

## Patent data - Globalisation of research

Through patent applicant and inventor addresses, it is possible to track cross-border ownership patterns of patents and to assess the intensity of international co-invention. The greatest difficulties in measuring the internationalisation of technology with patent information are due to the complexity of and lack of information on companies' ownership structure and strategy. This information needs, however, can be met by establishing links with corresponding datasets.

### Characteristics of patent data for analyzing the globalisation of research

Internationalisation of technological activities can be examined in patents resulting from the output of inventive activities. A patent document shows the inventor and the applicant—the owner of the patent at the time of application—along with their addresses and thus their country or countries of residence. The exploitation of this information, separately or jointly, can tell much about the international organisation of inventions. Citations can also be used: patents citing other patents corresponding to inventions made in another country reflect international knowledge flows.

The greatest difficulties in measuring the internationalisation of technology with patent information are due to the complexity of and lack of information on companies' ownership structure and strategy, which sometimes makes it difficult to attribute a particular country to the owner company declared in the patent file. Many of these difficulties, however, simply have to do with the issue of attributing a country to a company, a problem for all indicators of internationalisation (OECD, 2005). Examples of misleading cases are as follows:

- The owner's country as declared in the patent file may be the affiliate of a multinational group which is in charge of managing its international intellectual property and not the multinational company itself. As this affiliate may be located in a different country than the group headquarters (for strategic or tax-related reasons), this will give a distorted picture of cross-country linkages.
- A patented invention can be controlled by a foreign entity ex post, after its initial owner was acquired by or merged with this foreign entity or the patent right was transferred to the foreign entity. Conversely, a foreign-owned company may become national for similar reasons. The new owner may or may not take direct control of the patent. Standard patent databases do not register such changes in the ownership of patents when they occur after the grant and thus provide an imprecise picture of the actual control of inventions.
- The patent can be owned (or applied for) directly by the domestic subsidiary of a multinational group, which therefore is not mentioned as such in the patent file. In that case, foreign ownership is underestimated (e.g. the case of Belgium in Cincera et al., 2006), and, symmetrically, domestic ownership of foreign inventions is underestimated for the owner's country.

Care must be taken when using patents to interpret international co-invention activity. Inventors located in different countries frequently belong to the same multinational firm and company management practices may influence who is mentioned as an inventor (or first inventor, see Bergek and Bruzelius, 2005). Conversely, inventors located abroad can be involved in research that is contracted out.

The submission of company information (companies' country of origin and international ownership of companies) is not required in patent applications. When compiled solely with the information available in patent files, the indicators proposed here may underestimate the importance of internationalisation. It is recommended to supplement the information on the owner provided in the patent databases with other information regarding company ownership to get a more accurate

indication of how international that technology is. Hence, linking information from patent databases to firm databases can be particularly valuable. These links also enable development of indicators of patent activity based on other relevant criteria such as firm age, size or industry.

Different alternative indicators are available to measure the internationalisation of science and technology (S&T). They are based notably on R&D and international trade statistics, such as the share of R&D financed by sources abroad, exports and imports of high-technology products, and receipts and payments related to technology services (OECD, 2005). Regarding R&D activities, the analysis of internationalisation relies on survey data on the activities of multinational firms and case studies.

## Types of policy questions that can be addressed by patent data

### Policy questions

As countries differ in their specialisation and knowledge assets, complementary external knowledge can be found abroad. International collaboration by researchers can take place either within a multinational corporation (with research facilities in several countries) or through co-operative research among several firms or institutions (collaboration between inventors belonging to different universities or public research organisations). In that sense, co-invention indicators also reflect international flows of knowledge.

Indicators of cross-border ownership and of co-invention are not independent. By definition, international co-invention involved cross-border ownership. In fact, cross-border ownership can be broken down by whether inventions do or do not involve co-invention (the applicant country also being an inventor). Naturally, what is accounted for as foreign ownership in one inventor country implies a domestic-owned invention abroad by domestic firms in another country. Not surprisingly, worldwide totals are much lower than the figures reported by some countries, as counts are consolidated.

