International Rankings of Industrial Property

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Abstract: Intellectual property refers to creations of the mind, and includes industrial property (such as patents, trademarks, designs, utility plants and micro-organisms), as well as copyrights and related rights (such as Internet domain names, performances, phonograms, digital, and other emerging rights). The purpose of the paper is to provide international rankings for fifteen leading OECD countries using domestic industrial property statistics, specifically patents, trademarks and industrial designs, foreign industrial property registered in domestic systems, and foreign patents by the leading OECD countries registered in the USA. Based on domestic patent, trademark and design intensities, foreign industrial property in domestic systems, and foreign shares of US patents as indicators for inventiveness, localisation, originality, openness (or foreign presence) and advanced technology, the paper concludes that Japan and France were the best performing countries during 1975-2000, while the USA was outperformed by several OECD countries.

Keywords: *Industrial property, patents, trademarks, industrial designs, economic potential, international rankings*.

1. INTRODUCTION

Intellectual property refers to creations of the mind and includes industrial property (such as patents, trademarks, industrial designs, utility plants and micro-organisms), as well as copyrights and related rights (such as Internet domain names, performances, phonograms, digital, and other emerging rights). The purpose of the paper is to provide international rankings for fifteen leading OECD countries using domestic industrial property statistics, specifically patents, trademarks and industrial designs, foreign industrial property registered in domestic systems, and foreign patents by the countries registered in the USA. Creation of industrial property is directly related to economic potential, and hence impacts on the countries' positioning in the current globalised knowledge economy. Based on domestic patent, trademark and industrial design intensities, foreign industrial property in domestic systems, and foreign shares of US patents as indicators for inventiveness, localisation, originality, openness (or foreign presence) and advanced technology, the paper concludes that Japan and France were the best performing countries over the period 1975-2000, while the USA was outperformed by several OECD countries.

The plan of the paper is as follows. In Section 2, industrial property indicators are classified according to five categories, namely advanced technology, openness (or foreign presence) localisation, inventiveness and originality. Sources of data are discussed in Section 3, international rankings based on industrial property are presented in Section 4 and some concluding remarks are given in Section 5.

2. IDUSTRIAL PROPERTY INDICATORS

International rankings of the leading OECD countries will be based on the following five industrial property statistics, which have significant impacts on global development.

(1) **Advanced technology**: The world has not previously witnessed rates of technological development as have occurred over the last 25-30 years. A number of countries have been able to exploit new groups of technologies, such as telecommunications and information technologies, which has fostered economic performance and had significant impacts on the economy, society and the environment. Many countries are have begun to develop nanotechnologies, which are perceived as a significant contributor to future economic and technological growth. As the US economy is the most powerful and technologically advanced market that provides an encouraging environment for innovation, advanced technology will be measured by a country's patent share (PS) of US patents, namely:

$$PS_j = P_j/P,$$

where P_j denotes US patents held by country j and P denotes total US patents.

(2) **Openness:** The world's markets are interdependent, the protection of domestic markets is being continually challenged, and the power of large multinational corporations is comparable, if not greater than, that of governments. As indicators of openness of a domestic market to foreign participation, the foreign patent share (FPS_j), foreign trademark share (FTSj) and foreign

industrial design share (FDS_j) in the domestic system of country j are used to capture economic openness and globalisation. The foreign shares for country j are represented as follows:

$$FPS_j = FP_j / (DP_j + FP_j),$$

where FP_j and DP_j denote, respectively, foreign and domestic patents,

$$FTS_j = FT_j / (DT_j + FT_j),$$

where FT_j and DT_j denote, respectively, foreign and domestic trademarks, and

$$FDS_j = FD_j / (DD_j + FD_j),$$

where FD_j and DD_j denote, respectively, foreign and domestic industrial designs. The mean foreign share of industrial property in domestic systems (namely, the mean of FPS, FTS and FDS) will be used as an aggregate indicator of openness to foreign markets.

