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Methods for using patents in cross-country comparisons

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Drawing its insights from traditions in scientometrics, this paper proposes to gather data by computing the number of patents granted rather than applications for them. Given the precedent set by the Frascati manual, which prompted countries to compute data on the R&D of institutional sectors and to exclude the contribution of households, it is recommended to distinguish clearly between independent and institutional inventors. This paper also suggests computing data for multiple addresses in order to reveal patterns of collaboration. Finally, it is important to consider that patents are not only an indicator of novelty but also an indicator of intellectual property, hence, the paper suggests measuring both dimensions.

Introduction

Statistics on patents are already being used for international comparisons by the Organisation for Economic Co-operation and Development,[1] which draws most of its data from the World Intellectual Property Organization (WIPO).[2] Comparisons between European Union member states are prepared by Eurostat[3] using data from the European Patent Office (EPO). In the United States, the National Science Foundation uses data compiled by the United States Patent and Trademark Office (USPTO). We encounter problems when comparing data from these organisations due to the lack of a common approach. This paper makes a number of methodological suggestions that could increase comparability of statistics produced by individual countries and by international organisations.

Use of patents for international comparisons

Patents are widely used to compute statistics despite several well-known caveats associated with their use:[4–7]

1) incompleteness – many inventions are not patented since patenting is only one way of protecting an invention;

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2) inconsistency in quality – the importance and value of patented inventions vary considerably;
3) inconsistency across industries and fields – industries and fields vary considerably in their propensity to patent inventions;
4) inconsistency across countries – inventors from different countries have a different propensity to patent inventions and countries have different patent laws.

Despite a headstart due to the work of economists such as *Scherer*[8] and *Schmookler*,[9] the methods used to compute statistics on patents have not evolved as rapidly as those concerning bibliometrics and one can easily see that in several respects scientometrics is more sophisticated than technometrics. Importantly, though, R&D and innovation is increasingly perceived as key to economic growth[6], and patents are a valid if imperfect measure of output for R&D.[10]

In particular, Narin and Olivastro argue that a "comparative assessment of areas of national technological strength and excellence is of great practical interest, in that it can help a country to build upon its existing strengths".[11] It is clear that the information that can be drawn from cross-country comparisons of patenting activities is an important input in policy planning at the national and institutional levels. Here, we make a number of methodological suggestions to tabulate statistics from patent data that would increase their value in the policy-making process.

Measuring applications for patents or patents granted?

OECD[12] and Eurostat[3] often present data based on patent applications rather than on patents granted. This method is associated with an overestimation of the number of inventions and it neglects to take into account the varying success rate of countries in obtaining patents. The equivalent of this methodological decision in bibliometry would be to calculate the number of submitted papers rather than those that are actually published.

On average the USPTO granted patents for 58.6% of applications (Figure 1) between 1850 and 1999.[13] Similarly, the EPO granted patents for 59.9% of applications between 1978 and 1999.[14] Hence, using applications for patents rather than patents granted can introduce an important overestimation.

This is not the only pitfall of using data based on patent applications. Comparing data for patent applications versus patents actually granted by the USPTO uncovers important differences between countries (see Annex, Table I). Using data for countries that applied for U.S. patents more than 500 times between 1965 and 1999[15–17] reveals overestimations ranging between 19% for Liechtenstein to nearly 170% for Taiwan. A glimpse at data from WIPO[2] also shows that the percentage of patents issued relative to those applied for varies greatly from year to year, as well as between national offices.

Hence, it is clear that measuring applications rather than patents granted widely affects results and that the resulting overestimation is not distributed homogeneously between countries, i.e., *ceteris imparibus*.

