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POLICY-MAKERS AND THE R&D-PATENT RELATIONSHIP

Summary of presentation *A policy insight into the R&D-patent relationship*, given at Industry Canada, Distinguished Speakers in Economics Series, Ottawa, Canada, 18 April, 2008

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Policy-makers and the R&D-patent relationship

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This policy contribution summarises a communication entitled "*A policy insight into the R&D-patent relationship*" presented at Industry Canada in their *Distinguished Speakers in Economics Series*, Ottawa, Canada, 18 April, 2008. It argues that the number of priority filings should be used as a patent-based measure of Europe's innovation performance. It also identifies several policies that may affect the R&D-patent relationship.

Patent-based indicators at the country level are frequently used to assess countries' innovation performance or effort. Yet they are often said to reflect the propensity to patent rather than actual research productivity. We argue that patent-based indicators can rightly be used to measure research productivity, as witnessed by the influence of several policy tools on the R&D-patent relationship. We also put forward a new counting methodology, less subject to 'home bias'.

Research scholars specialised in the empirical analysis of innovation systems generally consider patents as an imperfect indicator of research efforts. Mansfield (1986) and Griliches (1990), amongst others, underlined that not all inventions are patentable…and not all patentable inventions are patented. In addition, a patentable invention can be protected with one single patent, several patents, or a large set of overlapping patents (patent thickets), and this 'propensity to patent' greatly differs across industries and types of firms. The motivations behind patenting are shifting from the traditional use of protecting one's own innovations to new strategic uses (cf. Guellec et al., 2007), further complicating the interpretation of patent data. At least the heterogeneity in propensity to patent casts some doubt on the relevance of patent-based indicators for the measurement of innovation performances. Yet they are commonly used by international organisations to rank countries according to their relative innovation effort or performance.[1]

As a matter of fact, two components characterise the R&D-patent relationship: a 'productivity' effect (the number of inventions generated by each researcher) and a 'propensity' effect (the extent to which an invention is protected with one or several patents). In a recent paper (de Rassenfosse and van Pottelsberghe, 2008), we present empirical evidence suggesting that patent-based indicators also measure the productivity of research, provided an accurate measure of patenting activity is used and the role of several policy tools

[1] Examples include the IMD 'World Competitiveness Yearbook' (2006); Eurostat, 'Science, technology and innovation in Europe'; or the Economist Intelligence Unit.

is accounted for. The next section presents a new patent count methodology based on priority filings. We then investigate the extent to which our indicator correlates with research effort. It turns out that the design of intellectual property (IP) and sciences and technology (S&T) policies do influence the R&D-patent relationship.

Measuring a country's innovative effort with patents

There is no perfect way to assess innovation effort. Although frequently criticised, the most common indicators are the level of R&D expenditure and the number of patents. R&D expenditure represents an input in the innovation process, whereas patent counts measure one particular type of output. There is a well-accepted measurement method for R&D effort and harmonised yearly series are provided by the OECD.[2] By contrast, there exists no standard methodology for patent data (see eg Dernis et al., 2001). It is possible to compute a large number of patent-based indicators, each meaning something different.

Assessing a country's patenting performance is more complex than might appear at first sight. Most studies generally rely on patent filings either at the European Patent Office (EPO) or at the US Patent and trademark Office (USPTO), but this practice induces a strong 'home bias'. USPTO filings include domestic priority filings from US firms and filings from abroad. Needless to say many more applications can be expected from US firms than from European firms. The reverse is true with the EPO, where European firms have a much higher propensity to file a patent application than US firms. In addition, EPO filings are generally second filings: they do not account for the original priority filings that are made beforehand (cf. Guellec and van Pottelsberghe, 2007).