(3) **Localisation:** Despite global connectivity, there have been high expectations imposed on local operators. The knowledge economy has eliminated many trade barriers and connected geographically-distant markets. However, customers need and demand the highest levels of quality and service which can be guaranteed through the establishment of long-lasting relations based on local presence and reputation. The sustainability agenda has emphasized social and environmental responsibility, in addition to the pursuit of economic profit. Owing to the nature of domestic trademarks, they represent a local identity which can be easily recognised. For example, domain names are a relatively new type of trademark (see McManis (2003), Rood (2000) and Tollett (2001)). In the long run, trademarks also contribute to the trust and prestige associated with the marketing of products as they are seen as a guarantee for quality (Greer, 1979). The more frequently are trademarks used, the greater will be the variety of products used and the localities represented. Confirmation of the economic importance of trademarks is given by their steadily increasing numbers in industrialised countries (Claus, 2001) and the numerous cases of litigation, including issues such as dilution and deceptive advertising (Gastwirth (2003) and Yin and Yeh (2002)). Appropriate indicators of localisation are the domestic trademark intensity (DTI), which is represented as:

$$DTI_j = DT_j/N_j$$

where DT_j denotes domestic trademarks registered in country j and N_j denotes the population of country j. Alternatively, the domestic trademark index (DTX) could be used, namely:

$$DTX_j = (DT_j/\Sigma_j DT_j) / (N_j/\Sigma_j N_j)$$

where DT_j and N_j are normalised relative to total trademarks and populations across all countries.

(4) **Inventiveness**: This feature of human nature is the engine of any development. Creativity is a necessary component for dealing with the challenges posed by the limitations of the available resources and the aspirations for a high quality of life. As indicators for inventiveness, patents have been used for an extended period as an indicator of technological innovation (see, for example, Archibugi (1992), Narin et al. (1987) and Patel and Pavitt (1994)). The domestic patent intensity (DPI) is a suitable indicator for measuring inventiveness, and is represented as:

$$DPI_j = DP_j/N_j$$

where DP_j denotes domestic patents registered in country j. This indicator gives the number of registered domestic patents per resident population, and is an absolute measure of inventiveness. Alternatively, the domestic patent index (DPX) could be used as a relative measure of inventiveness by comparing the performance of country j relative to its population, namely:

$$DPX_j = (DP_j/\Sigma_j DP_j) / (N_j/\Sigma_j N_j)$$

where $DP_j/\Sigma_j DP_j$ denotes domestic patents for country j relative to all domestic patents for countries in a particular sector that are invented by residents of country j, and $N_j/\Sigma_j N_j$ denotes the population share of country j relative to the total population across countries. Thus, DPX_j represents the relative inventiveness of country j. If $DPX_j > 1$, then country j is more inventive than average. Although having a different informative value, the absolute (DPI_j) and relative (DPX_j) indicators of inventiveness generate the same rankings in comparing individual countries.

(5) **Originality**: The diversity of forms witnessed in nature engenders uniqueness and inherent value. Recent industrial development has also shifted away from mass production toward the satisfaction of individual tastes through the originality of design. The unique use of forms and shapes makes products distinctively different and attractive. Industrial designs are important for creating originality in products. The higher the number of registered designs, the greater will be the variety and diversity of products, and the more likely will they be able to serve a wide range of tastes and purposes. There have been annual increases in the number of applications for industrial designs and deposits registered among the main industrial property offices worldwide (Claus, 2002). An appropriate indicator of originality is domestic industrial design intensity (DDI), which can be represented as:

$$DDI_j = DD_j/N_j$$

where DD_j denotes domestic designs registered in country j. As an alternative, the domestic design index (DDX) can be represented as:

$$DDX_j = (DD_j/\Sigma_j DD_j) / (N_j/\Sigma_j N_j).$$

3. INDUSTRIAL PROPERTY DATA

Two sources of industrial property data have been used in this paper. The first source of data is the

WIPO (World Intellectual Property Organisation) annual data on national patents, trademarks and industrial designs for 1975-2000. Indicators for inventiveness (or domestic patent intensity), localisation (domestic trademark intensity), originality (domestic industrial design intensity) and openness (foreign shares in domestic systems) were calculated on the basis of the information available in the WIPO data. The second source of data is the on-line patent database of the US Patent and Trademark Office (PTO), which allows an automatic data search for patents issued in the USA since 1976. This information has been used in previous research to determine technological strengths indicators (see, for example, Marinova (1999, 2001) and Marinova and McAleer (2003)). In this paper, the information on US patents is used to measure technological advance (specifically, foreign shares of US patents).

