



## Globalization of technology: Network analysis of global patents and trademarks

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### ABSTRACT

This study explored how the structure of globalization of technology via intellectual property networks has changed longitudinally, and compares the structures of global trademarks and patents. It suggests that network analysis provides useful tools for describing recent trends in the globalization of technology. Network analyses describe which countries have higher technological capabilities, and also how countries are mutually connected for technological collaboration or transfer. In addition, network analysis confirmed that both the trademark and patent networks have become decentralized over time.

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## 1. Introduction

Intellectual property (IP) refers to creative works, new technology, or an exclusive symbol or design used in commerce that has economic value in the marketplace [1]. Therefore, intellectual property rights (IPRs) are the legal rights governing the use of such creations to promote these innovations, which add to an economy's knowledge base. Although the details of IPRs have been modified over time according to changes in economic and social situations, their basic function is to protect owners' rights and prevent others from taking actions that infringe upon or damage the property [2–9].

In 1995, The World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) brought with it a new era in the multilateral protection and enforcement of IP rights. Provisions in the TRIPS directly complement the international treaties administered by WIPO. Since 1996, an Agreement between the World Intellectual Property Organization (WIPO) and the WTO provides for cooperation concerning the implementation of the TRIPS Agreement, such as notification of laws and regulations, and legislative assistance to member countries [10]. The TRIPS agreement covers not only general provisions and basic principles but also new areas and rights not previously addressed by international law – or even the national laws of many industrialized countries. WIPO currently has 184 Member States, 66 intergovernmental organizations (IGOs), and 265 non-governmental organizations (NGOs) that are accredited as observers at WIPO meetings.

According to TRIPS, the objectives of intellectual property rights are “the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the

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mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations". However, at the global level, the relationship between intellectual property protection and international technology innovation or transfer has been a controversial [10].

Technology will continue to grow at an accelerated rate and new technology will be diffused around the world. The phenomenon of "globalization" is experienced by the world of invention and innovation. Without new technologies, globalization would not be possible because they play a role in information transfer from one place to another, thus allowing for the speed and the intensity which characterize the modern world [11].

Technological innovation cannot be accomplished in solitude, but requires collaboration among inventors, both within a country and across national boundaries. After technological inventions, innovators attempt to obtain economic advantages by exploiting their technological competencies in non-domestic markets [11,12]. Although the trade (export and import) of innovative goods is a main route for the international exploitation of nationally produced innovations, they also exploit their technological advantages by transferring their know-how to foreign firms wanting to introduce the latest technology. This strategy of exploitation in foreign markets innovations is both: *embodied* in products (a product is patented to prevent others from producing similar goods, thus covering the existing market); and *disembodied* (an innovation is patented in order to license it). The strategy is all the more convenient when there are various types of obstacles such as: (1) high transportation costs; (2) barriers to imports; and (3) high wage differentials between the innovating country and the importing country.

Opinions about TRIPS under the WTO are sharply divided. Some have supported it because they consider it to be an instrument of the positive aspects of globalization, such as global harmonization, free and fair trade, and technology transfer. Conversely, opponents maintain that it is associated with the global technology gap, development barriers, the unfair structure of the global system, and the imperialism of international trade in general (for developing countries in particular). Although there have been disputes about the role of IPRs, they have impact on the globalization of technology. Thus, global IPR activities are used for measuring a country's technological capabilities and technology collaboration or transfer among countries.

This study reviews: 1) how IPR activities indicate the globalization of technology (e.g. countries' technological capability and technology collaboration and transfer among countries); 2) the differences between patents and trademarks in terms of technological globalization; and 3) the recent research regarding the debate around IPRs and globalization of technology.

Then, it uses network analysis to examine how the structures of the global trademark and patent flow networks differ in the globalization of technology and how the structure of global intellectual property network has changed over time. While most previous studies have focused on specific cases, or used IPR data from certain countries to indicate the globalization of technology, this study analyzes data from 151 countries' inbound and outbound patent and trademark registrations from 1995 to 2005. Through the network analysis, the study explores the global trends of technological diffusion. In addition, it reveals the core-peripheral structure of the patents and trademarks networks over time.

**Table 1**

Out-degree & in-degree change in global patents networks.

1996			2000			2005		
	Out-degree	In-degree		Out-degree	In-degree		Out-degree	In-degree
Japan	76,327	20,566	U.S.A	109,522	120,348	U.S.A	158,281	166,249
U.S.A	69,436	82,741	Japan	104,986	20,080	Japan	156,467	56,732
Germany	42,686	7943	Germany	62,034	9963	Germany	77,276	10,935
France	16,564	3233	France	24,184	3134	Korea	39,852	38,000
UK	13,471	8191	UK	18,996	9850	France	29,458	2492
Korea	11,452	14,150	Switzerland	13,746	440	Netherland	25,442	538
Switzerland	10,940	671	Netherland	12,948	453	UK	22,651	9019
Netherland	7831	526	Korea	12,817	28862	Switzerland	21,213	372
Italy	7510	1597	Sweden	10,580	603	Canada	14,261	33,975
Canada	6115	11374	Canada	9659	10335	Italy	12,585	–
Sweden	4561	711	Italy	9243	1314	Sweden	11,023	390
Belgium	3095	305	Finland	5076	319	Australia	7493	21,180
Finland	2753	474	Belgium	4215	229	Finland	7096	224
Austria	2441	443	Israel	3754	5174	Belgium	5945	92
Australia	2263	13,137	Australia	3398	19982	Israel	5874	4808
Denmark	1725	138	Austria	3177	335	Denmark	4713	150
Spain	1684	504	Denmark	2998	125	Austria	4104	221
Israel	1643	2084	Spain	2170	449	China	4080	79,298
Norway	700	1607	Norway	1381	–	Spain	3364	261
Ireland	597	122	China	1081	26414	India	3013	–
South Africa	580	–	Ireland	976	151	Norway	2114	–
Liechtenstein	517	–	New Zealand	838	–	Ireland	1779	75
New Zealand	497	3556	India	713	4146	New Zealand	1296	4941
Russia	421	4468	Russia	703	4737	Singapore	1187	7768
Brazil	359	3319	Liechtenstein	688	0	Russia	1021	8590

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