Boundless Protection

Legal-Technical Expertise and the Expansion of Patent Rights

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Markus Lang

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Introduction

Since the 1980s, multinational companies and high income countries have supported the introduction of stronger patent rights in many parts of the world. A series of formerly unpatentable technologies was made patentable and existing restrictions on patent rights were removed. Katharina Pistor (2019: 109) describes a long list of changes in national and international patent laws as "aggressive enclosure not only of (...) nature's code, but of skills and knowledge in other areas as well."

This widespread support of stronger patent rights is remarkable if one remembers just how difficult multinational companies had found it to avoid rejections of patent applications for lack of novelty and non-obviousness in the postwar decades. The costs of making sure that there were no foreign language documents undermining the patentability of inventions was often just too high to bother. Patent offices of high income countries were, in turn, quite similarly overwhelmed with patent applications from countries whose languages examiners did not speak or whose classifications they were not familiar with. Their way of not bothering was to ignore or reject patent applications, those by foreign companies in particular.

How did the introduction of stronger patent rights become so attractive for multinational companies and high income countries nonetheless? Or to put it another way: why did language and classification differences cease to matter much for patent protection?

The standard economic explanation is that countries independently decide to introduce stronger patent rights once they cross a certain income and innovation capacity threshold (Ginarte and Park 1997; Maskus and Penubarti 1995). To some extent, this is correct. Yet many countries with high income and innovation capacity, such as Japan and South Korea, have only introduced stronger patent rights after long waiting periods. Moreover, many lower income countries saw sharp increases in patent rights protection that cannot be explained at all in the standard economic framework.

This is partly why political science-based explanations of stronger patent rights protection have emphasized the importance of external coercion. According to these explanations, higher income countries forced stronger patent rights upon lower income countries in the course of international trade negotiations (Braithwaite and Drahos 2000; Drahos 1995; Sell 2003).

They evidently did this in response to lobbying campaigns by multinational companies located in higher income countries.

Though I agree with this explanation, which is consistent with recent empirical research (see Allred and Park 2007; Chen and Puttitanun 2005), I still find it puzzling why forcing stronger patent rights upon lower income countries would, in the absence of a global patent system, be in the interest of multinational companies and high income countries. In other words, why would multinational companies support external coercion to create difficult to acquire patent rights in lower income countries, no matter how strong they might be?

My argument in this dissertation is that stronger patent rights became attractive for multinational companies and high income countries because information specialists in their employment successfully addressed language and classification differences. In essence, they were able to develop concepts, devices, and arrangements that made it possible for both multinational companies and large patent offices to make sense of masses of complex and diverse patent documents.

If it had been possible to replace national patent offices with a global patent system, the legal-technical expertise of information specialists would likely not have mattered much. Yet such a system never found sufficient support, and patent offices instead relied on information specialists and commercial intermediaries to deal with language and classification differences. Step by step, patent law-making, and thus strengthening efforts, became critically dependent on legal-technical expertise. Using both archival research and quantitative methods, I will demonstrate that devices, concepts, and arrangements covering new countries, i.e. the buildup of legal-technical expertise, measurably influenced the strength of patent rights in many countries.

This claim should not be understood as a challenge to the view that repeated initiatives by lawyers were critical in strengthening patent rights (see Pistor 2019, chap. 5). On the contrary: some of the evidence I will present in the following chapters is intended to defend the relevance of legal expertise against an overemphasis on purely economic and political determinants. My point, rather, is that lawyers typically worked in *temporary teams* with information specialists and thus benefitted from their “legal-technical expertise". If strictly legal initiatives had been sufficient to support the adoption of stronger patent rights, how can we make sense of numerous failed efforts to substantially harmonize national patent laws during the postwar decades?

The Expansion of Patent Protection

There is a vast literature on efforts to strengthen patent rights[1]. Often, however, this literature zooms in so closely on specific countries and regions that it can be difficult to assess whether there really has been an across-the-board increase in patent protection. In order to demonstrate that patent rights have not just been strengthened in the United States, Europe, or India, I rely on an index that was originally developed by Juan Ginarte and Walter Park (1997), and has since then been updated a number of times (Park 2008, 2021). This "patent rights index" seeks to capture the strength of patent rights in a large number of countries by basically ticking boxes whenever the country in question adopted polices that unambigously strengthened patent rights. The overall index aggregates five categories of patent strength in 120 countries over a period of 55 years; arguably, this index shows more clearly than any other data source that statutory patent rights became stronger in many countries.

The first category of the patent rights index records if and when a given country became a member of a protection-related international patent agreement. The international agreements considered in the index are the Paris Convention, the Patent Cooperation Treaty (PCT), the International Convention for the Protection of New Varieties of Plants (UPOV), and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). If a country became a member of all four agreements, it received the highest possible score. If it did not became a member of any of the four agreements, it received the lowest possible score. I will discuss later what exactly changed for countries which became members of these agreements. For now, I am content with showing that most countries became members of more and more international agreements. Fig 1 illustrates that the average country had barely joined a single protection-related international agreements in the middle of the 1980s but had already joined almost three out of four agreements thirty years later.

[1]To mention just a few works: Adam Jaffe and Josh Lerner (2007), as well as James Bessen and Michael Meurer (2009), have written widely cited books on the extension of patent protection in the United States. Peter Drahos (2010) and Ingrid Schneider (2010), in turn, have written books that discuss the legal and administrative expansion of patent protection in Europe in great detail. While there are proportionally fewer works on the strengthening of patent protection in other countries and regions, there are still plenty. For instance, Kenneth Shadlen (2017) has worked on pharmaceutical patent protection in Latin America, Amy Kapczynski (2009) on TRIPS implementation in India, Peter Yu (2019) on the Chinese Intellectual Property System, and Nitsan Chorev (2012) on the "reactive diffusion" of divergent protection standards in Thailand, South Africa, and a number of other low and middle income countries.

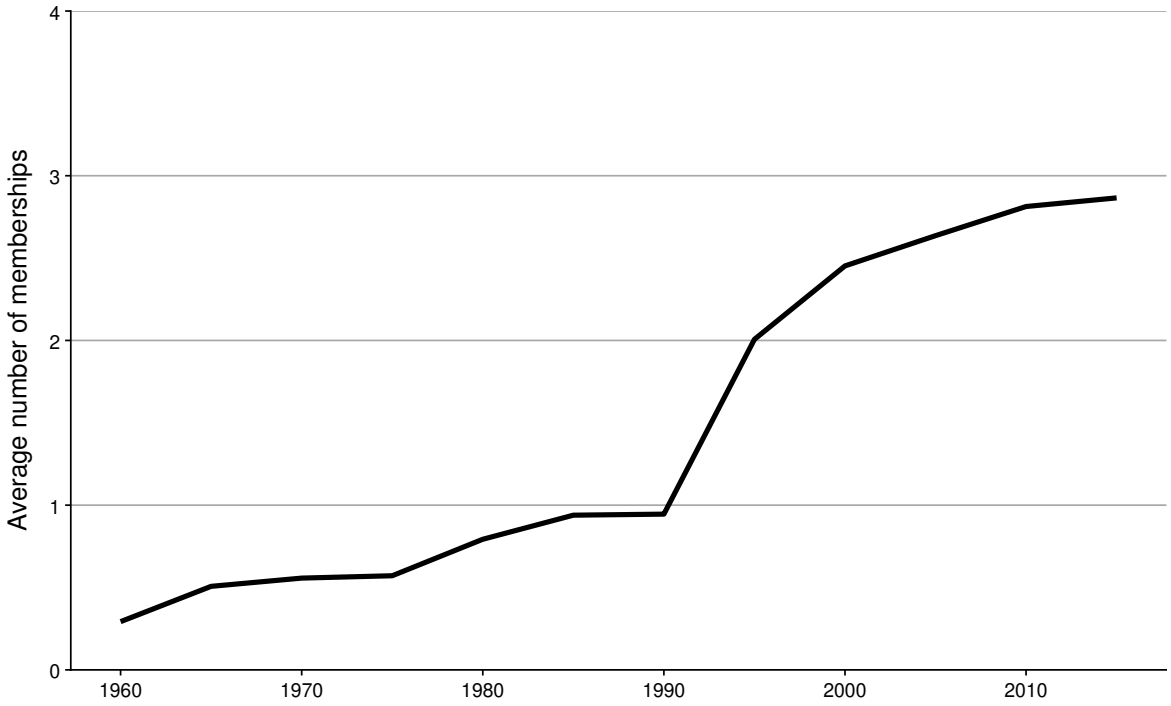


Fig. 1 Membership in international patent agreements, 1960-2015
Source: The data are from Park 2021 ("membership" category).

The second category of the patent rights index counts how many formerly unpatentable technologies became patentable in a particular country. The relevant technologies are:

1. pharmaceuticals,
2. chemicals,
3. food,
4. plant and animal varieties,
5. surgical products,
6. microorganisms, and
7. utility models[2].

If a country allowed patent applicants to acquire protection for all seven technologies, it was assigned the highest possible score. If it was, by contrast, impossible for applicants to gain protection for any of the technologies, the country received the lowest possible score. Fig 2 shows that the average country granted only patents for around two out of seven technologies until the 1980s, yet began to enable patenting for more than four technologies

[2]Utility models are, of course, not a technology in the strict sense. What is meant here is the possibility to protect "improvements of existing products, which do not fulfill the patentability requirements, [but] may have an important role in a local innovation system" (WIPO 2021e)

in the 2010s. This shift towards the "enclosure" of more technologies can be observed for most countries covered by the index.

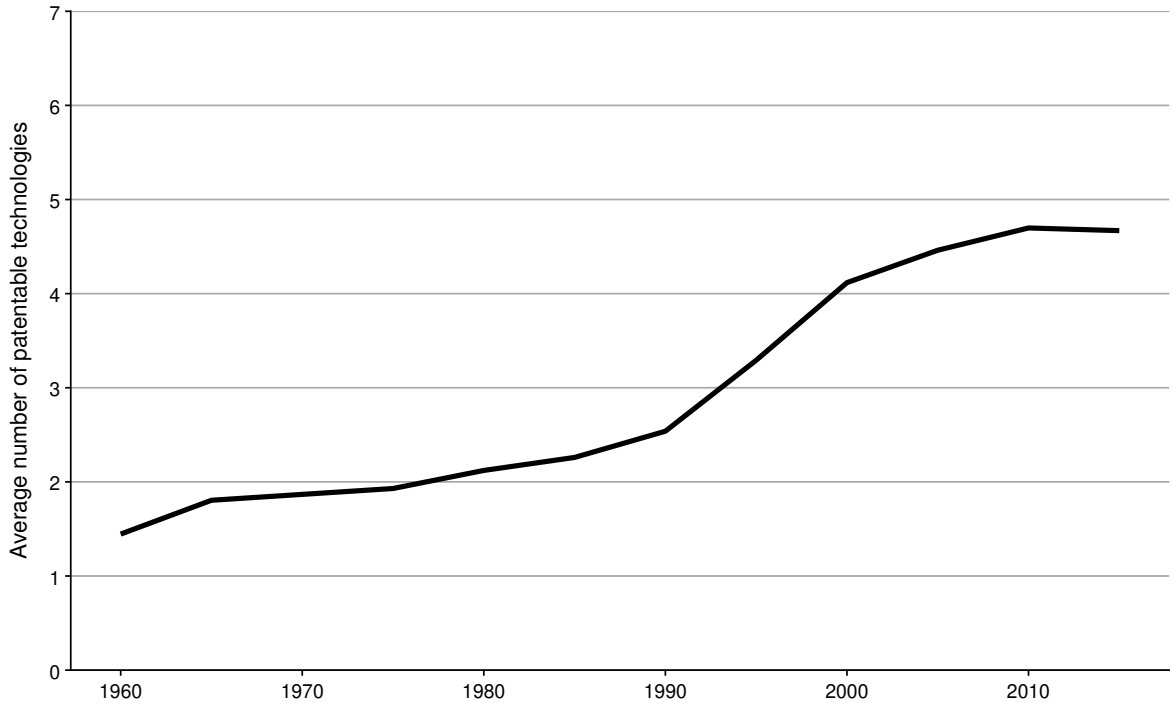


Fig. 2 Coverage of patentable technologies, 1960-2015
Source: The data are from Park 2021 ("coverage" category).

The third category of the patent rights index captures whether governments made particularly stringent enforcement mechanisms available to patent owners. An example for a particularly stringent enforcement mechanism are *preliminary injunctions*; these court orders enable patent owners to prohibit the use of inventions even before formal infringement proceedings begin. Similarly stringent enforcement mechanisms are *contributory infringements* which allow patent owners to hold companies responsible for infringements of third parties, and *burden-of-proof reversals*, which force firms accused of patent infringement to show that they have not infringed third party patent rights. If a given country made all of these particularly stringent mechanisms available to patent owners, it received the highest possible score. If it made only one of the three mechanisms available, it received the lowest possible score. Fig 3 demonstrates that the average country began to allow the use of at least one of these particularly stringent enforcement mechanisms.