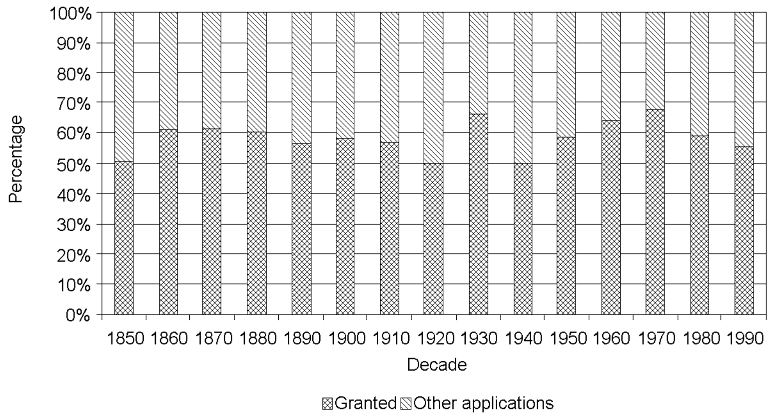

Figure 1. Ratio of patents granted to patent applications at the USPTO, 1850-1999
Source: United States Trademark and Patent Office patent database.

In addition to empirical evidence, there are rational reasons for doubting the use of patent applications as a technometric indicator. For one, applications that are not granted a patent cannot be counted as new, useful or non-obvious, and hence, cannot be counted as a non-trivial novelty. They cannot be counted either as part of the intellectual property of a household, institution, or country. Applications for patents, therefore, do not qualify as a robust indicator of invention or IP. That is not to say that computing these statistics cannot be useful. For example, it could be useful to calculate the amount of applications to get an idea of the workload of a patent office since the workload of examiners is determined by applications rather than by patents granted.

Independent and institutional inventors

The *Frascati Manual*[18] suggests measuring science and technology in the main economic sectors (government, universities, and enterprises). Implicitly, this means excluding households. However, several statistics on patents presented by OECD diverge from this implicit suggestion since they include the patents produced by independent inventors. There are strong reasons to believe that statistics on independent inventors are substantially different from those that refer to institutional inventors and that both ought to be tabulated separately. For example, *Narin* and *Olivastro* state: "For U.S.-invented patents in the U.S. system approximately 75% are assigned to a company and some 25% are unassigned and thereby owed by the inventors. More often than not these unassigned patents are relatively unimportant patents, of local interest".[11] Despite this notice, these authors make no particular effort in distinguishing independent from institutional patents. In fact, as noted by *Amesse* et al., the literature on individual inventors is meagre.* [19,20]

The percentage of patents from independent inventors varies greatly from country to country (see Annex, Table II). For example, Taiwan has a proportion of patents by individual inventors that is more than 20 times greater than that of Japan (60.8% vs. 2.8%). Canada, Australia and Israel all have about twice as many independent inventors as the world average. In fact, the share of patents by Canadian independent inventors is so important that Canada occupies the third rank when the 1980s and 1990s are considered, coming behind the U.S. and Germany. This compares to an 8th rank for Canada when calculating institutional patents. As one can see, computing patent data on independents and institutions produces widely diverging results. Whereas data on independent inventors can be used to assess the inventiveness of a country's citizens, data on institutional patents is a more robust indicator of a country's technological competitiveness. When both are combined, it is not all that clear what is actually being measured.

For example, problems can occur when one calculates a ratio of input into R&D, which is usually calculated for institutions when one follows OECD guidelines, to the patented output, regardless of whether these patents were made by independent or by

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* According to *Amesse* et al., apart from their own study of Canadian inventors and that of *Séguin-Dulude* and *Déranleau*, the literature that takes into account independent inventors comprises Refs 21–24.

institutional inventors (See, e.g., Ref. 25). It is clear that the numerator is not comparable to the denominator:

$$\frac{\text{Input: R\&D by institutions}}{\text{Output: Patents by individuals and by institutions}}$$

Given the prescriptions of the Frascati Manual, it is more robust methodologically to tabulate statistics separately for independent and institutional patents.