**Examples of indicators Using the information contained directly or indirectly in patent documents, the following two indicators of cross-border ownership can be computed at the country or regional level (Guellec and van Pottelsberghe, 2001):**

- **Foreign ownership of domestic inventions.** This refers to the number of patents which are applied to applications residing abroad and which have at least one domestic inventor, divided by the total number of patents invented domestically.
- **Domestic ownership of inventions made abroad.** This refers to the number of patents granted, divided by the total number of patents owned by the country.

In most cases, patents with inventors from abroad correspond to inventions made at the research laboratories of multinational companies and applied for at company headquarters (although in some cases national subsidiaries also may own or co-own the patents). Hence, the first indicator expresses the extent to which foreign firms control domestic inventions. Similarly, the second reflects the extent to which domestic firms control inventions made by residents of other countries. Some fraction of these patents subject to cross-border ownership may also represent co-ownership between two companies located in different countries; again, this more likely concerns cases of co-ownership between headquarters and foreign subsidiaries. However, this represents a very small share of total patents with cross-border ownership.

These indicators therefore reflect the role of foreign affiliates of multinational companies in inventive activities. They complement data on the R&D of foreign affiliates of multinational firms. Foreign control means that the economic benefits arising from the inventions are shared among countries, that is, the country of invention, the country of ownership, but also partly other countries, as multinational companies may implement part of their technology worldwide (in terms of manufacturing or sales).

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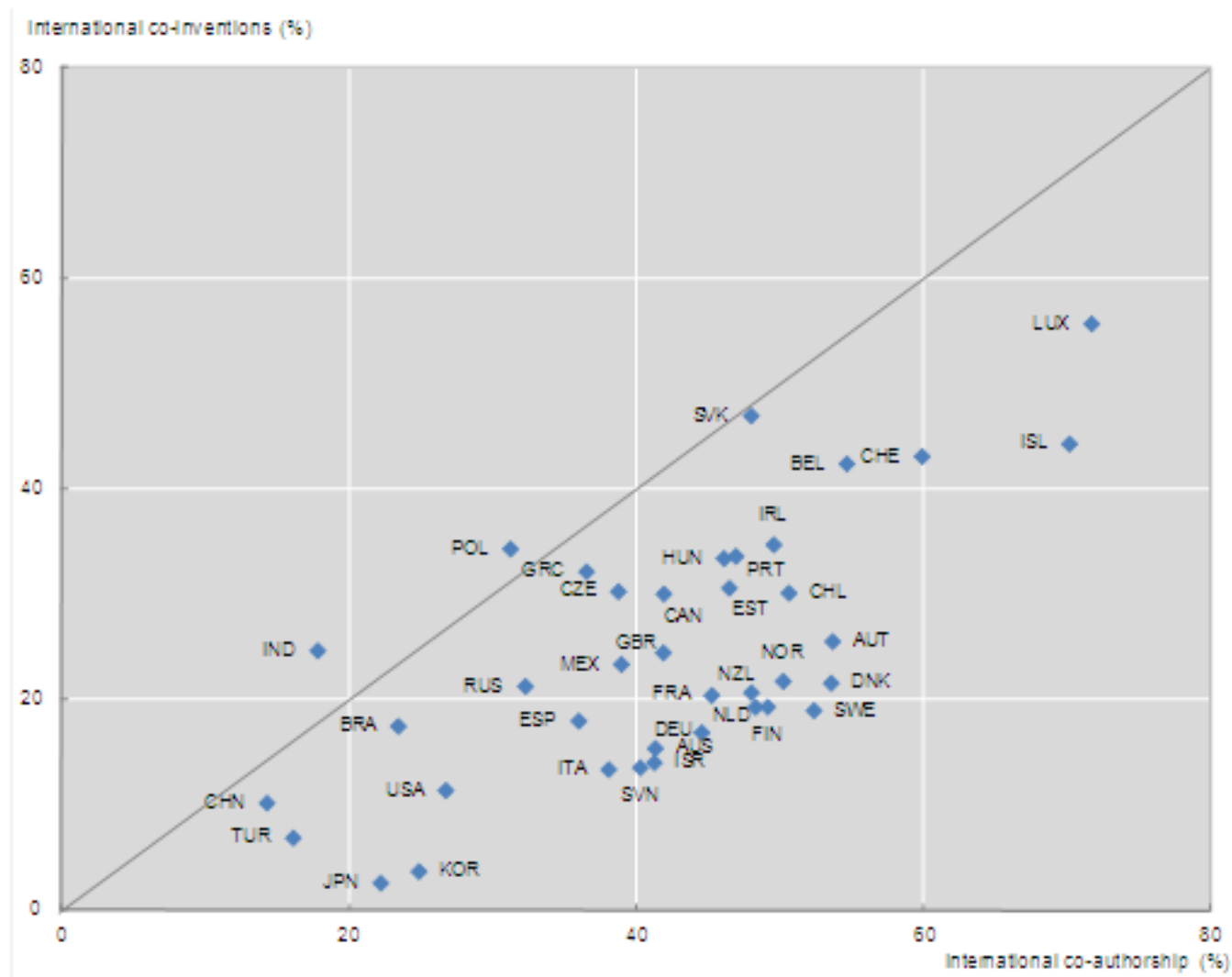
Another measure of the internationalisation of technology is international co-operation on research as measured by patents involving inventors from a different country of residence. It refers to the number of patents invented by a country with at least one inventor located in a foreign country in the total number of patents invented domestically.