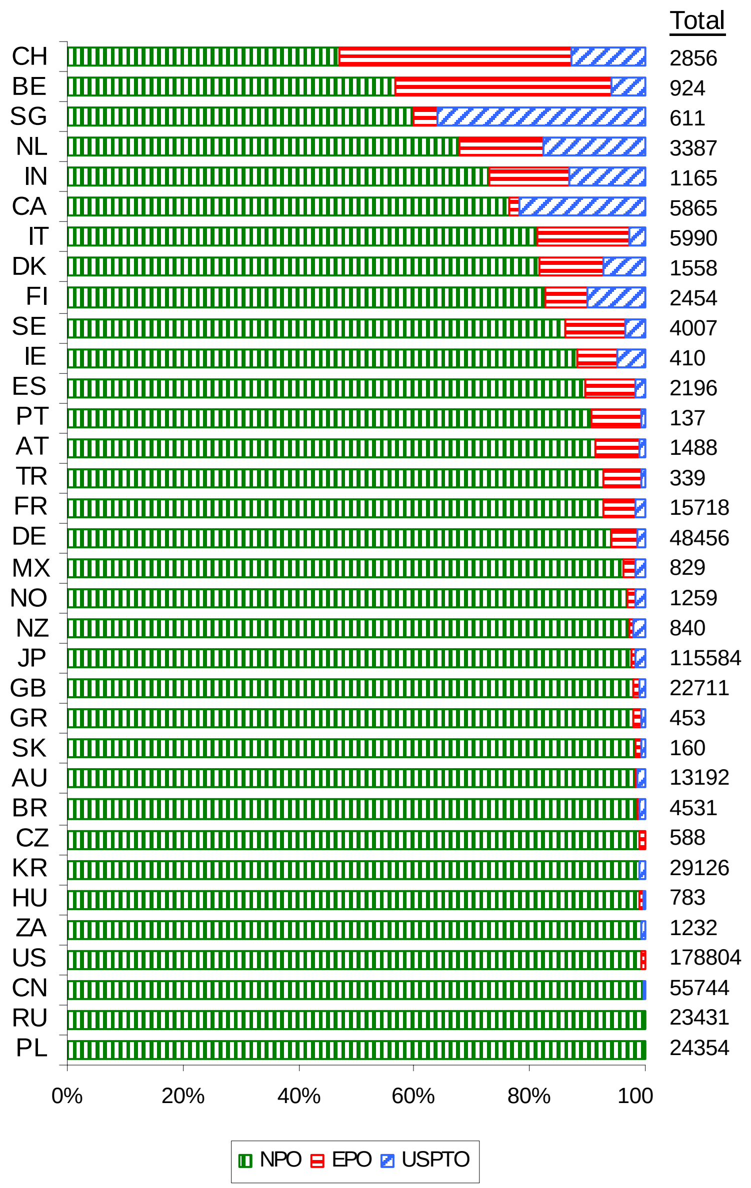
An alternative approach is to rely on the number of priority filings made by the residents of a country. To the best of our knowledge, this counting methodology has rarely been adopted. It is not straightforward to implement, as the firms of a country may choose several routes to file their priority applications. It is particularly true in Europe, where the EPO co-exists with national patent offices, and where firms sometimes first file an application at the USPTO and then transfer it to the EPO. A 'correct' (or less biased) methodology would therefore consist of counting the number of priority patents filed at different national or regional patent offices. In the case of the Netherlands, for example, 2,298 priority filings were made to the national patent office in 2003 (EPO's PATSTAT database, April 2007). During the same year Dutch applicants filed 495 priority filings at the EPO, and 594 priority applications at the USPTO. In other words, a total of 3,387 filings were made by firms based in the Netherlands, a net increase of more than 1,000 patents.

Neglecting EPO or USPTO filings may result in large biases, as Figure 1 points out, especially for Belgium, Canada, India, the Netherlands, Singapore, and Switzerland. The corrected count is reported on the right-hand side of the figure. As compared with the methodology that consists of counting only USPTO or EPO filings, this alternative counting methodology has the advantage of being less subject to home bias, because three routes for priority filings are accounted for (national, EPO and USPTO). An alternative methodology that would also correct the home bias would be to count triadic patents, ie patents that have been filed simultaneously at the USPTO, the EPO and the JPO. It is an indicator developed by

[2] See the Frascati Manual published by the OECD for technical information on R&D, and the Main Science and Technology Indicators as well as the ANBERD database for yearly series.

the OECD that essentially tracks patents with a very high potential value (as they are filed in three patent offices).