Looking at the larger picture: computing statistics from multiple addresses

Although reports do not always explicitly mention the methods used to tabulate data by country, statistics are often calculated with the address of the first inventor. There are at least two shortcomings associated with this method: 1) as we have seen in the first part, everything is not always equal in patent data and we can expect discrepancies in the propensity of inventors from different countries being listed as first inventor; 2) using only the first inventor does not allow the calculation of collaboration in a similar manner to the way scientific collaboration is calculated through co-authorship.

There are some important variations between countries depending on whether only the first address or every address is considered. Needless to say, if two inventors are from the same country, the invention is computed only once, but if inventors from different countries appear on a patent, then each country receives a score of one. Table 1 reveals important differences between countries, particularly for institutional inventors. Generally, the largest difference is for less active countries and it tends to be negligible for the US. The total invention count shows that China is recognised for 34% more inventions than it would be with the first-inventor method. The inventors of China that work for institutions have contributed to 50% more inventions than would be accounted for by the first-inventor method. Independent inventors do not collaborate widely across countries, which explains why statistics do not diverge much using different methods. The largest difference noted with this method is for Hong Kong which shows 10% more inventions when every inventor is taken into account.

Probably the largest advantage of tabulating statistics for every country that participates in inventions is the ability to identify trends in international collaboration. The OECD argues:

"Most patents have more than one inventor (an inventor is an individual). Among these patents, many have co-inventors residing in different countries. Carrying out inventive activity in a group involves sharing knowledge, the knowledge which is at the root of the invention as well as the new knowledge generated in the inventive process. Hence, co-invention is a vector of international circulation of knowledge."[26]

Table 1. Inventions by country by first address and by multiple addresses, 1980-1999

	Independent inventions			Institutional inventions			All inventions		
Country	First address	Multiple addresses	Difference	First address	Multiple addresses	Difference	First address	Multiple addresses	Difference
China	298	323	8.4%	457	690	51.0%	755	1,013	34.2%
Liechtenstein	37	40	8.1%	262	342	30.5%	299	382	27.8%
Mexico	409	435	6.4%	432	602	39.4%	841	1,037	23.3%
Ireland	242	260	7.4%	704	906	28.7%	946	1,166	23.3%
Brazil	274	288	5.1%	606	775	27.9%	880	1,063	20.8%
Hong Kong	352	388	10.2%	789	983	24.6%	1,141	1,371	20.2%
Belgium	558	601	7.7%	6,460	7,782	20.5%	7,018	8,383	19.4%
Spain	868	896	3.2%	1,632	1,978	21.2%	2,500	2,874	15.0%
Israel	1,717	1,777	3.5%	4,600	5,308	15.4%	6,317	7,085	12.2%
Switzerland	2,909	3,076	5.7%	21,259	23,809	12.0%	24,168	26,885	11.2%
USSR/Russia	2,025	2,086	3.0%	1,466	1,785	21.8%	3,491	3,871	10.9%
Austria	1,411	1,439	2.0%	5,301	5,990	13.0%	6,712	7,429	10.7%
Denmark	673	706	4.9%	3,571	3,959	10.9%	4,244	4,665	9.9%
Netherlands	1,206	1,291	7.0%	15,674	17,255	10.1%	16,880	18,546	9.9%
Norway	615	637	3.6%	1,733	1,931	11.4%	2,348	2,568	9.4%
New Zealand	461	474	2.8%	654	733	12.1%	1,115	1,207	8.3%
United Kingdom	5,358	5,555	3.7%	46,354	50,072	8.0%	51,712	55,627	7.6%
Australia	2,818	2,875	2.0%	5,565	6,096	9.5%	8,383	8,971	7.0%
South Africa	876	900	2.7%	1,123	1,234	9.9%	1,999	2,134	6.8%
Canada	13,010	13,205	1.5%	22,895	25,036	9.4%	35,905	38,241	6.5%
Hungary	189	195	3.2%	1,488	1,581	6.3%	1,677	1,776	5.9%
Sweden	3,369	3,442	2.2%	13,102	13,849	5.7%	16,471	17,291	5.0%
France	5,381	5,522	2.6%	48,948	51,442	5.1%	54,329	56,964	4.9%
Italy	3,215	3,287	2.2%	18,906	19,845	5.0%	22,121	23,132	4.6%
Finland	826	853	3.3%	5,074	5,305	4.6%	5,900	6,158	4.4%
Germany	13,875	14,157	2.0%	127,558	132,556	3.9%	141,433	146,713	3.7%
Taiwan	12,268	12,335	0.5%	7,489	7,948	6.1%	19,757	20,283	2.7%
South Korea	1,223	1,263	3.3%	13,525	13,845	2.4%	14,748	15,108	2.4%
United States	233,631	234,410	0.3%	761,326	771,549	1.3%	994,957	1,005,959	1.1%
Japan	10,140	10,273	1.3%	348,799	351,822	0.9%	358,939	362,095	0.9%