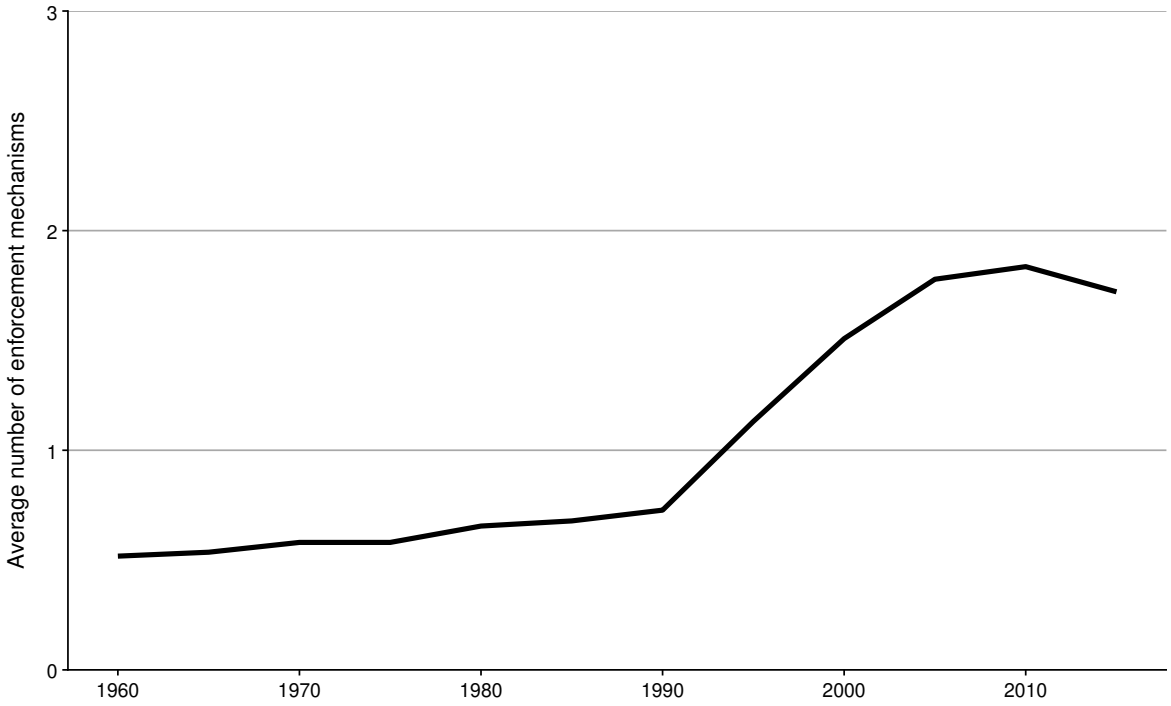


Fig. 3 Patent enforcement mechanisms, 1960-2015

Source: The data are from Park 2021 ("enforcement" category).

The fourth category of the patent rights index looks whether restrictions on patent rights that countries used to have on their books were removed or never introduced in the first place. According to Park and colleagues there are three possible restrictions on patent rights:

1. **working requirements** obliging patent owners to use inventions
2. **compulsory licensing** forcing patent owners to open up inventions to third-party use
3. **revocation**, i.e. the possibility to revoke patents in the case of non-working

In general, the patent rights index assigns higher scores to countries which have fewer patent rights restrictions on their books. This means that a country which lost all three restrictions just mentioned received the highest possible score, while a country with all three restrictions still in place received the lowest possible score. Fig 4 shows that the average country lost or never introduced at least one major restriction on patent rights. It is also possible to see that this loss happened quite recently when many poorer countries had to implement TRIPS and TRIPS+.

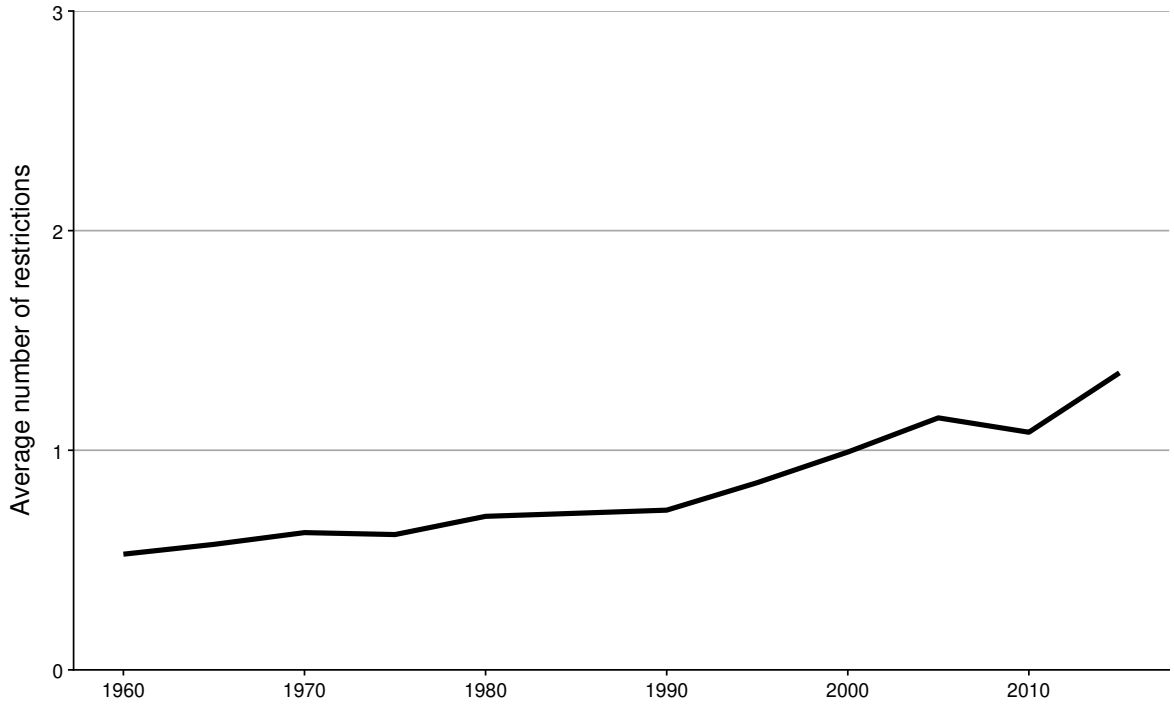


Fig. 4 Loss of patent rights restrictions, 1960-2015

Source: The data comes from Park 2021 ("loss of rights" category).

The fifth category of the patent rights index concerns the maximal length over which a patent can be maintained in a country. No patent can be maintained forever, yet countries differ in how many years they allow patent rights to be enforced. In order to determine whether the patent term in a given country is long or short, Park and colleagues compared the number of available years to the "appropriate maximal term of protection". This term differed between countries that set the starting date of the patent term from the date of application (20 years) and countries that set the starting date of the patent term from the date of grant (17 years). If a country set the starting date from the date of application, and allowed patent owners 20 years or more of protection, it received the highest possible value 1. If a country allowed patent owners only 15 years of protection, but could have allowed 20 years, it received a score of 0.75 (15 years/20 years). Fig 1.5 reveals that the patent term in the average country moved closer and closer to the maximum term. This implies that patents were generally used longer to generate monopoly profits.

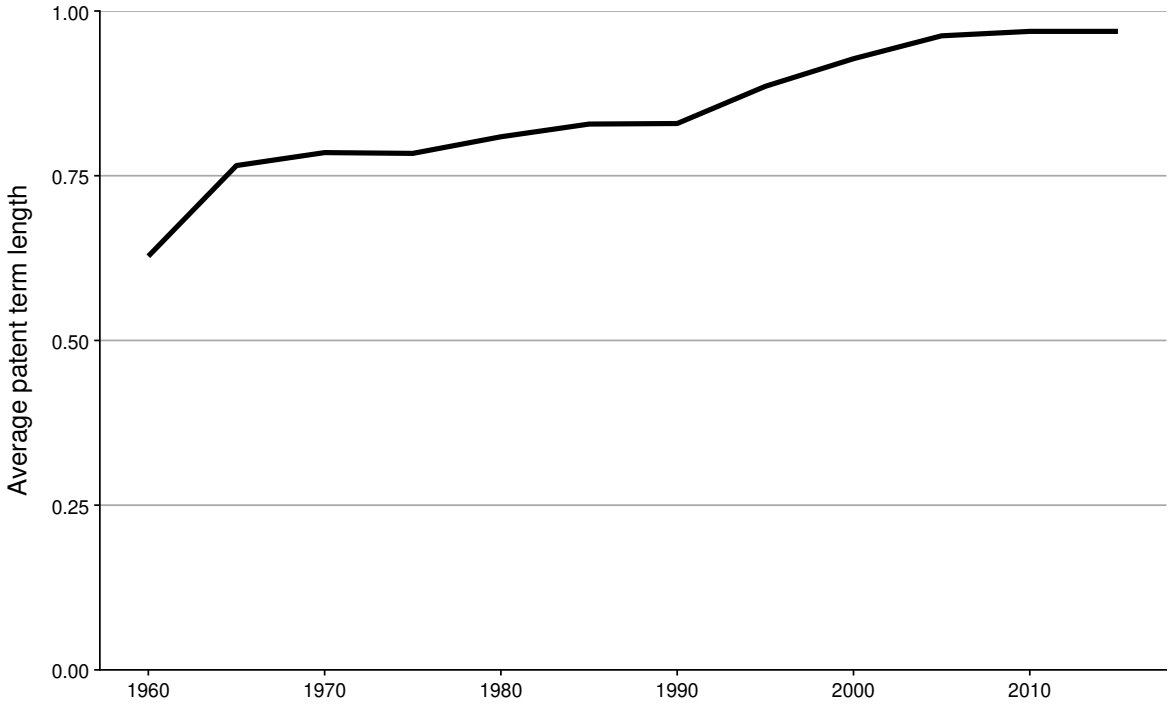


Fig. 5 Patent term length, 1960-2015

Source: The data comes from Park 2021 ("duration" category).

To ultimately calculate the patent rights index, Park and colleagues summed up the values countries received in all five categories. This means that a country with the highest possible index score became 1) a member of all agreements, made 2) all technologies patentable, introduced 3) all enforcement mechanisms, removed 4) all restrictions, and granted 5) protection for the maximum term. A country with the lowest possible score, by contrast, either never strengthened its patent laws, or never established a patent system to begin with. Yet, as figure 6 shows, no country in the patent rights index still received the lowest possible score in 2015. Even countries at the lower end of the figure, ordered from maximum to minimum strength, were assigned values above zero. The sudden darkening of tiles in the 1980s indicates that patent strength first abruptly increased in the United States and Europe, and then since the 1990s, increased in most countries included in the patent rights index.

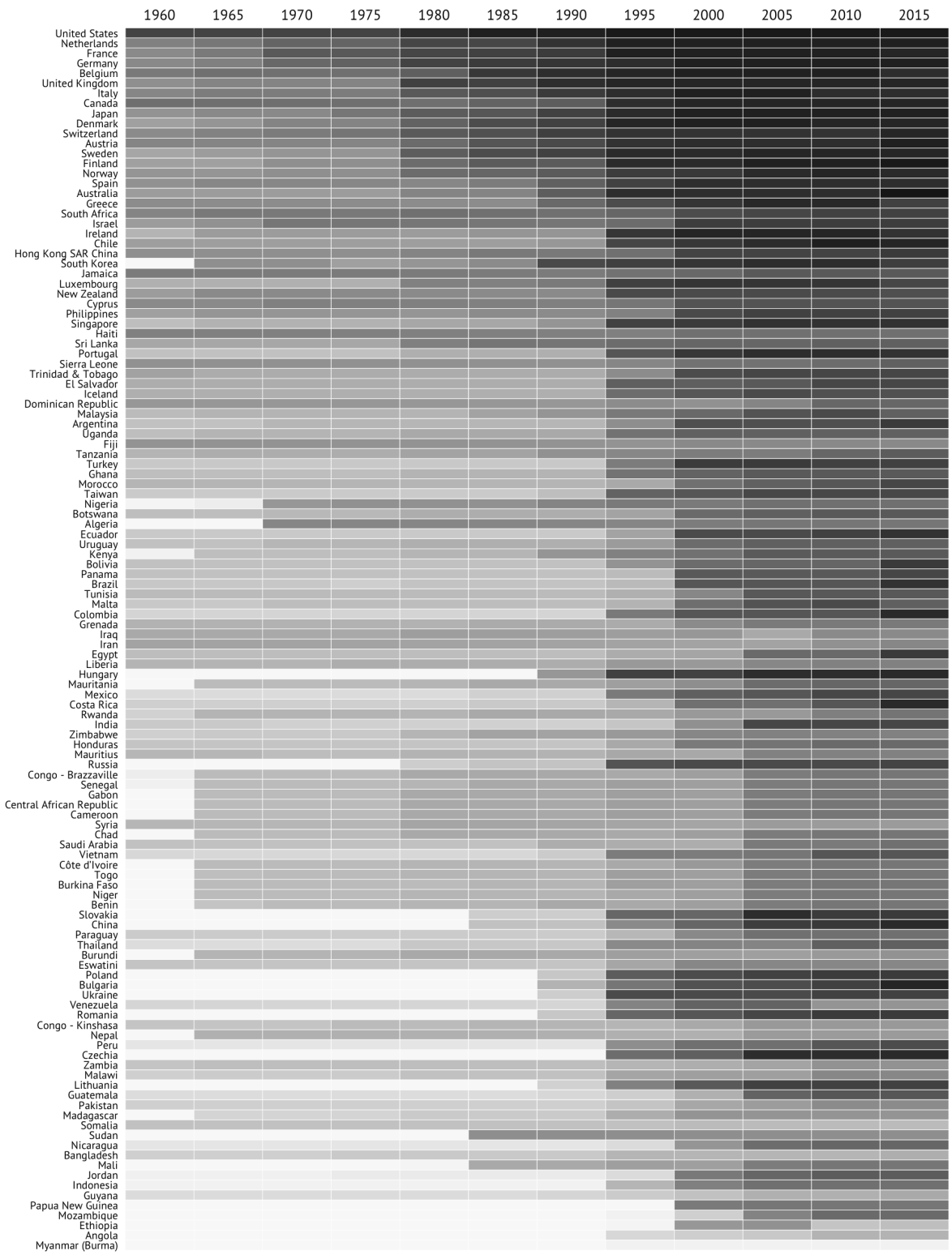


Fig. 6 Patent Rights Index, 1960-2015

Source: The data is ranked according to protection strength (United States = highest level of protection; Myanmar (Burma) = lowest level of protection. It comes from Park 2021 ("overall" category).