The following section presents international rankings for the leading OECD countries which are most active in the industrial property field. It was possible to include only fifteen of the leading twenty countries due to the incompleteness of data for Finland and Italy (where domestic patent data were not available), Belgium and the Netherlands (where only amalgamated Benelux data on trademarks and industrial designs were available), and Taiwan-China (where no domestic patent, trademark and design data were available). Consequently, the fifteen countries that are ranked according to various industrial property indicators are Australia, Austria, Canada, Denmark, France, Germany, Israel, Japan, Korea, Norway, Spain, Sweden, Switzerland, UK and USA.

4. INTERNATIONAL RANKINGS BASED ON INDUSTRIAL PROPERTY

Tables 1 presents the indicators for domestic inventiveness (or patents), localisation (or trademarks) and originality (or industrial designs) for fifteen OECD countries for the period 1975-2000. With 42,604 domestic industrial property certificates per million of population, Japan is the most active country in the industrial property field. Japan also has the largest number of domestic patents and trademarks per million, 13,801 and 21,814, respectively, and is fourth in domestic industrial designs with 6,989. France has the second highest number of domestic industrial property certificates per million of population with 32,622, and is also ranked second in domestic trademarks and industrial designs, with 18,053 and 10,870, respectively. Germany has the highest number of domestic industrial designs at 18,360, which is more than 2.5 times that of Japan, and is ranked third overall in domestic industrial property with 29,351. Although the Japanese domestic patenting system encouraged greater patenting in the past by limiting the number of claims per patent (Tong and Frame, 1994), the high degree of inventiveness is impressive. Moreover, the large number of domestic trademarks shows the prestige that is vested in recognised local products. The USA is ranked rather lowly in domestic industrial property at number 11, based on a rank of 5 for patents and 14 for both trademarks and designs. Australia is also at the low end of the spectrum, with the smallest number of domestic patents at 916, and with the numbers of trademarks and designs at 6,897 and 2,534, respectively, being below the corresponding mean values. Of these leading countries, Israel has the smallest number of domestic trademarks at 2,510 and Canada has the smallest number of domestic designs at 432.

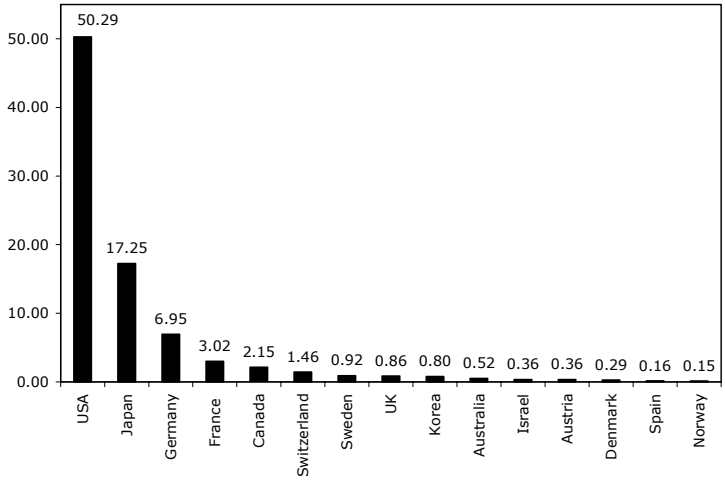
It is interesting to note that only two countries, namely Japan and Switzerland, have a domestic patent index greater than 1, with 2.62 and 1.21, respectively, which means that the inventiveness of only two countries exceeds the domestic average. There are five countries which perform better than average in domestic trademarks, namely Japan, France, Spain, Switzerland and Denmark, and also five countries which perform better than average in domestic designs, namely Germany, France, Austria, Japan and Korea. Overall, five countries perform better than average in domestic industrial property, namely Japan, France, Germany, Austria and Sweden, with the remaining countries having indexes below 1.

In this paper, technological advance is determined by the extent of involvement of the countries in the USA, which is the world's largest and most technologically advanced market. Although there is a degree of arbitrariness in this measure, it is nevertheless an accurate indicator of the quality of research and development that has generated inventions with potential commercial potential. Figure 1 presents the foreign shares of total patents granted in the USA (hereafter, US patents) that are held by the individual countries. Not surprisingly, the USA holds around 50% of US patents issued between 1976 and 2000 (the US PTO search engine does not permit searches before 1976). Japan again performs strongly according to this indicator, and is the foreign country with the largest number of US patents at 423.091, or 17% of the total, followed by Germany and France, with 170,565 (7%) and 73,990 (3%), respectively. Of the remaining countries, only Canada and Switzerland have shares above 1%, at 2% and 1.5%, respectively. Although the differences among these leading countries are significant, they account for more than 80% of all US patents issued during this period.