Figure 1 - Priority filings in 2003, by route of application

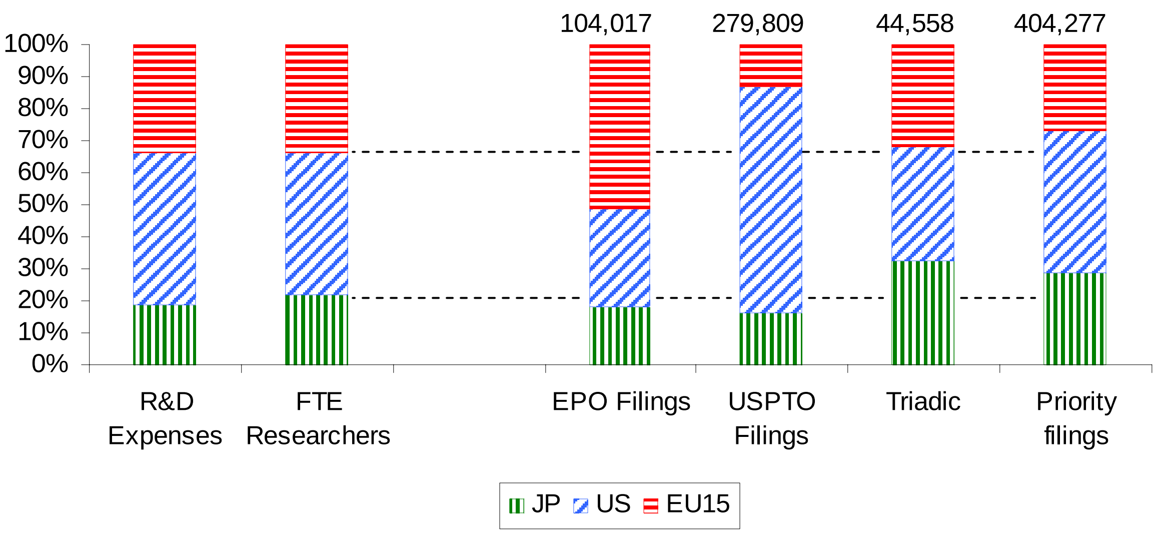


Source: adapted from de Rassenfosse and van Pottelsberghe (2008). Note that the number of Japanese priority filings has been divided by 3, as Japanese patents are on average composed of far fewer claims, about 8 in 2003, as opposed to 24 in the patents filed at the USPTO). A similar approach has been adopted for South Korean patents. For a discussion, see de Rassenfosse and van Pottelsberghe (2008).

Figure 2 shows the results of various counting methodologies (on the right-hand side) compared to two well-known indicators of R&D effort (on the left-hand side): gross expenditure on research and development (R&D spending) and the number of full-time equivalent (FTE) researchers. The home bias clearly appears for patent counts based on EPO or USPTO data. Filings by European (US) applicants are much more numerous with EPO (USPTO) data than the number of researchers or the level of R&D spending would predict.

Triadic patents and priority filings are more in line with the two indicators of R&D activities, with Japan being overrepresented in both cases. In other words, patent counts based on the corrected number of priority filings or on the number of triadic patents seem to provide a more accurate measure of relative research efforts. It is worth noting that the total number of priority filings generated in Europe, Japan and the US is around 400,000, whereas the total number of triadic patents is around 44,000, suggesting that about one patent out of nine is associated with a high value that justifies a global protection strategy.

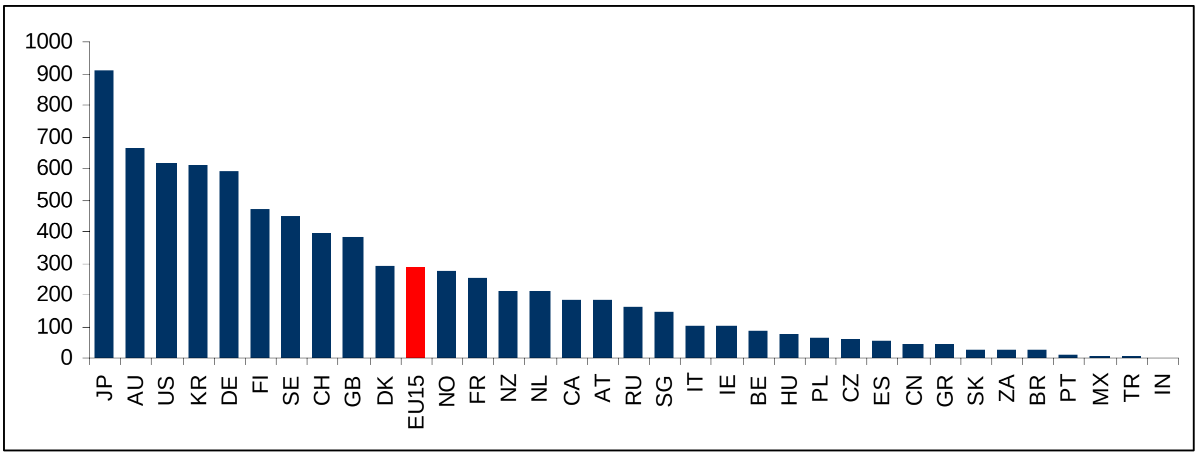
Figure 2 - Research effort (left) versus patenting activity (right)