Source: United States Trademark and Patent Office patent database.

Figure 2 shows that although collaboration is still limited, it is rising rapidly, particularly between institutional inventors. Between 1980 and 1999, the international collaboration by institutional inventors has increased more than threefold and that of independent inventors has more than doubled (see Annex, Table III). These data reveal that international collaboration occurs in 45% of inventions involving Liechtenstein and in one third of inventions involving Chinese inventors. The more established and fastest-growing countries do not collaborate frequently (Japan, US, South Korea, Taiwan, Germany).

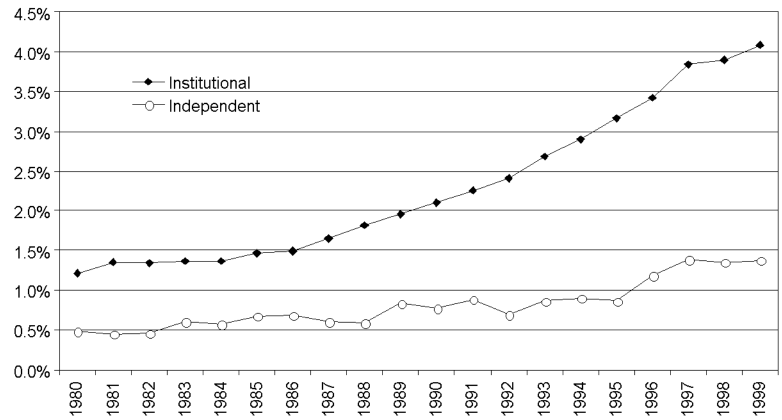

Figure 2. International collaboration by independent and by institutional inventors, 1980-1999
Source: United States Trademark and Patent Office patent database.

Hence, calculating data for multiple addresses is consistent with accepted practice in scientometrics and it reveals the patterns of collaboration in technological development. As we will see later in this paper, it is suggested to compute two statistics from patents: novelty and patents. The examples provided on international collaboration covered the novelty indicator. It is also possible to look at international patterns of technological cooperation by examining how patents are assigned to institutions and inventors from different countries.

Two dimensions of patents: novelty and intellectual property

Pavitt states: "The variety of analytical approaches to the use of the patenting statistics is matched by the variety of explicit or implicit assumptions as to what type of activity the patent statistics actually measure".[27] He enumerates a series of indicators that patents have provided: 1) invention; 2) output of R&D activities (a "knowledge production function" in the words of Griliches); 3) productivity provided by the ratio of patents to R&D inputs. A fourth indicator, one that is often forgotten in the literature or referred to only implicitly, is intellectual property. This indicates not only the level of novelty in the industrial structure of a country, but also how much market power it possesses, hence it is an indicator of industrial and commercial power.

Whereas the first indicator, that is inventions, is measured by the inventor field of patents, intellectual property is measured by the assignee field (or applicant field depending on the patent system) when the owner is an institution. When the owner is an individual, the data is extracted from the inventor field, who retains the right to the invention.