Table 1. Domestic industrial property and indexes, 1975-2000

Country	Patents (index)	Trademarks (index)	Industrial designs (index)	Industrial property (index)
Australia	916 (0.17)	6,897 (0.71)	2,534 (0.53)	10,347 (0.52)
Austria	3,590 (0.68)	8,855 (0.91)	9,411 (1.95)	21,855 (1.11)
Canada	965 (0.18)	5,847 (0.60)	432 (0.09)	7,243 (0.37)
Denmark	1,125 (0.21)	10,205 (1.05)	1,989 (0.41)	13,319 (0.67)
France	3,699 (0.70)	18,053 (1.86)	10,870 (2.26)	32,622 (1.65)
Germany	4,792 (0.91)	6,199 (0.64)	18,360 (3.81)	29,351 (1.49)
Israel	1,319 (0.25)	2,510 (0.26)	2,848 (0.59)	6,677 (0.34)
Japan	13,801 (2.62)	21,814 (2.25)	6,989 (1.45)	42,604 (2.16)
Korea	3,293 (0.63)	7,032 (0.73)	5,520 (1.15)	15,845 (0.80)
Norway	1,624 (0.31)	4,934 (0.51)	1,426 (0.30)	7,984 (0.40)
Spain	981 (0.19)	17,264 (1.71)	1,569 (0.33)	19,813 (0.97)
Sweden	4,812 (0.92)	7,853 (0.81)	3,834 (0.80)	16,500 (0.84)
Switzerland	6,339 (1.21)	12,909 (1.33)	1,620 (0.34)	20,869 (1.06)
UK	2,008 (0.38)	5,563 (0.57)	1,233 (0.26)	8,803 (0.45)
USA	4,535 (0.86)	4,645 (0.48)	488 (0.10)	9,668 (0.49)
Mean	3,587	9,372	4,608	17,567

Figure 1. Foreign shares of US patents, 1976-2000



Openness to foreign presence is a distinctive feature of the knowledge economy. Table 2 gives the shares of foreign patents, trademarks and designs in domestic systems. Canada has the highest foreign patent share at 92.86%, which is most likely because of the proximity to the USA, and is followed closely by Australia at 91.21%. Norway, Denmark and Israel, with 85.67%, 85.08% and 84.40%, respectively, form a close group behind the two leaders in foreign patent shares. The country with the most closed domestic market in terms of patents is Japan at 13.76%, which is in striking contrast to Japan's high activity on foreign markets, particularly the USA. Canada also has the highest foreign design share at 74.50%, ahead of Norway at 66.74% and Denmark at 61.17%. Norway has the highest foreign trademark share at 81.12%, followed by Sweden at 65.77% and Denmark at 65.22%. Overall, Norway, Canada and Denmark have the most open economies in terms of foreign shares in domestic systems. Japan has the most closed domestic economy, not only in terms of the foreign paten share, but also in relation to foreign trademark and foreign design shares, with 8.79% and 2.90%, respectively. The USA is ranked at number 11 overall in terms of foreign industrial property share, with rankings of 12, 13 and 9 in foreign patent, trademark and design shares, respectively.

Table 3 provides the rankings of the fifteen individual countries according to the five industrial property indicators, and also presents the overall rankings of the countries. Japan is ranked first,

with the highest ranking for two of the five industrial property indicators (namely, domestic patents and trademarks), and the second highest ranking for the foreign share of US patents. France is ranked second overall, and is also second for two of the five indicators, namely domestic trademarks and designs. Sweden and Switzerland are equal third, with domestic patents as the highest ranked indicator for both countries at numbers 3 and 2, respectively. Germany is ranked at number 5 overall, but is ranked the highest in domestic designs. Austria and Norway are ranked together at number 6, with Austria having a highest ranking of 3 for domestic designs and Norway ranked the highest for foreign shares in the domestic system. The USA is ranked rather lowly overall at number 9, but has the highest ranking for shares of US patents (which, for the USA, is equivalent to domestic shares). At the bottom of the list are Korea, Spain and Israel, with Australia being ranked at a modest number 12. Spain is ranked at number 14 overall, but has the third highest ranking for domestic trademarks. Although Canada is ranked at number 11 overall, the ranking for foreign shares in the domestic system is second highest.