Sources: cf. de Rassenfosse and van Pottelsberghe (2008); OECD MSTI, USPTO 2003 annual report, EPO 2003 annual report, own computation. Note that the number of Japanese priority filings has been divided by 3, as Japanese patents are on average composed of far fewer claims, about 8 in 2003, as opposed to 24 in the patents filed at the USPTO). A similar approach has been adopted for South Korean patents. For a discussion, see de Rassenfosse and van Pottelsberghe (2008).

Figure 3 shows the corrected count of priority filings per million inhabitants. Germany is the only European country to perform as well as the US, while EU15 clearly lags behind. The following sections summarise the factors that impact countries' patenting performance.

Figure 3 - Corrected priority filings per million inhabitants

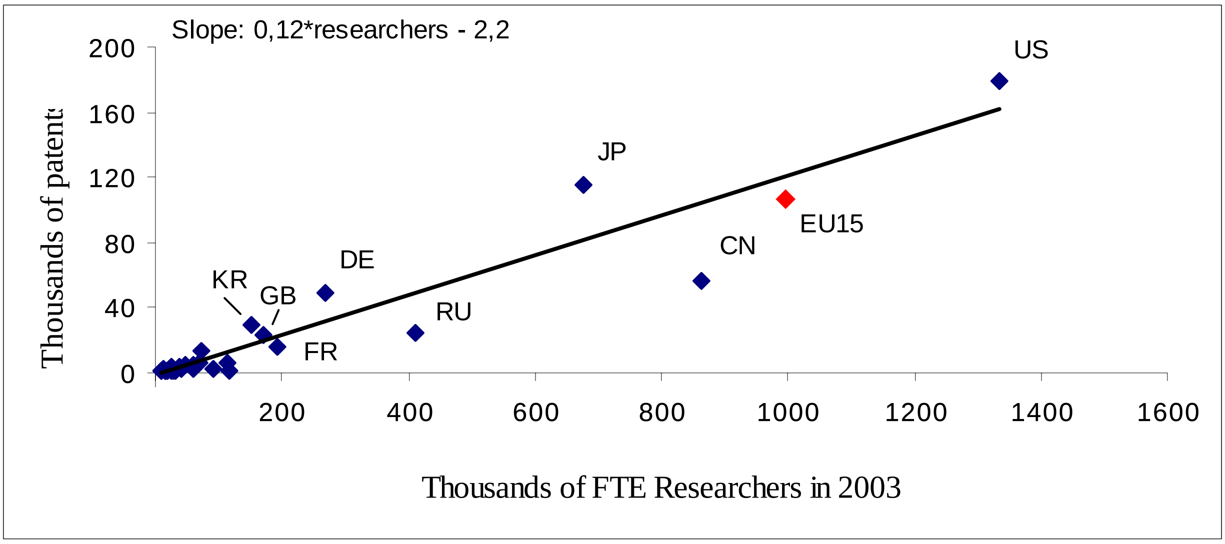


Source: adapted from de Rassenfosse and van Pottelsberghe (2008)

The ‘R&D-patent’ relationship...

A first glimpse into the R&D-patent relationship is provided by Figures 4 and 5, where the number of full-time equivalent (FTE) researchers is plotted against the corrected counts of priority filings. A clear positive relationship between the number of researchers and the number of patents applied for appears, but it is subject to substantial heterogeneity. Countries like the US, Japan, Germany, South Korea, Great Britain and Australia are markedly ‘above’ the line. In other words, firms in these countries patent more than the number of researchers would predict. The EU15 is slightly under the line, as are France, Spain, Canada, Russia, India or China. These differences may be due either to varying propensities to patent or to varying productivity levels of research activities.