Patents provide two complementary indicators of the internationalisation of research. The first is the share of patents filed by one country for an invention made in another country (ownership of inventions made abroad). The second is the share of inventions made in one country and patented by a foreign country (foreign ownership of domestic inventions).

Figures 1, 2, 3 and 4 provide concrete examples on indicators based on patent data aimed at illustrating different aspects of international collaboration on research.

**Figure 1: International collaboration in science and innovation, 2007-09**

Co-authorship and co-invention as a % of scientific publications and PCT patent applications



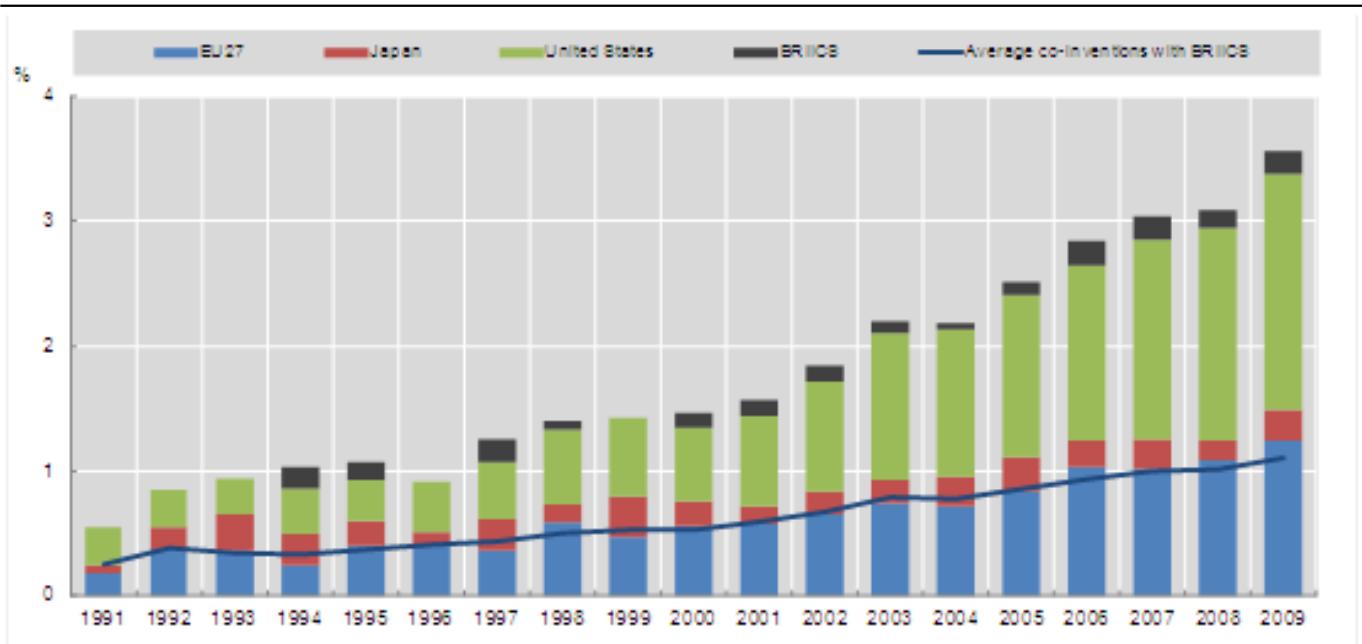
Source: OECD (2011a), "OECD Science, Technology and Industry Scoreboard 2011", [www.oecd-ilibrary.org/sites/sti\\_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti\\_scoreboard-2011-8-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti_scoreboard-2011-8-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html) [1]; OECD, Patent Database, May 2011; OECD and SCLmago Research Group (CSIC) (forthcoming), Report on Scientific Production, based on Scopus Custom Data, Elsevier, June 2011.