Computing data on the participation of countries in inventions together with their intellectual property provides a means to calculate flow of technology. OECD proposed the use of a similar indicator:

> "SHIA is the share for a given country of patents with a domestic inventor and a foreign applicant in the country's total domestic inventions. It reflects the extent to which foreign firms control domestic technology".[28]

The indicator used here provides a net flow of technology. When it is positive, it means that a country owns more technology than it has invented; when it is negative, a country has invented more new technology than it currently owns. For the period 1980-1999, with the exception of the United States and Liechtenstein, all leading countries had a negative flow of technology (see Annex, Table IV). The countries that were the most severely affected were Belgium, the Netherlands and China, all of which possessed 30% less patents (IP) than the number of inventions they contributed to. The greatest part of the flow was in the institutional sector and was likely due to the research outposts of multinational corporations or to patenting by local subsidiaries. An analysis of countries holding more than 10 patents over the 1980-1999 period revealed that the only countries with positive flow provided advantageous fiscal and/or banking regimes (Netherlands Antilles, Panama, Liechtenstein, Bermuda, Luxembourg, Cyprus, and the Bahamas).

Discussion

Although none of the procedures presented here are new, there have been few attempts made at modernising and standardising the way patent statistics are computed.* The originality of the framework proposed here lies in its capacity to clarify how basic patent statistics could be computed in order to increase their value in innovation and technology policy-making.

* Numerous bodies, such as the USPTO, produce data for granted patents rather than applications for patents. *Sirilli* has already taken great care in distinguishing independent from institutional patents (see Refs 24, 26). He has already suggested to take co-inventors into account. When organizations compute data on the ownership of patents by companies, they calculate a part of the IP, although this neglects the IP owned by households.

Nevertheless, other improvements could be brought to patent statistics and one of the most promising avenues is the calculation of a country's IP by counting only patents that are still in force (e.g. 20 years in the US) and for which maintenance fees have been paid.[29] This patent portfolio of countries is a strong indicator of industrial and commercial power, more particularly when associated with a method of grouping patents obtained in different countries by patent families.[30]

The central suggestion of this paper is to use patents for the measurement of novelty and intellectual property while distinguishing individual and institutional contributions:

	Novelty	Property
Individual level	Independent inventions	Household IP
Institutional level	Institutional inventions	Institution IP

Whereas the novelty indicator uses the inventor field of patents, intellectual property is calculated on the basis of the ownership of the patent and, hence, the assignee field. The computation of detailed statistics shows that although inventions and IP differ between countries, there is not a great deal of difference between the level of invention and the IP of individuals. This only occurs when an individual assigns the rights to an invention to another individual who happens to live in a different country – a rare occurrence. However, there are relatively important flows of technology between countries in the case of institutional patents and this phenomenon invites further qualitative inquiry.

In addition, it is suggested to compute data on the basis of patents granted rather than on patent applications as well as on the basis of multiple addresses. The former eliminates overestimations whereas the latter reveals the full extent of every country's participation in inventions and has the added benefit of illustrating patterns of international collaboration. Table 2 presents statistics for leading countries, taking into account the suggestions made in this paper.

The advantages of using these methodological procedures are numerous: greater analytical possibilities; greater compatibility with the best scientometric practices; compatibility with more detailed statistical analyses such as patterns of collaborations, the index of specialisation and the impact index; amenability to different scales of geographic analysis (countries, states, regions, metropolitan areas). The downside comprises a slight increase in complexity and the possibility of reopening the debate on the fractioning of authorship, only in this case, it would be about inventorship.