Figure 4 - FTE researchers in 2003 vs corrected priority filings

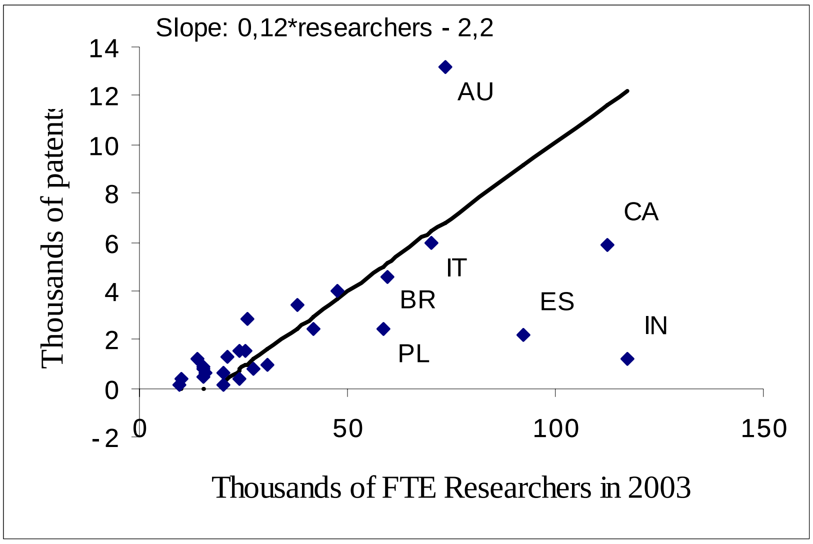


Source: adapted from de Rassenfosse and van Pottelsberghe (2008)

The extent to which countries apply for more or fewer patents than the number of researchers would predict has been analysed by de Rassenfosse and van Pottelsberghe (2008). The authors argue that the relationship between research effort (measured by the number of full-time equivalent researchers) and the number of priority filings depends on both a research productivity effect and a propensity effect.

In order to test the role of the productivity and propensity effects, the authors have performed a cross-sectional econometric analysis of 34 countries, representing more than 95% of worldwide priority filings. The results suggest that the two effects explain the observed heterogeneity in the number of patents per researcher, as witnessed by the impact of the design of several policy tools. The most important results are summarised as follows.

Figure 5 - FTE researchers in 2003 vs corrected priority filings, countries with less than 150,000 FTE researchers.



Source: adapted from de Rassenfosse and van Pottelsberghe (2008)

... depends on a research productivity effect

The design of education policies and S&T policies influence the R&D-patent relationship through a 'productivity' effect.

- **The higher the human capital index is (or the more educated a country is)**, the more productive the research effort is. In other words, countries with a more educated population have more priority filings per researcher. In this respect, Finland, Sweden and Austria score the highest, whereas India, China and Turkey score the lowest.[3]

- The **number of scientific publications per researcher**, an indicator of research quality, also has a positive impact on the observed number of patents. Switzerland, Italy and the Netherlands have the highest performances, while China, Russia, and Japan lag behind.

- **Gross expenditure on R&D per researcher** is an additional determinant of the productivity of research. It seems that better-equipped – or better-paid – researchers are more productive in terms of patent filings. Italian, Dutch and Swiss researchers enjoy the highest relative expenditure, Russian, Polish and Slovakian researchers the lowest.

The three results suggest that patent indicators partly reflect the productivity of research effort. The design of a number of policies has a substantial influence on research productivity and therefore affects the R&D-patent relationship.

[3] Please refer to de Rassenfosse and van Pottelsberghe (2008) for the complete dataset.

… and a propensity effect

Patent-based indicators also reflect varying propensity to patent across countries. In particular, intellectual property policies play an important role in fostering the demand for patents.

- **Patenting fees** are a significant determinant of the demand for patents: a reduction of about 10% in patenting fees would result in an increase in patent filings of 3 to 5%. See de Rassenfosse and van Pottelsberghe (2007) for an in-depth discussion about the role of fees on patenting behaviour.

- **Stronger patent rights**, such as better enforcement mechanisms, a lower number of restrictions or more patentable subject-matter stimulate inventors to file more patent applications. It is measured by the Ginarte-Park index on the strength of patent rights.

- **A country's industrial structure** also matters. For the same level of aggregate R&D intensity, specialisation in the computer or the electronic instruments industry leads to proportionally more patent filings.

The above-mentioned factors constitute pitfalls that make patent-based indicators an imperfect measure of productivity of research: two countries with a similar productivity of research effort but with varying IP policies or technological specialisation may exhibit major differences in patenting performance. Nevertheless, patent data also reflect the productivity of research effort, as witnessed by the impact of education and S&T policies on the R&D-patent relationship.

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