It is surely possible to criticize and improve the patent rights index constructed by Park and colleagues by, for instance, relying on different aggregation techniques or more finegrained country assessments. The index remains, however, one of the few useful and reliable tools for economists and social scientists to study long-term changes in patent rights in a substantial number of countries. Unlike detailed case studies, it leaves no doubt whether statutory patent rights have been strengthened in many countries of the world. And it allows us to reject a few simplifying narratives right out of the gate: it is, for instance, clearly not the case that high and low income countries always had statutory patent rights that were as strong as today. Moreover, both high and low income countries used to have restrictions on patent rights that disappeared over time. The overall index demonstrates that there is a long-lasting upwards trend towards the strengthening of patent rights in high, middle, and low income countries.

My main goal in this dissertation is to develop a better explanation for the adoption of stronger statutory patent rights. I explicitly emphasize that I only seek to explain statutory changes better because some researchers claim, in my opinion prematurely, that they can shed light on patent rights enforcement as well. I am rather sceptical with respect to such claims given that even the most basic, quasi-mechanical effects of statutory changes in patent law are not particularly well understood. For instance, quite a few researchers have failed to recognize that seeming declines in patent applications in European countries have very little to do with specific patent rights changes - and all to do with a general shift of patent law-making from the national to the European level (see Hall and Helmers 2019). This example alone suggests that statutory shifts need to be understood much better before it makes sense to study enforcement in greater detail.

In the next section of this introduction, I introduce key economic and social scientific explanations for the adoption of stronger statutory patent rights. While none of these explanations can simply be rejected out of hand, it will become clear that explanations for the disappearance of cultural and institutional barriers are missing. It will be the burden of this dissertation to not only provide evidence that the ability to overcome cultural and institutional barriers influenced the adoption of stronger patents rights but also to explain this ability with the built-up of legal-technical expertise.

The Political Economy of Patent Rights

Independent Decision-Making and Economic Determinants

Efforts to explain the adoption of stronger patent rights are not as frequent as one might think. Economists typically treat patent strength as "exogenous policy choice" and go on to study the effects of patent rights on innovation, investment, and technology transfers. There is, however, a smaller literature on the "political economy of patent rights" that also looks at the economic determinants of patent rights policies in different countries [3]. To be more precise, scholars like Keith Maskus and Walter Park argue that governments independently assess the costs of stronger patent rights and weigh them against the welfare-maximizing benefits of strengthening efforts (Ginarte and Park 1997; Maskus and Penubarti 1995). The potential benefits ascribed to stronger patent rights are the creation of stronger incentives for innovation, and access to more and better goods. Conversely, the potential costs associated with stronger patent rights are higher prices for consumers who can temporarily only choose between medicines and other patented goods from companies that have already innovated.

In particular, countries with limited innovation capacity that depend heavily on patentable medicines and other essential technologies are assumed to independently arrive at a welfare analysis that tells them to favor either *weak* patent rights, or *no* patent rights at all. The overall results of this welfare analysis purportedly change, however, when the income of a given country grows and its innovation capacity increases. Park and Maskus agree that countries with increasing innovation capacity develop an interest in stronger patent rights. This argument is consistent with historical research on the rise and ultimate success of pro-patent movements in countries like the United Kingdom, Germany and the Netherlands (see Schiff 1971; Seckelmann 2006). And it is further, at least partially, consistent with empirical research by Park, Maskus and collaborators that finds a positive influence of innovation capacity on patent strength (Ginarte and Park 1997; Maskus 2000; Park 2008).

Of course, any explanation that focuses on the importance of increasing income and innovation capacity has difficulties to account for the adoption of stronger patent rights by countries with low income and weak innovation capacity. Maskus and Penubarti (1995), who in an early study found evidence for precisely this tendency, argue that the relationship between income and patent strength is not simply linear, but U-shaped. The reason why countries with low income and weak innovation capacity adopt stronger patent rights could be, according to the authors, that there is an interest in just "getting goods" in low income countries and practically no resistance by domestic companies against stronger patent rights.

[3] Keith Maskus (2019) explains in more detail how explicit research on patent rights fits into overall economic research on patents and innovation.

If this explanation is correct, then the resistance of middle income countries against stronger patent rights could be explained with the emergence of larger domestic companies. High income countries could, by contrast, be supportive of stronger patent rights because of "transnational expansion plans" of formerly domestically-oriented companies.

Taken together, the political economy literature expects a straigthforward effect of innovation capacity on patent rights strength, and a more ambiguous effect of income. This mixed view is informed by a number of empirical studies with divergent results. Ginarte and Park (1997), for instance, claim to have found positive and significant effects of innovation capacity, market freedom, and political rights on patent strength. At the same time, they were unable to detect a significant effect of income on patent rights strength. This is to some extent challenged by Maskus (2000: 107-109) who claims to have reproduced the U-shaped result of his earlier study by relying on Ginarte and Park's index. After adding a quadratic term for income to account for a non-linear trend, Maskus claims to have found a significant positive effect of income on patent rights strength. In a more recent study, Yongmin Chen and Thitima Puttitanun (2005: 486-488) similarly report a positive effect of income squared on patent strength after controlling for a country's involvement in international trade and its membership in the World Trade Organization (WTO).

External Coercion and International Agreements

The perceived need to take into account a country's WTO membership illustrates that economists have recently become more sceptical of explanations of patent strength that focus solely on independent welfare-maximizing decisions. In a review of the economic literature on patent protection and development, Maskus (2019: 660) acknowledges that "countries may not be fully free to select their desired IPRs regimes, even where governments are welfare maximizers, in a world of open trade and investment."

This is essentially what political scientists and law-and-political-economy (LPE) scholars have argued for decades[4]. From their perspective, high income countries have used their inherent leverage in trade negotiations to coerce middle and low income countries into becoming members of international patent agreements. TRIPS, in particular, required new member countries to grant patents in more fields of technology, as well as to remove statutory limits on patent rights. Middle and low income countries were effectively forced to choose between stronger patent rights or tariff-free access to markets via multilateral and bilateral trade agreements (see Athreye et al. 2020).

[4]On the extension of patent rights in low and middle income countries see, among others, Braithwaite and Drahos (2000), Drahos (1995), May (2000), Sell (2003), Shadlen (2005), Shadlen et al. (2020).

According to a growing interdisciplinary consensus, external coercion played a pivotal role in strengthening patent rights. Scholarly debates nowadays appear less and less interested in the question whether external coercion mattered at all, and more interested in the question how quantitatively important WTO membership and bilateral trade agreements were for the adoption of stronger patent rights (see Allred and Park 2007; Chen and Puttitanun 2005). In addition, there is an extensive literature on the politics of patent protection, discussing for instance conflicts between multinational companies and subsistence farmers, AIDS activists, genomic scientists, and free-software programmers[5].

Abstract economic models by scholars like Suzanne Scotchmer (2004), and Gene Grossman and Edwin Lai (2004), are still helpful for this literature because they show, using the techniques of mainstream economics, that countries with high income and innovation capacity have clear material interests in high patent protection, but no plausible *welfare economic arguments* that could help them to advance these interests without external coercion. In other words, some kind of "norm substitution"[6] within the World Intellectual Property Organization (WIPO), the most central international organization in the patent world, would likely have been difficult to achieve. From high income countries' point of view, formal-institutional change had to be hammered out between states. To achieve this, WIPO seemed to be the wrong forum, however: low and middle income countries could routinely use their majority in this UN organization to block harmonization initiatives that seemed to harm their position as technology importers (Braithwaite and Drahos 2000; Sell 2003).

What rich countries, under the influence of multinational companies, tried instead was to shift the forum of international patent law-making from WIPO to the WTO. Peter Drahos (1995) shows that large chemical and pharmaceutical companies that had early on independently lobbied their respective governments for stronger patent rights, were able to set aside their differences, and jointly campaigned for the inclusion of international patent agreements in the Uruguay Round of Multilateral Trade Negotiations. TRIPS, one of they key outcomes of these negotiations, was at the end indeed hammered between states, but only because multinational companies had recognized the limitations of "norm substitution" and had convinced high income countries to link patent protection, as well as IP protection in general, to trade agreements (see Braithwaite and Drahos 2000; Sell 2003).

In general, then, the strengthening of patent rights is explained by either independent decisions of countries with high income and/or innovation capacity, or by external coercion of countries with low income and innovation capacity in the course of trade negotiations.

[5] See, among others, the work by Deere (2008), Eimer and Lütz (2010), Haunss and Shadlen (2009), Kapczynski (2008), Sell and Prakash (2004).

[6] The notion of norm substitution was introduced by Alexander Kentikelenis and Sarah Babb (2019: 1726) and refers to "the shifting of routine expectations about the appropriateness of particular practices".

Apart from these two main lines of argumentation, that are sometimes integrated into more nuanced explanations of patent rights strength (see Shadlen 2017), there is a lot of uncertainty about how factors like income, innovation capacity, and membership in trade agreements really were for the adoption of stronger patent rights. If one reads only studies by economists it is easy to get the impression that mainly economic determinants of patent strength matter, whereas if one reads only studies by political scientists and LPE scholars it becomes natural to see stronger patent rights solely as outcomes of power politics[7].

Unfortunately, there is a strong tendency in both lines of argumentation to underemphasize how states dealt with differences in languages and classification. This is the case even though early studies explicitly stressed that economic determinants alone cannot account for low levels of patent protection. Park and Ginarte (1997: 291), for example, were very clear that in Japan "cultural and structural aspects work together to make it difficult for non-Japanese firms to obtain effective patent protection“. Similar concerns about non-economic determinants of patent rights strength appear in Josh Lerner's (2002) highly cited study of patent rights changes in 60 countries over 150 years. He explicitly describes the "costs associated with administrating these rights" (Lerner 2002: 221) as essential barrier to stronger patent rights.

Neither Park and Ginarte, nor Lerner, however, explain why language and classification differences that made it difficult to obtain strong patent rights in Japan and elsewhere suddenly disappeared; they further provide no explanation how administrative costs that were hard to bear for states that had maintained patent offices for a hundred years or more could abruptly be incurred by some of the poorest countries in the world. Moreover, while political scientists and LPE scholars explain how low income countries were ultimately forced to adopt stronger rights, they offer no framework that would enable us to make sense of the end game of multinational companies in these countries. If one assumes that multinational companies' activities are mainly driven by profit, it is not clear how stronger patent rights could be converted into profits under conditions in which the acquisition of patents remained associated with, as WIPO government director Klaus Pfanner (1969: 334) put it, "gigantic and uneconomic duplication of work". How could multinational companies avoid to prepare applications for the same inventions again and again, working with different languages and classification systems?

In the next section of this introduction I give an overview of the argument I will develop in this work. I will set out a more detailed theoretical framework in chapter 2.

[7] I will later show that a more nuanced conceptualization of power, namely Michael Mann's (1993; 2008) concept "infrastructural power" is helpful to explain the adoption of stronger patent rights under conditions of limited cultural and institutional harmonization. What follows can largely be seen as microfoundation of infrastructural power.

The Argument

Chapter 1

To understand why countries strengthen patent rights or not, I assume a legal-technical perspective. By this, I mean a perspective that explores how information specialists, devices, concepts, and arrangements, which are not part of the legal discourse, influence patent rights changes across countries. In other words, a legal-technical perspective concerns essential technical prerequisites of rights that cannot typically be found in legal texts.

Information specialists are mostly former research scientists who create representations of legal documents from different countries on behalf of attorneys in multinational companies and state agencies.

Devices are representations that contain translated summaries of and links to legal documents from different countries. Both abstracts and indexes can be seen as devices.

Concepts are principles according to which representations of legal documents from different countries, i.e. devices, are created.