Table 2. Inventions and intellectual property of leading countries, 1980-1999

	Inventions			Intellectual Property		
Country	**Independent**	**Institutional**	**Total**	**Households**	**Institutions**	**Total**
United States	234,410	771,549	1,005,959	234,317	801,732	1,036,049
Japan	10,273	351,822	362,095	10,222	348,786	359,008
Germany	14,157	132,556	146,713	14,113	119,007	133,120
France	5,522	51,442	56,964	5,494	45,163	50,657
United Kingdom	5,555	50,072	55,627	5,499	37,586	43,085
Canada	13,205	25,036	38,241	13,172	19,742	32,914
Switzerland	3,076	23,809	26,885	3,069	20,081	23,150
Italy	3,287	19,845	23,132	3,260	16,939	20,199
Taiwan	12,335	7,948	20,283	12,319	7,341	19,660
Sweden	3,442	13,849	17,291	3,419	12,599	16,018
South Korea	1,263	13,845	15,108	1,248	13,654	14,902
Netherlands	1,291	17,255	18,546	1,278	9,626	10,904
Australia	2,875	6,096	8,971	2,880	4,867	7,747
Finland	853	5,305	6,158	853	5,191	6,044
Austria	1,439	5,990	7,429	1,413	3,894	5,307
Israel	1,777	5,308	7,085	1,775	3,422	5,197
Belgium	601	7,782	8,383	601	4,186	4,787
Denmark	706	3,959	4,665	700	3,312	4,012
USSR/Russia	2,086	1,785	3,871	2,057	999	3,056
Norway	637	1,931	2,568	635	1,691	2,326
Spain	896	1,978	2,874	893	1,244	2,137
South Africa	900	1,234	2,134	889	834	1,723
Hungary	195	1,581	1,776	191	1,436	1,627
Hong Kong	388	983	1,371	388	810	1,198
Liechtenstein	40	342	382	43	1,125	1,168
New Zealand	474	733	1,207	473	557	1,030
Ireland	260	906	1,166	260	539	799
Brazil	288	775	1,063	289	469	758
Mexico	435	602	1,037	428	321	749
China	323	690	1,013	310	374	684
TOTAL	**322,421**	**1,493,198**	**1,815,619**	**322,421**	**1,493,198**	**1,815,619**

Source: United States Trademark and Patent Office patent database.

However, given the drawbacks associated with the lack of structured approaches to tabulating basic statistics on patents, such as the lack of international comparability, there are compelling reasons to argue that the benefits of using the framework suggested here outweigh the inconveniences.

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Annex

Table I. Success rate of countries with more than 500 patent applications in the US, 1965-1999

Country	Patents granted	Applications	Succes rate	Overestimation
Liechtenstein	514	612	84%	19%
France	83,532	128,072	65%	53%
Luxembourg	640	986	65%	54%
Switzerland	41,979	64,679	65%	54%
USSR	6,964	10,765	65%	55%
Germany	216,339	341,441	63%	58%
Czechoslovakia	2,043	3,227	63%	58%
Austria	10,083	15,995	63%	59%
Sweden	27,531	44,084	62%	60%
Netherlands	26,002	42,199	62%	62%
Norway	3,517	5,846	60%	66%
Japan	420,490	707,521	59%	68%
Italy	31,780	54,885	58%	73%
Belgium	10,757	18,748	57%	74%
United Kingdom	94,347	165,992	57%	76%
Denmark	6,346	11,472	55%	81%
Hungary	2,366	4,296	55%	82%
Romania	357	649	55%	82%
Venezuela	509	937	54%	84%
Canada	52,618	97,871	54%	86%
Bulgaria	473	881	54%	86%
Poland	682	1,322	52%	94%
Finland	6,957	13,684	51%	97%
Mexico	1,667	3,340	50%	100%
Yugoslavia	325	652	50%	101%
Australia	11,236	22,728	49%	102%
South Africa	2,984	6,204	48%	108%
Spain	3,556	7,599	47%	114%
South Korea	14,852	32,000	46%	115%
Israel	7,333	16,670	44%	127%
Greece	342	783	44%	129%
Ireland	1,178	2,703	44%	129%
Hong Kong	1,318	3,033	43%	130%
India	760	1,767	43%	133%
Argentina	804	1,895	42%	136%
New Zealand	1,447	3,432	42%	137%
Brazil	1,138	2,701	42%	137%
China (People's Republic)	804	1,998	40%	149%
Singapore	747	1,957	38%	162%
Russian Federation	736	1,929	38%	162%
Taiwan	19,979	53,819	37%	169%
Foreign applications	1,121,466	1,908,400	59%	70%
U.S. applications	1,709,403	2,770,084	62%	62%
Average	2,830,869	4,678,484	61%	65%

Source: United States Trademark and Patent Office patent database.