1. International co-authorship of scientific publications is measured as the share of scientific articles with at least one author from a different country in total scientific articles. The scientific publication indicators are developed from the information contained in the Scopus® database (Elsevier B.V.).

2. International co-inventions are measured as the share of patent applications filed under the Patent Co-operation Treaty (PCT) with at least one co-inventor located in a different country in total patents invented domestically. Patent counts are based on the priority date and the inventor's country of residence.

**Figure 2: Co-inventions with BRIICS countries, 1991-2009**

% of total patents filed by countries



Source: OECD (2011a), "OECD Science, Technology and Industry Scoreboard 2011", [www.oecd-ilibrary.org/sites/sti\\_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti\\_scoreboard-2011-8-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti_scoreboard-2011-8-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html) [1]; OECD, Patent Database, May 2011.

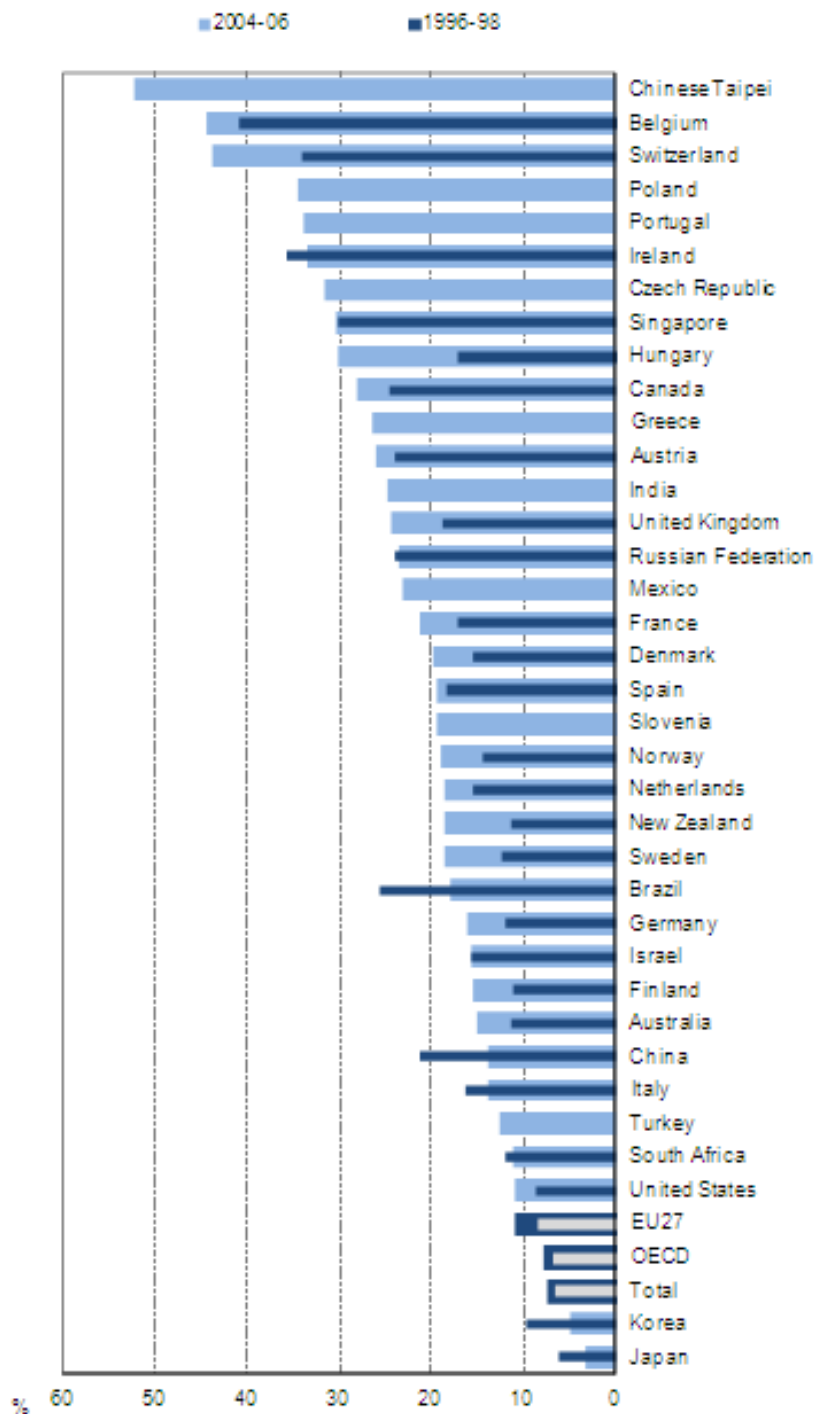
1.Co-inventions are measured as the share of patent applications with at least one co-inventor located in one of the BRICS countries over total patents invented domestically.