Arrangements are technical standards on which information specialists in multinational companies and state agencies agree in order to be able to prepare abstract collections, as well as indexing systems.

Chapter 2 will define legal-technical expertise in more detail and how its buildup influences patent rights changes. Chapter 3 and 4 will describe why legal-technical expertise became important at all for patent rights changes and where it was first developed.

Chapter 2

The fact that even high income countries granted weaker patent rights in the postwar years is often explained by the prevalence of an anti-patent attitude among economists and judges. This attitude indeed existed, yet it neither had the influence often claimed nor did it concern patents per se: judges, in particular, were mainly opposed to the way patent examination was socially organized.

Reports by legal scholars that concern the development of patent rights in the postwar years frequently fail to mention that some of the largest national patent offices, such as the United States Patent Office and the German Patent Office (GDPO), were severely overwhelmed by the sheer number of patent applications they received. The high numbers of applications produced not only rejections of applications on an unprecedented scale but also numerous attempts to invalidate already granted patents in the court system, which was what really bothered judges.

All of this still might have been acceptable, had the patent applications boom of the postwar years just followed, as it is sometimes argued, an inventions boom. Yet, there are very few signs that such an inventions boom actually existed. It is much more likely that the number of patent applications increased dramatically because multinational companies benefiting from the Marshall Plan began to file applications for the same inventions in more countries. To put it differently: the postwar patent applications boom was most likely the result of U.S. or German companies entering or reentering markets, not of an inventions boom.

An important strategy in dealing with masses of patent applications was, according to prominent information scientists, the development of new legal-technical devices and concepts. But respective projects by patent offices on the national level mostly failed. Similar projects on the transnational levels, which required the cooperation of different national patent offices, were somewhat more successful, yet also made little difference. Ultimately, patent offices were forced to repeatedly increase the number of patent examiners only to keep the examination system running.

Apart from legal-technical efforts to overcome synchronized patent office crises in the postwar years, governments also relied on the introduction of deferred examination. The introduction of deferred examination, in essence, meant that companies were allowed to file applications in order to get a priority date, but the applications were not actually examined for a while. The assumption behind this was that many companies would eventually withdraw their applications after market conditions had changed, and would thus save patent offices examination time. And, indeed, over the short term, deferred examination really reduced the examination burden of national patents offices. However, by publishing many more, often quite speculative patent applications, patent offices incidentally also increased the pool of prior art, which made examination over the medium and long term more instead of less difficult.

Even high income governments avoided to substantially strengthen patent rights under these conditions. Given that their patent offices had severe difficulties to examine the patent applications by foreign companies adequately, they had little interest in increasing the enforceability of patents that referenced documents in foreign languages. The attractiveness of strong patent rights in the postwar years cannot be taken for granted as much as legal scholars assume.

Chapter 3

The dramatic growth of patent applications worried not only government patent offices but also multinational companies. Former research scientists were especially worried: They had

begun to prepare uniform representations of patent documents for attorneys and scientists in multinational pharmaceutical and chemical companies. Now, they feared that they would soon be unable to abstract and index patent applications in ever more languages and classifications.

To avoid the loss of a just recently claimed task area in multinational companies, these former research scientists, who began to call themselves information specialists, began to work together across national and corporate boundaries. Notably in Europe, information specialists in the employment of pharmaceutical and chemical companies located in Germany, France, the Netherlands, the United Kingdom, and a number of other countries joined forces. They essentially established a division of labor that required German information specialists to abstract and index relevant patent documents that first appeared in German, French information specialists to abstract and index relevant patents documents that first appeared in French, and so on. They even founded their own organization for precisely that purpose: the so-called Patent Documentation Group (PDG).

While a series of legal-technical projects by national patent offices failed, information specialists cooperating in the PDG and similar groups developed new devices and concepts to reorganize and synthesize patent documents. What they were lacking, however, was economies of scale in the abstracting and indexing of patent documents. Despite initial successes, this seemed necessary to information specialists as the adoption of deferred examination by several offices further intensified the already dramatic growth of patent applications.

Largely because of the growth of patent applications, but also because everyday cooperation across national and corporate boundaries became strenuous, information specialists decided to transfer accumulated abstracts and indexes to commercial intermediaries, such as Derwent. These commerical intermediaries were subsequently not exactly left alone by information specialists, but both closely supported by the help of costly subscriptions, and closely controlled by the help of regularly working group meetings. By keeping commercial intermediaries at close distance, information specialists assured that abstracts and indexes were prepared according their conceptual specifications.

An important side-effect of propping up commercial intermediaries was that patent offices and international organizations were suddenly put into a position to access abstracts and indexes. This allowed patent offices and international organizations to catch up in the pharmaceutical and chemical field even if they had made only very limited progress in their own legal-technical projects. Practically out of nowhere, it became reasonable to put initiatives for the harmonization and strengthening of patent rights on the legislative agenda.

Chapter 4

The most important international organization with respect to patent matters, the United International Bureaux for Protection of Intellectual Property (BIRPI), had early on begun to prepare legal harmonization initiatives with the help of a number of legal-technical projects. Yet since these projects mostly failed, substantial legal harmonization initiatives remained stuck along with them.

In principle the success of legal-technical projects would not have been essential for legal harmonization, had government representatives been able to agree on a global patent system. Such a system could simply have replaced patent documents in different languages and different classification systems with a single uniform global patent document and a global patent classification system. Yet opposition against a global patent system came from a perhaps unexpected corner: patent attorneys in private practice feared to lose their lucrative cross-national patenting business whereas national patent offices feared to lose fees associated with cross-national patent activities. Both opponents of a global patent system remained, however, open towards limited, cross-national harmonization on the basis of legal-technical expertise.

For that reason, BIRPI only considered it promising to put new initiatives for legal harmonization on the legislative agenda once the successes of commercial intermediaries indicated that the administrative crises of patent offices were likely a thing of the past. Despite a lack of successful public legal-technical projects, BIRPI and USPTO officials began to work on a proposal for the harmonization of national application procedures. The so-called Patent Cooperation Treaty (PCT) was signed by government representatives in 1970 even though necessary breakthroughs in legal-technical projects were merely expected but had not yet materialized. This partly explains why the PCT became only effective eight years later, in 1978.

The idea behind the PCT was basically that large patent offices, such as the USPTO and the newly founded European Patent Office (EPO), would, on the basis of newly acquired legal-technical expertise, determine the novelty and non-obviousness of patent applications on behalf of countries with smaller patent offices. These preliminary searches would then enable multinational companies to export patents that were already considered novel and non-obvious by the USPTO or EPO to countries with smaller patent offices. Since they later would, under the PCT, no longer conduct their own searches, they would also not independently reject the patent applications in question.

Generally speaking, this meant that important legal initiatives, such as the PCT, were put on the legislative agenda because large patent offices and BIRPI gained access to private

legal-technical expertise and expected to soon also gain access to public legal-technical expertise.

Chapter 5

During the 1970s, information specialists aimed to facilitate a strict division of labor between the intermediaries they supported, such as Derwent, and new intermediaries that patent offices and BIRPI established. While Derwent, for instance, continued to supply multinational companies with abstracts and indexes, the EPO and BIRPI setup a government corporation that began to offer bibliographical and legal status data. The fact that the new government corporation offered complementary legal-technical expertise to multinational companies and patent offices was partly due to the mediating influence of information specialists: they vehemently opposed the buildup of more sophisticated legal-technical expertise by patent offices and BIRPI.

As industry-supported and patent office-supported intermediaries began to cover more and more countries, as well as fields of technology, long planned legal initiatives, such as the PCT and the European Patent Convention (EPC), suddenly looked implementable. Both multinational companies and patent offices gained access to enough legal-technical expertise to deal with language and classification differences with much less disruption. In the absence of a truly global patent system, the PCT became, as BIRPI officials like to emphasize, a surprisingly successful second best option.

Chapter 6

Up to this point in the dissertation, my goal has been to show that the buildup of legal-technical expertise mattered for the expected implementability of initiatives for stronger patent protection. Yet, it is clear that initiatives, like the PCT and the EPC, could also influence the further buildup of legal-technical expertise once they were implemented. To be more precise, the implementation of the PCT, for instance, meant that new international patent documents were published that could be used by intermediaries to cover patent positions in PCT member countries more effortlessly. To some extent, intermediaries could even cover international patent documents instead of national patent documents.

It would be wrong, however, to assume that the mere possibility of relying on international patent documents would actually have enabled intermediaries to use international patent documents in everyday practice. What I will show in chapter 6 is that information specialists successfully lobbied for greater access to international patent documents on behalf of intermediaries. In other words: without interventions by information specialists, there

would only have been a causal arrow from legal-technical expertise to patent rights protection, but no causal arrow from patent rights protection to legal-technical expertise.

The presence of such an arrow makes it more difficult, yet not impossible to statistically determine whether there actually is a causal effect of legal-technical expertise on patent rights strength. My approach is to compare the patent rights strength of countries which were covered by intermediaries in a given period with the patent rights strength of countries that were not covered by intermediaries in the same period. Such a comparison can only be interpreted causally if the countries included in the comparison are as similar as possible before some countries were covered while others were not. To ensure that this is the case I make use of matching methods, a set of machine learning techniques.

Using matching methods essentially means to construct matched sets of treated (covered) countries to which control (uncovered) countries can be compared. For the construction of my matched sets, I rely on the same basic control variables that are used in the economic and political science literature (see section . . .). Since I myself have shown that patent protection can also reversely influence legal-technical expertise, I also include lagged versions of patent protection in the matching procedure. Finally, I compare covered and uncovered, matched countries with the help of differences-in-differences (DiD) regressions.

The final results suggest that coverage indeed had a positive causal effect on patent protection. Given a wide confidence interval, however, the question remains how legal-technical expertise could continue to influence patent rights strength even after enormous patent office digitalization and automation projects in the 1980s and 1990s. Moreover, it is not obvious how a potentially strong effect of legal-technical expertise on patent rights strength can be squared with legal and social-scientific theorizing about corporate patent practice. I tackle these two questions in chapters 7 and 8, respectively.

Chapter 7

If economic studies concern themselves with the handling of patent documents at all, they mostly point to enormous patent office digitization and automation projects in the 1980s and 1990s. The sheer size of these projects raises justified doubts whether commercial intermediaries really played a continually important role in strengthening patent rights.

What is often overlooked, however, is that information specialists on the national level, just like on the transnational level, sheltered commercial intermediaries against potentially negative effects of patent office projects. In particular, the United States Patent Office (USPTO) and the German Patent Office (GDPO) showed no ambitions to commodify the activities with which commercial intermediaries made their money. On the contrary: they made vast amounts of digitized patent documents available to commercial intermediaries

at cost price. In the Western world, only the European Patent Office (EPO) took initially a somewhat more confrontative stance, yet soon also reverted to the role of raw information supplier.

Arguably because digitized patent documents from East Asian countries remained more difficult to get and patent offices there did become engaged in abstracting and indexing activities, partly explains why it took longer until multinational companies based in the U.S. and Europe could acquire access to legal-technical expertise from Japan, South Korea, Taiwan, and China. Here, once again, information specialists were important in brokering access.

Wherever patent documents or utility model documents still remain more difficult to acquire than technically necessary, such as in China, patent protection can mostly also be kept on a lower level. It does not seem to matter that China has relatively high income levels, high innovation capacity, and is deeply embedded in the WTO trade system.

Chapter 8

In the last substantive chapter, I seek to answer the question why legal-technical expertise is mostly neglected in existing studies of patent rights changes. I am especially concerned with the argument that patent rights changes which are not hammered out between states must be traced back to the sophistication of lawyers and the malleability of law.

My criticism of this argument is that it underestimates the relevance of legal-technical expertise because the latter is mainly assembled outside multi-national conglomerates and law firms. Since a seemingly small number of information specialists often handles language and classification differences remarkably well, there is a genuine under-appreciation of the myriad of devices, concepts, and arrangements that are required to make lawyers sophisticated and the law malleable.

By focusing on the patent practice of multinational companies, such as BASF and Siemens, I seek to demonstrate that information specialists cannot only remove language and classification barriers for lawyers but also change how lawyers view where the law could move and what purposes it serves. In particular, the view that patent rights should produce immediately useable monetary assets is a view that only makes sense if information specialists help lawyers to see the patent positions of their own companies, as well as those of competitors, as cross-national patent portfolios whose monetary value can be assessed.

This suggests that lawyerly sophistication in practice often is a product of teamwork between information specialists and lawyers for which lawyers often get the most credit because they are the last link in a long chain of expert transcriptions. In many legal fields it might, in fact, also not really be necessary to inspect this chain more closely. Yet, in the

case of legal fields in which the source of change is rarely the last link in the chain, such a strategy tends to leave the main sources of legal change unstudied.

I will explain in chapter 1 why legal fields like patent law, security law, and property law are fields in which legal-technical expertise likely matters much more for legal change than in other fields.

Situating the argument

The overall argument presented in this work differs from other arguments insofar as it puts less emphasis on gradual increase in income and innovation capacity and also less emphasis on sudden initiatives to impose stronger patent rights on countries in the course of trade negotiations. Instead, I focus on legal-technical expertise that grew slowly in high income countries, yet quite suddenly made it seem possible to reorganize and synthesize patent documents from middle and lower income countries. In other words, I am interested in why cultural and institutional differences that had for a long time not been addressed by high income countries suddenly became quite easily addressable when it came to strengthening patent protection in middle and lower income countries.