Table II. U.S. Patents granted to independent and to institutional inventors in leading countries, 1980–1999

Country	Independent inventions	Institutional inventions	All inventions	% Independent inventions
Taiwan	12,335	7,948	20,283	60.8%
USSR/Russia	2,086	1,785	3,871	53.9%
South Africa	900	1,234	2,134	42.2%
Mexico	435	602	1,037	41.9%
New Zealand	474	733	1,207	39.3%
Canada	13,205	25,036	38,241	34.5%
Australia	2,875	6,096	8,971	32.0%
China	323	690	1,013	31.9%
Spain	896	1,978	2,874	31.2%
Hong Kong	388	983	1,371	28.3%
Brazil	288	775	1,063	27.1%
Israel	1,777	5,308	7,085	25.1%
Norway	637	1,931	2,568	24.8%
United States	234,410	771,549	1,005,959	23.3%
Ireland	260	906	1,166	22.3%
Sweden	3,442	13,849	17,291	19.9%
Austria	1,439	5,990	7,429	19.4%
Denmark	706	3,959	4,665	15.1%
Italy	3,287	19,845	23,132	14.2%
Finland	853	5,305	6,158	13.9%
Switzerland	3,076	23,809	26,885	11.4%
Hungary	195	1,581	1,776	11.0%
Liechtenstein	40	342	382	10.5%
United Kingdom	5,555	50,072	55,627	10.0%
France	5,522	51,442	56,964	9.7%
Germany	14,157	132,556	146,713	9.6%
South Korea	1,263	13,845	15,108	8.4%
Belgium	601	7,782	8,383	7.2%
Netherlands	1,291	17,255	18,546	7.0%
Japan	10,273	351,822	362,095	2.8%
TOTAL	**322,421**	**1,493,198**	**1,815,619**	**17.8%**

Source: United States Trademark and Patent Office patent database.

Table III. International collaboration by type of inventions, 1980–1999

Country	Independent	Institution	Total
Liechtenstein	30.0%	46.8%	45.0%
China	11.8%	43.6%	33.5%
Ireland	13.1%	37.9%	32.3%
Belgium	14.3%	28.9%	27.8%
Brazil	6.3%	31.1%	24.4%
Mexico	7.6%	35.7%	23.9%
Hong Kong	13.1%	27.1%	23.1%
Switzerland	9.3%	20.2%	18.9%
Spain	4.6%	25.2%	18.8%
Israel	6.1%	22.3%	18.3%
Denmark	8.2%	17.7%	16.3%
Austria	4.2%	19.0%	16.2%
USSR/Russia	4.5%	28.7%	15.7%
Norway	6.1%	18.4%	15.4%
Netherlands	9.5%	15.4%	15.0%
United Kingdom	6.6%	12.9%	12.3%
New Zealand	4.6%	16.9%	12.1%
South Africa	6.2%	16.4%	12.1%
Canada	3.3%	16.2%	11.8%
Australia	3.3%	15.1%	11.3%
Hungary	8.2%	8.9%	8.8%
France	4.6%	8.9%	8.5%
Sweden	3.8%	9.5%	8.4%
Finland	6.1%	8.0%	7.7%
Italy	3.6%	8.0%	7.4%
Germany	3.8%	7.4%	7.1%
Taiwan	0.9%	8.2%	3.7%
South Korea	4.8%	3.3%	3.4%
United States	0.8%	3.2%	2.7%
Japan	2.1%	1.5%	1.5%
TOTAL	**0.9%**	**2.6%**	**2.3%**

Source: United States Trademark and Patent Office patent database.