2.Data relate to total PCT patent applications, at international phase, published by the World Intellectual Property Organization (WIPO). Patent counts are based on the priority date and the inventor's country of residence.

3.BRICS refers to Brazil, the Russian Federation, India, Indonesia, China and South Africa.

**Figure 3: PCT patent applications with co-inventors located abroad, 2004-06**

% of total patent applications



Source: OECD (2009b), "OECD Science, Technology and Industry Scoreboard 2009", [www.oecd-ilibrary.org/sites/sti\\_scoreboard-2009-en/04/01/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication&itemId=/content/chapter/sti\\_scoreboard-2009-45-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/04/01/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication&itemId=/content/chapter/sti_scoreboard-2009-45-en&containerItemid=/content/serial/20725345&accessItemids=&mimeType=text/html) [2]; OECD, Patent Database, June 2009.

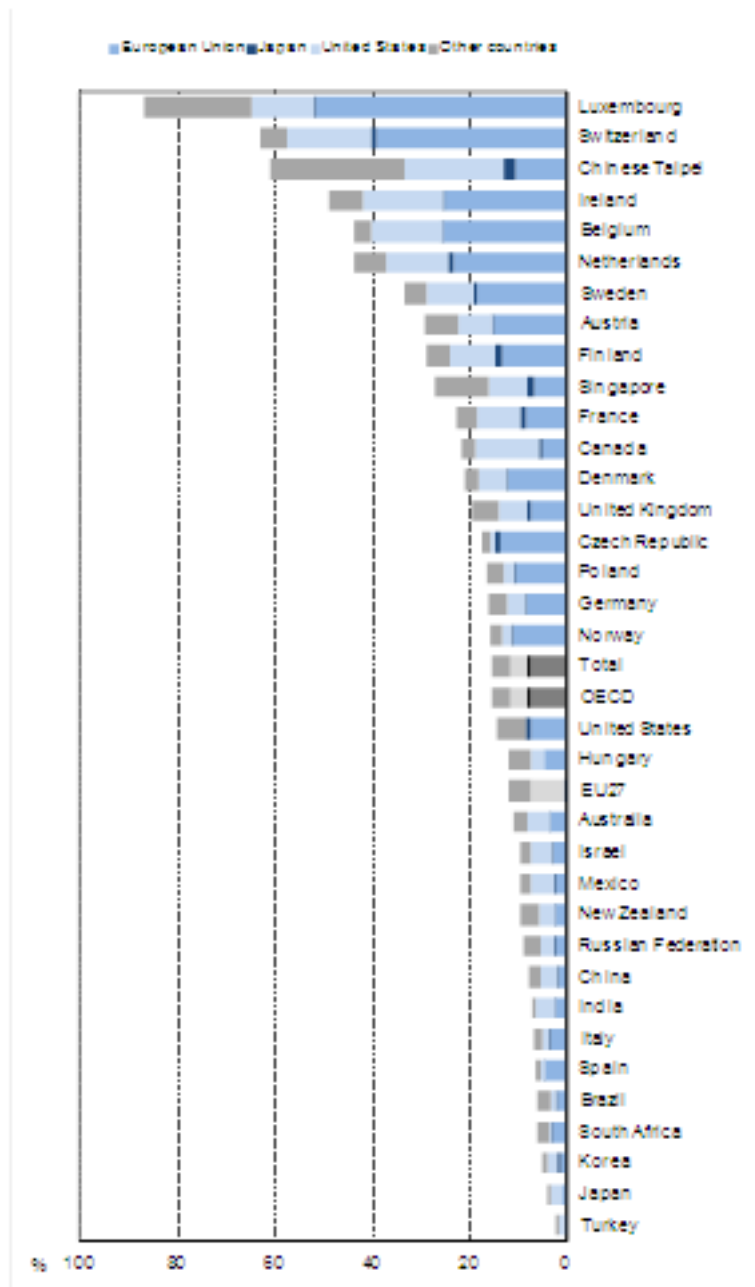
1.Co-inventions are measured as the share of patent applications filed under the Patent Co-operation Treaty (PCT) with at least one co-inventor located abroad in total patents invented domestically.

2.Patent counts are based on the priority date and the inventor's country of residence. The EU is treated as one country; intra-EU co-operation is excluded. Average co-operation is provided for OECD total and total patents.

3.Figures only cover countries with more than 250 PCT filings over the periods.

**Figure 4: Domestic ownership of inventions made abroad, 2004-06**

% with partners in the three major regions