This does not mean that I doubt that countries began to favor higher patent protection at a certain income and innovation threshold. Similarly, I do not doubt that company lobbying decisively contributed to the inclusion of patent protection requirements in international trade agreements. My point is, rather, that these arguments assume away language and classification differences that slowed down further rights increases even in high income countries. As language and classification differences are frequently assumed away, it is not recognized enough that more than legal initiatives were necessary to render patent rights increases in middle and lower income countries at all plausible.

While there is a growing literature on how states achieve the ability to see citizens (Scott 2020), or companies achieve the ability to see customers (Fourcade and Healy 2017), there is arguably not enough research on how states are able to see rights granted by other states, and how multinational companies are able to see these rights as well. The argument presented here implies that the ability of state patent offices to see patent positions granted by other state offices matters a great deal for legal outcomes. It also implies that this ability can critically depend on corporate information specialists and commercial intermediaries if they are able to develop legal-technical expertise first.

In this dissertation I intend to show how a sociological focus on legal-technical expertise can be helpful to explain why initially important cultural and institutional differences can be overcome by both multinational companies and state agencies. In contrast to parts of the

literature on transnational law-making that focuses mainly on lawyers, I emphasize that the sophistication of lawyers can often be a product of teamwork; the malleability of law can, in turn, be heavily dependent on widely available legal-technical expertise.

Chapter 1

Legal-Technical Expertise and Transnational Patent Rights

1.1 Defining Legal-Technical Expertise

Rather than neglect language and classification differences, I suggest to study the conditions under which multinational companies were able to strengthen patent rights in the absence of a global patent system. To this end, I introduce only one theoretical concept that is currently not used in the social-scientific literature on transnational law-making[1]; it concerns what I will call legal-technical expertise. By this, I mean a network of information specialists, devices, concepts, and arrangements that addresses cultural and institutional differences for companies and agencies (see Cambrosio et al. 1992; Eyal 2013). In what follows I will explore each major element of this definition in detail.

Information specialists

Information specialists are mostly former scientists who create representations of legal positions in different countries for companies and government agencies. The fact that information specialists create representations for corporate lawyers and government officials who are frequently overwhelmed by the amount of legal documents is widely known in the sociological literature on professions and expertise (see Abbott 1988, chap. 8). What is less widely known is that information specialists also develop representations of legal documents

[1] Following Marie-Laure Djelic and Sigrid Quack (2018: 124), I define transnational law-making "as the setting, application, and enforcement of rules with a cross-national or global scope" (see also Djelic and Quack 2003; Djelic and Sahlin-Andersson 2006).

in other countries on behalf of lawyers and government officials. In the literature, the efforts of information specialists are mostly limited to legal documents from a specific country.

The problem with legal documents from different countries is, of course, that information specialists are confronted with legal documents in languages they do not necessarily speak, along with legal documents that are classified according to systems with which they are not necessarily familiar. One possible strategy to deal with these challenges is to team up with information specialists who speak the respective languages and who are familiar with the classification systems in question.

Assuming information specialists can successfully team up across national and organizational boundaries, they might be able to collectively reconstruct existing representations and concepts (Djelic and Quack 2018; Quack 2007). It is, for instance, conceivable that cooperating information specialists succeed in replacing incommensurable classification systems with a single uniform indexing system (Espeland and Stevens 1998). And it is, moreover, also conceivable that cooperating information specialists develop techniques to translate and abstract legal documents in ways that allow corporate lawyers and government officials to make sense of underlying legal relations without reading masses of diverse legal documents (Kellogg 2014).

But why would information specialists cooperate in the first place? Why would they not just develop abstracts and indexes for specific companies or government agencies? I argue that information specialists in different countries and organizations are more likely to work together if they face the loss of abstracting and indexing tasks when they continue to work on their own (Eyal 2013). In essence, information specialists might join forces if lawyers and government officials in their respective organizations become similarly impatient with abstracting and indexing work in general. A more widely felt inability to address language and classification differences within budgetary restraints might motivate inter-organizational and transnational cooperation (Ingram and Yue 2008; Sytch et al. 2012).

If transnational cooperation projects can be initiated under such conditions, they are likely to be successful, given the potential for collective reconstruction outlined above. Cooperation projects might not only be helpful to reduce costs through joint abstracting and indexing but also through coordinated support for commercial intermediaries. The sociological literature on professions and expertise suggests that information specialists often provide lawyers with growing amounts of abstracts and indexes through close ties to commercial intermediaries (Abbott 1988, 1998). The latter might also be able to cover more countries if they are assured the continuous support of information specialists and their companies.

Devices

Devices are uniform representations of legal positions in different countries. Both longer, not-mainly scientific abstracts and indexes are seen as devices in this dissertation. Much like information specialists, devices are not unknown in the sociological literature on professions and expertise either. It can only seem so because the term used varies frequently: what I call devices is sometimes also called objects, tools or artifacts (Barley 1986; Bechky 2003; Callon 2021; Eva Hemmungs Wirtén 2019).

What is known from the literature is that information specialists create devices, such as abstracts and indexes, in order to make legal documents more understandable for scientists and more manageable for lawyers (see Abbott 1988, chap. 8). To some extent, abstracts and indexes created by information specialists can be helpful to overcome professional boundaries between scientists and attorneys within large organizations that are still maintained outside (Kellogg 2014). A good patent abstract, for instance, strips away the legal jargon that permeates official patent documents.

With respect to devices I am not aware of literature that concerns the development of transnationally uniform devices. Yet it is quite clear that devices that represent legal documents from different countries exist. Figure 1.1, for example, shows a stylized patent abstract on the right that uniformly represents the 11 official patent documents listed on the left. As one can see, the documents listed on the left side were drafted in different languages and were partly also classified according to different systems.

A roughly similar example can be found in the world of finance where, since the financial crisis of 2007-2008, "legal entity identifiers" have been developed to uniformly identify participants in financial transactions (see Financial Stability Board 2012; GLEIF 2021). This had previously been difficult due to differences between national code systems and had led to misjudgments of multinational companies' risk exposure, as well as to misjudgments of risk across the market.

Finally, if I use the term devices in this dissertation, I refer not only to single documents that uniformly represent different legal positions but also to entire abstracts collections, and even interactive entries in online databases. I basically use the term to cover a whole number of material representations that can be used as understandable representations of legal positions (see Carruthers and Stinchcombe 1999; Stinchcombe 2001)..

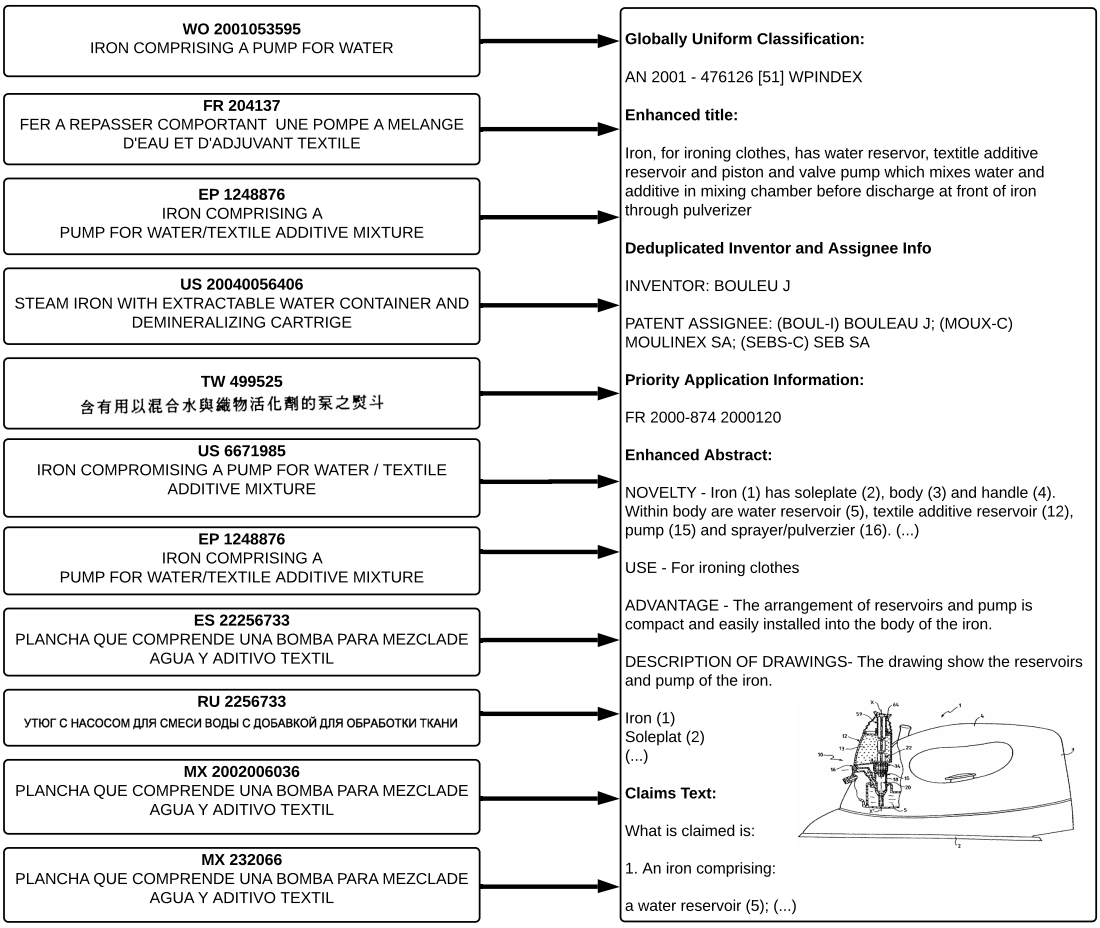


Fig. 1.1 The Process of Constructing a Patent Abstract

Source: Stylized depiction of a patent abstract based on Michel 2014, 18-19.

Concepts

Concepts are conventions according to which representations of legal positions in different countries are created. For instance, a key convention in the preparation of a patent abstract is that patent documents from different countries that refer to the same basic invention are grouped together as a so-called patent family (see EPO 2021). Patent abstracts that contain references to sets of equivalent patent documents act essentially like guides to individual patent families.

The patent family concept is, as I will show, an extremely important concept for the organization of patent documents through commercial intermediaries and patent offices. Yet, it is barely ever mentioned in the legal literature and it is typically not at all mentioned in patent laws and treaties. The concept is, despite its unquestioned practical significance, not a part of the legal discourse and can arguably be best understood as a legal-technical concept.

Sociologists of science who have studied how patent offices introduce new patent classes have found that legal-technical concepts, like the patent family concept, matter for patent offices far more in this process than aspects of the broader scientific and legal discourse (Kang 2012). While they criticize that patent office conventions are closed off to broader discourses, this is exactly my point in this work: the built-up of legal-technical expertise and its consequences are barely understood in broader societal discourses.

When I refer to legal-technical concepts in this dissertation, I mean conventions that were initially developed by information specialists but which subsequently gained significance in the representation of patent documents from different countries.

Arrangements

Arrangements are technical standards on which information specialists in companies, state agencies and international organizations agree in order to facilitate the creation of representations of legal documents. If patent offices and international organizations decided for some reason to set technical standards that would make it impossible to develop abstracts and indexes under market conditions, information specialists would no longer be able to deal with patent documents from different countries. They would become dependent on the rudimentary legal-technical expertise patent offices and international organization had to offer.

In reality, however, information specialists and intermediaries are not merely dependent on patent offices and international organizations. Rather, the latter are at least as dependent on information specialists and intermediaries as the other way around. Patent offices, in particular, require access to the devices of commercial intermediaries to examine patent docu-

ments for any larger group of countries. Not least for that reason, information specialists and commercial intermediaries find it easy to settle on favorable technical standards concerning the volume of citations in patent documents, the listing of classifications, and so on.

While technical standards appear less important at first sight, they matter in the aggregate and can influence the creation of abstracts and indexes. This explains why information specialists and commercial intermediaries continually seek to influences the activities of patent offices and international organizations. Even though arrangements between information specialists and commercial intermediaries on the one hand, and patent offices and international organizations on the other, were not important for the early buildup of legal-technical expertise, they became important when national and international patent law-making became dependent on the ability to represent legal positions in a growing number of countries.

1.2 A Legal-Technical Perspective on Law-Making

If government representatives had been able to agree on a global patent system, legal-technical expertise would likely not have played an important role in national and international patent law-making. In the absence of a global patent system, however, national and international patent laws could only be updated gradually over time. Both multinational companies and patent offices had to deal with language and classification differences on a country by country basis. Without a corresponding buildup of legal-technical expertise, patent offices would have been overwhelmed by the sheer mass of potentially relevant documents; multinational companies would subsequently have faced rejections of applications and invalidations of patents. All in all, stronger patent rights would not have made much of a difference.

