to frontier scores for the extent of conflict of interest regulation index and the extent of shareholder governance index.

The *relative value* shows the country's distance to frontier score for protecting investors.