Source: OECD (2009b), "OECD Science, Technology and Industry Scoreboard 2009", [www.oecd-ilibrary.org/sites/sti\\_scoreboard-2009-en/04/04/index.html?contentType=/ns/Chapter/ns/StatisticalPublication&itemId=/content/chapter/sti\\_scoreboard-2009-45-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/04/04/index.html?contentType=/ns/Chapter/ns/StatisticalPublication&itemId=/content/chapter/sti_scoreboard-2009-45-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html) [3]; OECD, Patent Database, June 2009.

1.Share of patent applications filed under the Patent Co-operation Treaty (PCT) invented abroad in total patents owned by country residents, by priority date.

2.The EU is treated as one country and excludes intra-EU co-operation; average co-operation is provided for OECD total and total patents.

3.Figures only cover countries with more than 250 PCT filings over 2004-06.

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[1] [http://www.oecd-ilibrary.org/sites/sti\\_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti\\_scoreboard-2011-8-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/01/04/index.html?contentType=/ns/StatisticalPublication,/ns/Chapter&itemId=/content/chapter/sti_scoreboard-2011-8-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html)

[2] [http://www.oecd-ilibrary.org/sites/sti\\_scoreboard-2009-en/04/01/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication&itemId=/content/chapter/sti\\_scoreboard-2009-45-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html](http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/04/01/index.html?contentType=/ns/Chapter,/ns/StatisticalPublication&itemId=/content/chapter/sti_scoreboard-2009-45-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html)

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[4] <http://dx.doi.org/10.1787/9789264056442-en>

[5] [http://dx.doi.org/10.1787/sti\\_scoreboard-2009-en](http://dx.doi.org/10.1787/sti_scoreboard-2009-en)