Assuming this argument – that patent law-making depended on the buildup of legal-technical expertise – is correct, theories of law-making need to be extended in order to include a legal-technical perspective. Why such a perspective is not only useful but necessary with respect to some fields of law is demonstrated by Max Weber's (2010: 346) writings on legal-technical schemata; my previously introduced legal-technical expertise concepts builds on these writings. Weber uses the concept legal-technical schemata primarily for property deeds which are not merely treated as evidence that somebody is in possession of something but which also visually represent the thing that is being possessed. Such representations developed, according to Weber (2010: 348), mainly in trading relations between medieval European law-making communities, and were "particularly well-fitted for the emerging modern capitalism."

The problem with legal-technical schemata, which had their roots in the religious laws of medieval European law-making communities, was, however, that they were, because of their

usefulness, only accepted by lawyers and government officials but not developed further. Because visual (originally: magical) representations had no place in the conceptual apparatus of lawyers and community officials trained in Roman law, they became a part of legal practice but not really a part of the evolving legal discourse (Weber 2010: 348,475). In other words: legal-technical schemata became, because of their sheer usefulness, critical elements of modern national and international law-making, yet remained conceptually underdeveloped.

Weber's notion of legal-technical schemata is helpful to explain more contemporary law-making successes and failures as well: it focuses attention on the difficulties that lawyers and government officials can have to overcome cultural and institutional differences through new, self-developed legal-technical schemata. Rather specific legal-technical schemata are, as Weber emphasizes, unlikely to be developed just because economic circumstances demand their development. Instead, they have to be "invented in much the same way as commercial-technical inventions need to be invented in order to be of service to current economic interests." (Weber 2010: 344) Even more than in medieval times, inventing visual representations is typically not part of the job description of lawyers and government officials.

1.3 Information Specialists' Support for Lawyers

Not unlike Weber, I am skeptical with respect to the ability of lawyers and government officials to develop new legal-technical devices, concepts, and arrangements. Yet, I assume that lawyers and government officials are nonetheless able to push forward law-making proposals if they can count on information specialists to develop devices, concepts, and arrangements on their behalf. Both expansions of property and patent laws could have appeared plausible to regulatory audiences, like politicians and corporate executives, because information specialists were able to create new representations of land and inventions. The term information specialists is used rather indistinctly here: land surveyors are also described as information specialists for theoretical purposes.

Where exactly the ability to create legal-technical expertise comes from is difficult to determine. The most likely answer seems to be that scientific representations can serve as a cultural repertoire in much the same way as religious representations once served as a cultural repertoire (see Merton 2001; Swidler 1986). Perhaps information specialists in scientific surroundings, like chemical companies and patents offices, are more likely to find representations of legal positions than either lawyers on their own, or information specialists in less scientific surroundings. Fortunately, this question does not have to be answered in this dissertation: it is sufficient to state, based on existing research, that information

specialists in multinational companies and government agencies create devices, concepts, and arrangements for overwhelmed lawyers and government officials (Abbott 1988, 1998).

My main research question is instead to what extent information specialists have actually succeed in creating legal-technical expertise that renders cross-national legal agendas implementable. If one believes the sociological literature on international organizations, then the answer should be 'only to a very limited extent' (Alcacer and Ingramm 2013; Jandhyala and Phene 2015). According to this literature, cross-national transaction costs are mainly reduced by networks between international organizations. Multinational companies and state agencies are, by contrast, assumed to be too sparsely connected to effectively address cultural and institutional differences between countries.

This argument is intuitively plausible, yet overlooks that more localized initiatives involving multinational companies and state agencies have the under-appreciated advantage that they are under no obligation to overcome cultural and institutional differences on behalf of many member states. If information specialists start to cooperate across national and organizational boundaries, they can start small by creating devices, concepts, and arrangements for just a few countries (see Kochen 1974). From a legal perspective this might not be particularly relevant, from a legal-technical perspective, however, costs for translation, summarization, visualization, and so on, matter(see Agre 2000).

Assuming that information specialists allow multinational companies and state agencies to bundle resources, they might be able to develop legal-technical expertise that international organizations fail to develop early or ever. This clearly has the potential to raise the implementability of legal agenda, though on a more limited scale than if international organizations succeeded.

1.4 Legal-Technical Intermediaries and Transnational Law-Making

The fact that interfirm cooperation and interagency cooperation are often under-appreciated in the literature concerned with transnational law-making can partly be explained by their transitory nature. Both information specialists working for companies, and information specialists working for state agencies, tend to transfer commodifiable parts of their work to commercial intermediaries (see Abbott 1988, chap. 8). This does not have to mean that joint efforts to create legal-technical expertise end, it only means that information specialists become more focused on managing relations with intermediaries than on the day to day assembly of devices.

If information specialists can leave routine tasks in the creation of legal-technical expertise to commercial intermediaries while maintaining control over what devices will be available to lawyers and government officials, they can help the latter to push forward legal proposals. The reason for this is that commercial intermediaries should find it easier to cover more countries by avoiding the duplication inherent in efforts by individual companies and state agencies: the latter tend to recreate legal-technical expertise again and again that often already exists elsewhere (see Agre 2000; Bryan et al. 1999). In essence, commercial intermediaries only have to create more legal-technical expertise than any single interfirm cooperation and interagency project to replace these projects.

In principle, international organizations could also rationalize the creation of legal-technical expertise. Yet, they often have difficulties to get all member states on board and, even if they do, to develop legal-technical expertise for all of them at once. If information specialists and commercial intermediaries, by contrast, build legal-technical expertise early on, they can provide critical infrastructure to international organizations instead of the other way around.

What this suggests is that legal proposals by lawyers and government officials can become more acceptable because of infrastructural breakthroughs by information specialists and commercial intermediaries. Such infrastructural breakthroughs by information specialists and commercial intermediaries remain well hidden, however, because international organizations can often easily compensate for a lack of legal-technical expertise by purchasing services from commercial intermediaries. Only now scholars begin to study the consequences of dependencies on commercial intermediaries, that is, private infrastructural power, in greater detail (Braun 2020; Braun and Gabor 2019).

1.5 The Determinants of Transnational Law-Making

As I explained in the introduction, economists assume that countries accept more far-reaching increases in patent protection if their national income and innovation capacity cross a certain threshold (Ginarte and Park 1997; Maskus and Penubarti 1995). This is certainly plausible but leaves unexplained why some countries with higher income and higher innovative capacity have avoided to raise patent protection for a long time, whereas other countries with lower income and lower innovation capacity have suddenly raised patent protection quite dramatically.

According to a more political science-oriented literature, this sudden increase in patent protection in lower income countries can mostly be explained by initiatives by multinational companies and high income countries. The literature intends to show that lower income

countries had practically no other choice but to accept far-reaching increases in patent protection in the course of international trade agreements (Braithwaite and Drahos 2000; Sell 2003).

My main criticism of both explanations is that they fail to take into account cultural und institutional boundaries that prevented the adoption of stronger patent rights in both higher and lower income countries during the postwar decades. I argue that these boundaries ceased to matter as much as in the postwar decades because the buildup of uniform legal-technical expertise made it easier for multinational companies and higher income countries to campaign for stronger patent rights at home and abroad.

This argument does not imply that income and innovation capacity played no role in company and state initiatives to adopt far-reaching patent laws. What concerns me is merely the slow increase in patent protection in the U.S. and Europe during the postwar decades, as well as in Japan, South Korea, and Taiwan years after that. I argue that the ultimate increase in patent protection in a number of high income, high innovation capacity countries cannot just be explained with income and innovation disparities, but also needs to be explained with the ability of commercial intermediaries to process patent documents from these countries on behalf of multinational companies and patent offices. When the latter had full access to legal-technical expertise from countries like Japan and Taiwan, the level of patent protection in these countries increased soon after, too.

In a similar way, I do not want to suggest that countries with lower income and lower innovation capacity were not forced to adopt much stronger patent rights in the course of international trade negotiations. On the contrary: my argument supports this explanation by insisting that multinational companies and higher income countries were able to acquire a more granular understanding of patent activities in lower incomes countries with the help of legal-technical expertise supplied by commercial intermediaries. Patent positions in many lower income countries became either easier to make sense off because commercial intermediaries began to directly cover the respective countries, or because the respective countries could be covered indirectly. This was possible if they became – either voluntarily or by pressure – members in international agreements which allowed intermediaries to cover them via international documents instead of directly. Either way, I argue that the availability of legal-technical expertise put lower income countries on the map of multinational companies and high income countries and thus made the pursuit of stronger patent rights with respect to these countries more attractive.

1.6 Methodological Remarks

The main dataset I will use to study the impact of legal-technical expertise on patent rights strength is the index constructed by Park and colleagues (Ginarte and Park 1997; Park 2008, 2021). In contrast to this index, which was been used by many social scientists to study patent rights strength, my other main data source, a patent information coverage table put together by Stephen Adams (2020), has to my knowledge not been used by social scientists. To understand how I operationalize the main explanatory variable, legal-technical expertise, with this table, it is useful to know how legal documents from individual countries were turned into legal-technical expertise. In order to provide this background knowledge, the next four chapters of this dissertation present in narrative form how information specialists and patent offices in high income countries have co-constructed legal-technical expertise. Only after this exposition, I estimate the impact of legal-technical expertise on patent rights strength in a large number of countries using Adams's table.

In order to address methodological concerns related to the measurement of legal-technical expertise, and in particular concerns about endogenity, I capture the impact of legal-technical expertise with the help of matching methods. This means that I match countries whose patent documents were covered in legal-technical schemata to countries whose documents were not covered; I do this with standard matching methods that ensure that covered and uncovered countries have similar covariate values. The covariates used in the matching process are, whenever possible, the same covariates used by the economic and political science literature discussed above (Allred and Park 2007; Chen and Puttitanun 2005; Ginarte and Park 1997; Maskus and Penubarti 1995). Ultimately, the use of matching methods allows me to identify short-term and long-term average effects of legal-technical expertise on patent strength using difference-in-difference (DiD) estimators.

I rely on both quantitative methods and narratives in this dissertation to be able to relate the expansion of patent protection in a surprisingly large number of countries to legal-technical developments in just a few high income countries. If I would rely on matching and DID techniques alone, it would not be possible for me to trace the complex process behind the development and massproduction of patent abstracts and indexes. In turn, if I would rely only on narratives, it would not be possible to demonstrate that the availability of patent abstracts and indexes had a measurable impact on the adoption of stronger patent rights in multiple countries. I could merely assume that such an impact exists because international agreements could not have been widely implemented otherwise.

To construct the narratives I draw on reports and speeches which information specialists, patent lawyers, patent examiners, as well as patent office and BIRPI/WIPO officials published in journals like *World Patent Information*, *Journal of the Patent Office Society*, *Zeitschrift für*

Dokumentation, *Angewandte Chemie*, and several others. These reports and speeches provide otherwise unavailable insights into the development of legal-technical expertise from the end of World War II until more recent years. One weakspot of these sources is a lack of details about public legal-technical projects on the national and transnational level. I have gathered details about such projects drawing on USPTO files kept in the U.S. National Archives (U.S. Department of Commerce 1979; USPTO 1966), as well as on annual reports published by the European, German and Japanese patent office. To structure the wealth of available material I have conducted background interviews with leading patent lawyers, information specialists, and patent office officials in the U.S. and Europe. I have also participated in a series of professional conferences, meetings and workshops.

I describe all datasets and methods in much greater detail in the Appendix A,B, and C. Whenever I present and interpret results of analyses in the coming chapters, I stick to the minimum information necessary to transparently interpret the results. The appendices, by contrast, are written in a way that seeks to enable the replication of all quantitative results presented in this dissertation.

Chapter 2

The Postwar Administrative Crisis and Early Public Initiatives

A lot of historical studies of the rise of international patent protection begin with efforts by patent lawyers to overcome an "anti-patent attitude" within the United States. Craig Allen Nard (2020, 23), for instance, claims that U.S. district court and Supreme court judges attacked patent rights in the postwar years because they became increasingly worried about "the monopolistic and social-cost aspects of patents". These attacks by judges made it, according to Nard (2020, 23), "inevitable that members of the patent bar would take action".

Apparently, it were indeed efforts by patent lawyers that led to the passing of the 1952 U.S. Patent Act. This act was supposed to replace "patent-hostile" lack of invention requirements with a more calculable obviousness standard (see Baum 2010; Shapiro 1968). Essentially, the idea was that judges should not longer be able to uphold rejections of patent applications for "lack of invention". Yet, what is rarely discussed is that the 1952 Patent Act had at best very limited effects on patent practice. This is at least what one of the two main drafters of the 1952 U.S. Patent Act believed. Judge Giles Rich complained:

> Due to the delays in the Patent Office, the cases we were then reviewing [in the Appellate Court CCPA] were mostly rejections for "lack of invention," and yet we had Section 103 in the statue that had done away with it. But the judges on the court didn't seem to know that. (1986, 476)

If Rich was right, what could explain that U.S. judges continued to ignore new patent-friendly doctrines, that were already part of the law, for decades to come? I argue that the most likely explanation is not that U.S. judges cared deeply about the monopolistic and social-cost aspects of patents, but that they mostly attempted to correct granting decisions made by a patent office that was increasingly unable to organize the information necessary

to examine patent applications, especially foreign patent applications. The office's granting decisions continued to clock up the docks of district and appeals courts alike and did not magically stop after the 1952 Patent Act. It took the activism of Judge Rich and like-minded patent lawyers to actually strengthen patent rights over the very long term:

> [G]radually, through, a long series of opinions telling the Patent Office the same thing I had to tell the judge, and gradually educating the bar and the examiners to what had happened, we finally turned around the lack of invention requirement so that we stopped getting rejections on that ground. (1986, 476)

What I will show in this chapter, beginning with the United States, is that while there were numerous early legal initiatives to strengthen patent rights in high income countries, they would not have substantial effects on patent practice for a long time as the real constraints on stronger patent protection were mostly informational, not legal. Once I have established this, I will explore initial legal-technical efforts by major patent offices to acquire and process patent information. The next chapter will show how multinational companies approached the same challenge.