Finally, the range of rankings from the highest to lowest for the five components of industrial property is indicative of the degree of specialisation across countries. Both Sweden (ranging from 3 to 7) and Korea (9 to 13) have a relatively small range of 4, followed by Switzerland (2 to 10) with a range of 8. Japan and Norway, both ranging from 1 to 15, have the largest range of 14, followed with a range of 13 by Germany (1 to 14), USA (1 to 14) and Canada (2 to 15). High and low ranges occur for both highly and lowly ranked countries overall, with Japan at number 1 having a range of 14, Spain at number 14 having a range of 11, Sweden at equal number 3 having a range of 4, and Korea at number 15 also having a range of 4.

5. CONCLUSION

The industrial property indicators based on domestic and foreign patent, trademark and industrial design statistics, as applied to the fifteen leading OECD countries, revealed different rankings in the global knowledge economy. Based on the empirical evidence, the best performing country overall is Japan, which is ranked first in both domestic patents and domestic trademarks, second in foreign shares of US patents, fourth in domestic designs, but last in foreign shares in domestic systems. France, which is ranked second overall, is ranked at number 2 in both domestic trademarks and domestic designs, number 4 in foreign shares of US patents, number 6 in domestic patents, but number 12 in foreign shares in domestic systems.

The high overall rankings of Japan and France, combined with their low degree of openness to foreign participation in domestic systems, raise the question as to whether strong protection of domestic markets is a key to success. Those countries with the most connected and globalised economies, namely Norway, Canada and Denmark (with foreign shares in domestic systems of 78%, 71% and 70%, respectively) appear to have a moderate performance in terms of industrial property overall, being ranked at equal number 6, 11 and 8, respectively. However, having a domestic market that is relatively closed to foreign industrial property also does not appear to be a recipe for success. For example, Germany has the second lowest foreign shares in domestic systems, but the low ranking in domestic trademarks leads to an overall ranking of number 5. Of the highly ranked countries, Sweden and Switzerland, at equal third, do not show particularly outstanding performances in any of the five indicators, except possibly for domestic patents, but seem to have found a balance between the various aspects of the globalised knowledge economy. The USA seems to have excelled only in the share of patents registered in the USA, but not in other aspects of domestic or foreign industrial property.

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Table 2. Foreign shares of industrial property in domestic systems, 1975-2000

Country	Patents	Trademarks	Industrial designs	Mean foreign shares
Australia	91.21	53.66	32.82	59.23
Austria	68.71	41.83	42.65	51.06
Canada	92.86	45.48	74.50	70.95
Denmark	85.08	65.22	61.17	70.49
France	54.44	17.80	11.30	27.85
Germany	37.33	19.53	8.98	21.95
Israel	84.40	78.15	15.70	59.42
Japan	13.76	8.79	2.90	8.48
Korea	41.22	31.12	7.67	26.67
Norway	85.67	81.12	66.74	77.85
Spain	77.06	11.95	19.34	36.12
Sweden	66.10	65.77	32.56	54.81
Switzerland	68.90	44.01	41.48	51.47
UK	74.50	44.38	59.74	59.54
USA	42.46	15.63	31.52	29.87

Table 3. International rankings based on five industrial property indicators, 1975-2000

Country	Foreign shares of US patents	Foreign shares in domestic systems	Domestic patents	Domestic trademarks	Domestic industrial designs	Mean	Mean rank
Japan	2	15	1	1	4	4.6	1
France	4	12	6	2	2	5.2	2
Sweden	7	7	3	7	6	6.0	3
Switzerland	6	8	2	4	10	6.0	3
Germany	3	14	4	10	1	6.4	5
Austria	12	9	7	6	3	7.4	6
Norway	15	1	8	8	5	7.4	6
Denmark	13	3	12	5	9	8.4	8
USA	1	11	5	14	14	9.0	9
UK	8	4	9	12	13	9.2	10
Canada	5	2	14	11	15	9.4	11
Australia	10	6	15	9	8	9.6	12
Israel	11	5	11	15	7	9.8	13
Spain	14	10	13	3	11	10.2	14
Korea	9	13	10	13	12	11.4	15