Table IV. Flow of technology as measured by U.S. patents, 1980–1999

Country	Independant inventions	Household IP	Flow	Institutional inventions	Institutional IP	Flow	All inventions	All IP	Flow
Liechtenstein	40	43	7.5%	342	1,125	228.9%	382	1,168	205.8%
United States	234,410	234,317	0.0%	771,549	801,732	3.9%	1,005,959	1,036,049	3.0%
Japan	10,273	10,222	-0.5%	351,822	348,786	-0.9%	362,095	359,008	-0.9%
South Korea	1,263	1,248	-1.2%	13,845	13,654	-1.4%	15,108	14,902	-1.4%
Finland	853	853	0.0%	5,305	5,191	-2.1%	6,158	6,044	-1.9%
Taiwan	12,335	12,319	-0.1%	7,948	7,341	-7.6%	20,283	19,660	-3.1%
Sweden	3,442	3,419	-0.7%	13,849	12,599	-9.0%	17,291	16,018	-7.4%
Hungary	195	191	-2.1%	1,581	1,436	-9.2%	1,776	1,627	-8.4%
Germany	14,157	14,113	-0.3%	132,556	119,007	-10.2%	146,713	133,120	-9.3%
Norway	637	635	-0.3%	1,931	1,691	-12.4%	2,568	2,326	-9.4%
France	5,522	5,494	-0.5%	51,442	45,163	-12.2%	56,964	50,657	-11.1%
Hong Kong	388	388	0.0%	983	810	-17.6%	1,371	1,198	-12.6%
Italy	3,287	3,260	-0.8%	19,845	16,939	-14.6%	23,132	20,199	-12.7%
Australia	2,875	2,880	0.2%	6,096	4,867	-20.2%	8,971	7,747	-13.6%
Switzerland	3,076	3,069	-0.2%	23,809	20,081	-15.7%	26,885	23,150	-13.9%
Canada	13,205	13,172	-0.2%	25,036	19,742	-21.1%	38,241	32,914	-13.9%
Denmark	706	700	-0.8%	3,959	3,312	-16.3%	4,665	4,012	-14.0%
New Zealand	474	473	-0.2%	733	557	-24.0%	1,207	1,030	-14.7%
South Africa	900	889	-1.2%	1,234	834	-32.4%	2,134	1,723	-19.3%
USSR/Russia	2,086	2,057	-1.4%	1,785	999	-44.0%	3,871	3,056	-21.1%
United Kingdom	5,555	5,499	-1.0%	50,072	37,586	-24.9%	55,627	43,085	-22.5%
Spain	896	893	-0.3%	1,978	1,244	-37.1%	2,874	2,137	-25.6%
Israel	1,777	1,775	-0.1%	5,308	3,422	-35.5%	7,085	5,197	-26.6%
Mexico	435	428	-1.6%	602	321	-46.7%	1,037	749	-27.8%
Austria	1,439	1,413	-1.8%	5,990	3,894	-35.0%	7,429	5,307	-28.6%
Brazil	288	289	0.3%	775	469	-39.5%	1,063	758	-28.7%
Ireland	260	260	0.0%	906	539	-40.5%	1,166	799	-31.5%
China	323	310	-4.0%	690	374	-45.8%	1,013	684	-32.5%
Netherlands	1,291	1,278	-1.0%	17,255	9,626	-44.2%	18,546	10,904	-41.2%
Belgium	601	601	0.0%	7,782	4,186	-46.2%	8,383	4,787	-42.9%
TOTAL	**322,421**	**322,421**	**0.0%**	**1,493,198**	**1,493,198**	**0.0%**	**1,815,619**	**1,815,619**	**0.0%**

Source: United States Trademark and Patent Office patent database.

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