2.1 The Administrative Crisis

In the postwar years, it was not only judges who were irritated by patent office decisions but also economists. An epistemic community consisting of "neoliberal economists" [1] like Fritz Machlup (1958) in the United States, Michael Polanyi[2] (1944) in England, and Wilhelm Röpke (1942) in Germany became increasingly concerned about patents that could no longer effectively be distinguished. Polanvyi in particular went so far as to argue that:

> the [patent] law is essentially deficient, because it aims at a purpose which cannot be rationally achieved. It tries to parcel up a stream of creative thought into a series of distinct claims, each of which is to constitute the basis of a separately owned monopoly. (1944, 70)

The inevitable consequence was, according to Polanyi, that companies constantly went to court over badly separated patent claims. More often than not judges seemed to throw in the

[1] I use term "neoliberal" in the same way as Quinn Slobodian (2018, 3-4) , that is, to refer to 1) a "specific institution-building project" by a group of economists, sociologists, journalists, and business leaders, and 2) to neoliberal globalist theory.

[2] I have changed the name to Michael Polanyi even though the name on article is spelled Polanvyi.

towel and invalidated existing patents. This happened even to actually meritious inventors and not just to those who obviously gamed the system.

The neoliberalism criticism of patents more generally is summarized in a report that Machlup (1958) was asked to write for the U.S. Senate Subcomittee on Patents, Trademarks, and Copyrights. In this report, Machlup tells the controversial history of patent laws and lists a number of arguments against the practical usefulness of patent monopolies. While he does not got so far as to recommend the abolition of patents, he writes about the incentives to invent in the chemical and electronic industry:

> It seems very likely that even without any patents, past, present, or future, firms in these industries would carry on research, development, and innovation because the opportunities for the search for new processes and new products are so excellent in these fields that no firm could hope to maintain its position in the industry if it did not constantly strive to keep ahead of its competitors by developing and using new technologies. (1958, 78)

Unsurprisingly, this rather fundamental criticism of patents was not welcomed by defenders of the status quo. Harold Fox (1947, 206), a prominent legal scholar, called neoliberal economists who dared to criticise the patent system "modern witch-hunters who see in any form of monopoly none of the beneficial qualities but only the odious characteristics which arose from the early abuses". A particularly beneficial quality of patent monopolies was, according to Fox, that they created incentives to publicly disclose inventions that would otherwise remain trade secrets. In other words, patents were not really worrysome at all. On the contrary: new patent applications were to be welcomed because the "patent system has been the goad and spur of human improvement." (Fox 1947, 306)

What was remarkable about this debate was that it mainly concerned the existence of patents as such, whereas more practical concerns, like the capacity of patent offices to organize information and adequately examine applications, were largely off the table. Klaus Pfanner (1969), a government director of BIRPI, the key international organisation in the patent field, even had to explain to German patent lawyers that the administrative crisis of the German Patent and Trademark Office (GTPO) in the postwar years had not been a "positive" development related to more inventive activity, but a "negative" development related to more foreign patenting. If this view of higher application activity and patent office delays was correct, however, it also meant that the criticism raised by neoliberal economists to some extent misdiagnosed the sources of patent problems. They associated badly delineated patents with the stark formalism of patent law, yet ignored the more practical challenges patent offices faced. According to Pfanner, patent offices had mainly difficulties to cope with

incoming applications because multinational companies had begun to file applications for the same inventions in more and more countries.

Already a limited amount of "duplicate applications" seemed to administratively overwhelm national patent offices because examiners proved unable to quickly distinguish actually new applications from applications that had already been filed elsewhere. The consequence, according to Pfanner (1969, 336), was "gigantic and uneconomic duplication of effort" both by patent offices and companies. Fig 2.1 shows that the number of foreign applications at major patent offices increased dramatically between 1950 and 1970. While the United States had received around 11,000 foreign patent applications in 1950, it already received round 30,000 foreign patent applications in 1970. Foreign patent applications in the United Kingdom, Germany, and Japan rose even more sharply over the same period.

In order to explore whether foreign patent applications really "overwhelmed" major patent offices, it is instructive to estimate the effect of foreign applications on domestic patent grants. The assumption hereby is that a patent office becomes administratively overwhelmed if its domestic granting activity slows down as it receives a higher share of foreign patent applications.

Fig 2.2 portrays the results of a simple linear regression analysis of domestic patent grants on the "foreign application ratio". The figure suggests that the ratio of foreign applications had a significant negative effect on domestic patent grants. While controlling for Gross Domestic Product (GDP) and Human Capital, as well as country-year effects, the model predicts that countries with a higher share of foreign applications grant fewer domestic patents than countries with a lower share of foreign applications. This finding is consistent with Pfanner's argument that foreign duplicates increasingly overwhelmed patent offices.

More generally, the finding that patent offices were mainly informationally overwhelmed does not imply that patents were somehow easier to separate than argued by Polanyi (1944) and Machlup (1958). According to Pfanner (1969, 335), it did, in fact, also become more difficult for national patent offices to separate patent claims. He only emphasized that patent offices faced an administrative crisis for reasons that were largely unrelated to inventive capacity, and only related to economic activity to the extent that postwar economic integration under the Marshall Plan gave multinational companies incentives to duplicate applications. If this was true, then the reactions of economists, like Polanyi and Machlup, against badly separated patents were not simply an expression of an anti-patent attitude, as suggested in Nard's textbook, but responses to a very real administrative crisis.

From Pfanner's perspective, the adminitrative crisis in the postwar years had two main causes: 1) explosive growth of foreign patent applications, and 2) increasing differentiation and complexity of technology. While problems posed by technological differentiation and

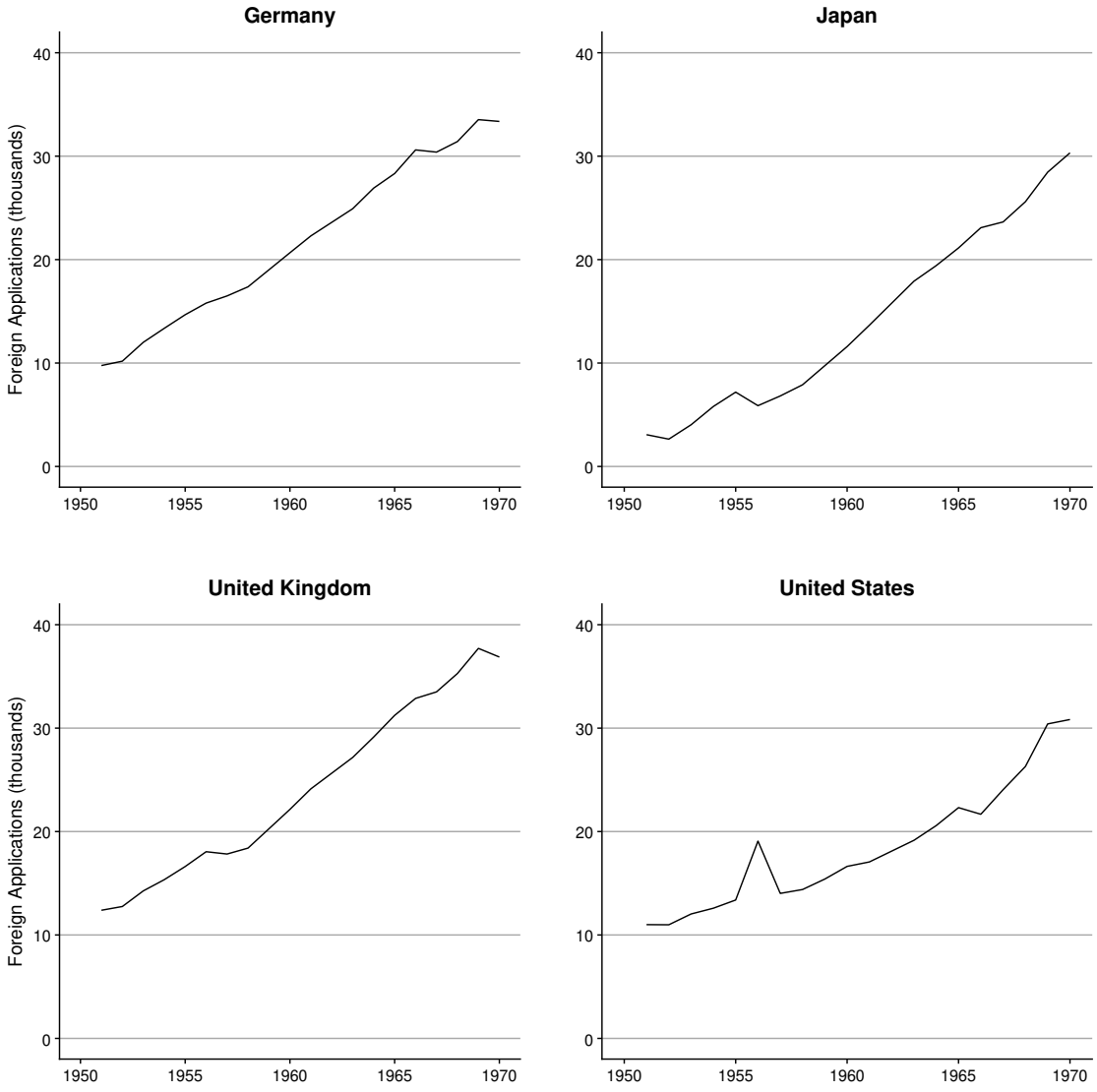


Fig. 2.1 Foreign patent applications, 1951-1970

Source: The data are from Federico 2011 and WIPO 2021b

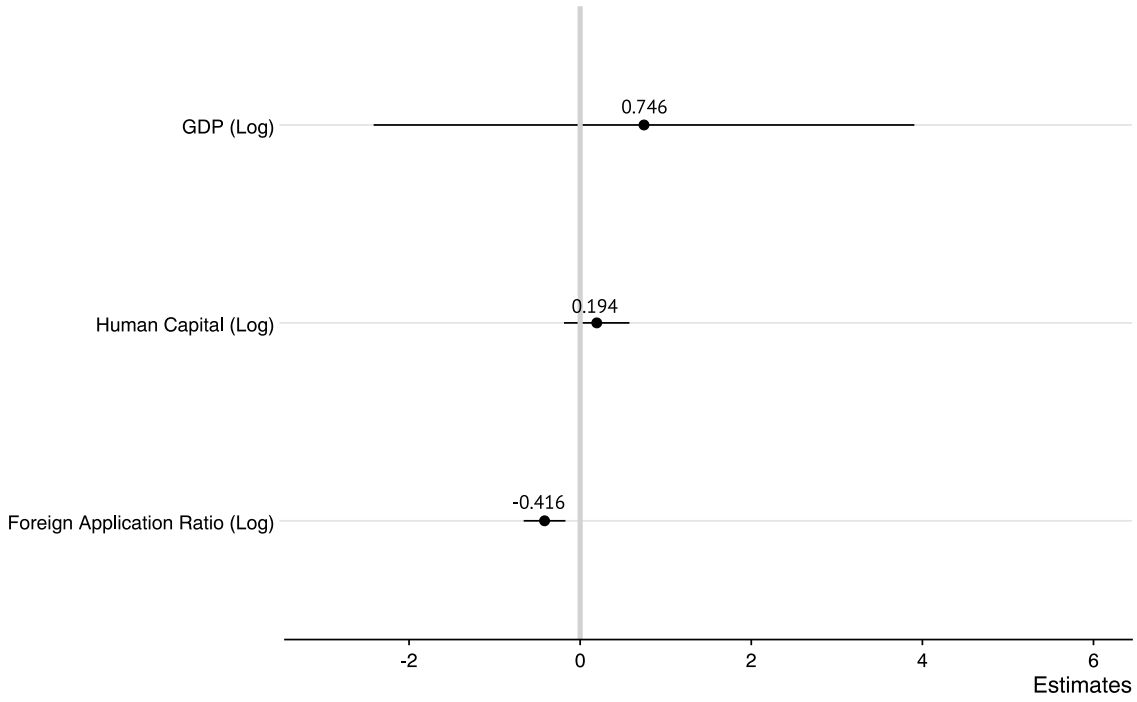


Fig. 2.2 Estimates from model predicting domestic patent grants in 11 countries, 1951-1960

Note: 95 percent confidence intervals are shown as black lines. The model includes controls for GDP, human capital, as well as country-year fixed effects (not shown). Included countries: Austria, Canada, Denmark, Germany, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, United States.

Source: The data are from Federico 2011 and Feenstra et al. 2015.

complexity are carefully discussed in the work of economists (see von Graevenitz et al. 2013), there is a continued neglect of legal-technical expertise required to process foreign patent and non-patent information. Even though there is work by economists on patent office funding and failed mechanization projects (see Jaffe and Lerner 2007, chap. 5), the problem with this work is that projects by information specialists in the private sector are practically never mentioned. Yet, as I will show in chapters 3 and 4, the outcomes of private legal-technical initiatives became critically important for public legal-technical initiatives.

Neither neoliberal economists nor defenders of the status quo in postwar patent law-making invested much time assessing the administrative crisis that confronted patent offices. For both groups, the important questions were whether patent rights actually created incentives to invent and how the publication of inventions in patent documents influenced the development of science and technology. There were only a few technically interested debate participants, like the famous information scientist and science planner Vannevar Bush, who recommended not just legal reforms in response to the "postwar patent crisis", but also legal-technical reforms. The legal-technical reforms suggested by Bush and information specialists in other countries are rarely if ever mentioned in historical studies of the rise of international patent protection. This is despite the fact that USPTO officials actually approached Bush with the intent to implement his reform proposals.

2.2 Early Legal-Technical Initiatives

Vannevar Bush was among the most widely known and admired scientists in the postwar world. In addition to his efforts to establish the National Science Foundation (NSF), Bush was famous for heading the U.S. Office of Scientific Research and Development (OSDR) that organized U.S. R&D efforts during World War II (see Zachary 1999). As one might expect, the OSDR's massive R&D efforts had created a substantial number of inventions with potential for commercial exploitation, especially in the fields of radar and medical technology. Bush (1957: 43) envisioned a myriad of startups springing up due to entrepreneurial efforts by "young men" who had worked on these inventions during the war. What prevented those young men from commercializing their inventions, according to Bush, were difficulties in aquiring and enforcing patents. To be more precise, he thought that potential entrepreneurs were held back by patent examination procedures that routinely took several years to complete and more often than not ended up in litigation.

Just like Machlup, Bush (1957) was asked to put down his ideas in a report for the U.S. Senate Subcommittee on Patents, Trademarks, and Copyrights. In this report, he laid out in detail what he thought was behind the USPTO's examination problems and what needed to be

done in order to support the creation of new companies. Perhaps unsurprisingly, Bush focused on the perceived validity of patents, which was in his mind closely tied to the administrative crisis facing the patent office. The office had, according to Bush, too little personnel and too few facilities to examine the full backlog of applications it had already received; it further lacked the capacity to reclassify existing patents so that they would become more easily searchable. Beyond these immediate concerns, Bush suggested that the Commissioner of Patents should have at its disposal personnel relieved from routine tasks that could plan the examination process in advance, and explore means for the improvement of current tasks. In other words, the patent office should become a learning entity, not a "paper factory".

Among the improvements with the highest value in Bush's opinion was the overhaul of the patent office's legal-technical support system. He argued that

> [a] more careful acquistion and examination of technical literature, both domestic and foreign, by the Patent Office before a patent is issued will distinctly lessen the possibility that issued patents will be overthrown on the basis of previously unnoticed publications." (Bush 1957: 45)

In order to attain this objective, he considered it urgent to process the more than seven million documents in the patent office as well as additional technical publications with the help of modern data-handling equipment. His expectation was that such equipment would make it possible to reduce the burden of extensive literature searches that overwhelmed the patent office, as well as companies and courts.

Bush claimed that the odds of a "mechanization project" succeeding were high. He promised the committee that practically every step in the examination process could soon be mechanized. Some passages brim with optimism about technological possibilities. He wrote, for instance:

> It [the data-handling equipment] can have memory, so that the experience of one search will become available to other searchers. It can be fast and comprehensive. It can even be arranged to facilitate its own evolution, as its subject matters grows and the art changes." (Bush 1957: 45)

Because of Bush's techno-optimism, he also included a long list of proposals for legal reform. He suggested, amongst other things, the introduction of opposition procedures that would enable competitors of patent applicants to submit publications during the examination process which had hitherto not been discovered (Bush 1957: 46-47). His idea was to challenge the novelty of patent applications more consistently during the examination process and to thereby strengthen the validity of granted patents. But Bush did not stop there: he

also demanded from legislators that courts should receive help with technical nuances that judges had not been trained to understand and appreciate. Finally, Bush argued that Congress should take steps against anti-competitive licensing arrangements that were mostly used by large conglomerates to the detriment of smaller companies.

To make a long story short, Bush brought forward a number of reform proposals that were farreaching and creative, yet not nearly as radical as the proposals by neoliberal economists. Polanyi (1944: 67), for instance, had suggested to get rid of the legal enforcement of patents altogether and to replace it with a taxpayer-funded inventor compensation scheme. Bush's proposals were, by comparison, rather modest and legal-technical: he merely suggested to bring the patent system to a point at which it could support the commercial exploitation of wartime research and development efforts.

What made even such modest reform proposals difficult to implement, according to Bush, was not so much judges or economists but lawyers who practiced general law. He accused them of "profound ignorance of the patent structure" (Bush 1957: 35). Moreover, the patent bar was in his mind not substantially better as it was dominated by individuals who did not "understand fully the interrelationships between the patent system, the modern status of applied science, and the economic progress of society generally." (Bush 1957: 35) At the same time, however, he remained convinced that "there are some who have the full qualification for objective and thorough counsel and advice, and their efforts should be enlisted." (Bush 1957: 35) He likely referred to a younger generation of patent lawyers associated with mechanical and electrical engineering companies who were seemingly just as frustrated with duplicate applications and literature masses as patent examiners and judges were.

2.3 A Series of Failed Projects

It was complaints by company patent lawyers on the one hand and the Eisenhower administration's technological ambitions on the other that raised the interest in "mechanization" among top government officials. Sinclair Weeks, then Secretary of Commerce, asked Bush immediately after the war to direct a study of the patent office (Akera 2000: 197). Bush assembled a committee of information scientists for that purpose, but simultaneously assigned the responsibility to prepare a final committee report to a group within the patent office that was already working on mechanization.

When this external patent office group presented a final report that recommended the complete reliance on IBM punch cards - an older but practically tested technology -, Bush rejected the report (Akera 2000: 197-198). Instead, he asked Samuel Alexander, who headed

the Data Processing Division of the National Bureau of Standards (NBS), to provide a survey of electronic data processing systems. Alexander was an experienced information scientist: he had earlier on secured government funds to build the Standard Eastern Automatic Computer (SEAC), the first modern stored computer to be put into regular operation in the U.S. and also the only U.S. machine at the time capable of performing critical design calculations for the hydrogen bomb.

Alexander handed down the task of surveying electronic data processing systems for the patent office to Mary Elizabeth Stevens, originally his assistant, who had gradually taken over important tasks in the division. Stevens was in a similar position as the women portrayed in the biographical drama "Hidden Figures" (Melfi 2016), who arrived at government agencies with a technical background, but were "relegated to paperwork largely by virtue of her gender." (Akera 2000: 197) Yet, because Stevens's division increasingly focused on electronic data processing studies, and the preparation of these studies was considered "paperwork" at the time, Stevens's status in the division gradually rose vis-a-vis men who preferred to focus on purely technical tasks.

For the patent office project, Stevens compared the largest data processing installations in operation and compiled information about the newest systems available from manufacturers. In her work, she could rely on earlier experience the NBS had gained with its own computer procurement service. Because of her survey, the patent office signed an agreement with the NBS in which the latter committed itself to study computerized approaches to patent retrieval. The resulting project was called the PILOT project and was placed under Stevens's authority (Akera 2000: 198).

In a subsequent report for a congressional subcommittee, Stevens justified the approach that the NBS and her division pursued. She argued that mechanization was critical "if the patent system is to continue to make its contribution to our economy" (Akera 2000: 198). She further pointed out that the reliance on electronic data processing was essential in addressing the problematic increase in clerical workers in the patent office (aka patent examiners). This cost/benefit argument translated her division's projects into a language that the NBS director and Congress found convincing. Not unlike Bush, Stevens also emphasized future technological possibilities: "the increased use of automatic data processing systems for paperwork handling should enable to do things we cannot now do in any other way" (Akera 2000: 198).

Ironically, given the reliance on cost/benefits arguments for mechanization, there was subsequently never enough money for implementing the many research and development projects. Stevens's PILOT project was followed by project "POTOMAC", short for "Patent Office Techniques of Mechanized Access and Classification", which was supposed to allow

patent examiners to quickly search the prior art. This automation project was abandoned as a complete failure in 1972, after tens of millions of dollars had been spent. A similar fate befell a number of USPTO legal-technical projects with acronyms like "HAYSTAQ" (Have You Stored Answers to Questions), "ILAS" (Interrelated Logic Accumulating Scanner), "RAMP" (Random Access Mechanization of Phosphorus Compounds), "CAMP" (Card Mechanization of Phosphorus), and "SECIR" (Semiautomatic Encoding of Chemistry for Information Retrieval) (Jaffe and Lerner 2007: 139-140).

When the patent office actually did use computers in the postwar decades, it apparently used them to keep production records on examiners (see Weissman 1973). The production records captured, for over 1000 examiners, such statistics as the number of new applications acted on, the number of grants, and the number of abandonments. These records essentially enabled top patent office officials - mostly former and future patent lawyers -, to rate patent examiners' "productivity". A productive examiner, according to these production records, was an examiner who quickly granted or rejected patents; an unproductive examiner, by contrast, was an examiner who needed a lot of time to come to these decisions. From the perspective of Milton Weissman (1973: 611-612), primary patent examiner and editor-in-chief of the "Journal of the Patent Office Society", the patent office's production records amounted to "essentially nothing but a mass of trivia, and [were] not of the slightest consequence when pursuing a goal of processing patent applications to produce patents of the highest possible validity". He further complained that "[i]n view of the urgent necessity of finding some way to employ computers to aid an examiner in the examination of patent applications, the spectacle of employing a computer for nothing more useful than the compilation of infinitely detailed production records is almost ludicrous." (1973: 612)

What made the situation in the early 1970s even worse was that the careful acquisition of domestic and foreign technical literature that Bush had already demanded in 1957, had not made progress. Instead, the patent information available in the patent office, the so-called "file wrapper record", had lost more and more of its original value. There was in Weissman's (1973: 615-617) opinion too little prosecution time available for current examiners and there were, overall, too few technically and legally qualified examiners employed by the patent office. The consequence was that the key threat to patent validity in the postwar years, i.e. the large number of foreign patent applications, could not be warded off:

> The greatest defect of shortened prosecution time is that it practically eliminates all recent literature references and recent foreign patents as possible sources of prior art against patent applications; such recent material is obviously of extremely great value. Literature references cannot be searched as such; reliance

> must be placed on abstracting services and, more specifically, the literature abstracts and indexes they issue. (Weissman 1973: 617)

The "abstracting services" to which Weissman refers were commercial intermediaries that had become large enough to support patent offices through the support of company information specialists and patent lawyers. As I will show later, these commercial intermediaries used seemingly old-fashioned technologies, such as the punch cards rejected by Bush, to build up abstract collections and indexes that gave chemical and pharmaceutical companies an edge over patent offices. While the latter experimented with highly technically solutions, most examiners were really still searching by hand.

In the absence of reliably processed domestic and foreign patent information, the size of the examiner corps remained a critical factor in determining patent grants. Zvi Griliches (1998: 324), a well-known innovation economist, was able to show in regressions for the 1925-87 and 1945-87 periods that "the major determinant of the number of patents granted seems to be the number of patent examiners employed by the Patent Office". Griliches fervently rejected claims that stagnant or declining patent grants in the postwar decades had anything to do with the exhaustion of technological opportunities or the declining competitive inventive advantage of the United States. Citing an earlier study by G.G. Brunk and G. Demack (1987), Griliches (1998: 322) argued that the decline in the number of patents granted in the 1970s is almost entirely an artifact, induced by fluctuations in the Patent Office, culminating in the sharp dip in 1979 due to the absence of budget for printing the approved patents".

Fig 2.3 was constructed using Griliches original numbers. It illustrates that compared to a reasonable prediction of U.S. patent grants (upper panel), the actual number of patent grants sharply dropped in the late 1970s and early 1980s (middle panel). This visible drop in the number of patent grants appears to have followed an earlier, equally sharp drop in the number of U.S. patent examiners (lower panel).

To further underscore the point that patent grants may have been part of a "bureaucratic cycle, I have plotted the results of one of Griliches' regression analyses of U.S. domestic patent grants on the number of USPTO patent examiners. The results depicted in fig 2.4 indicate that there was indeed a strong positive effect of adding patent examiners on domestic patent grants. It is also possible to see that the foreign application ratio apparently still has a negative effect on domestic grants when examiner numbers are included in the analysis.

Fig. 2.3 Actual versus predicted patent grants and the number of patent examiners, 1947-1989

Source: The data are from Griliches 1998.

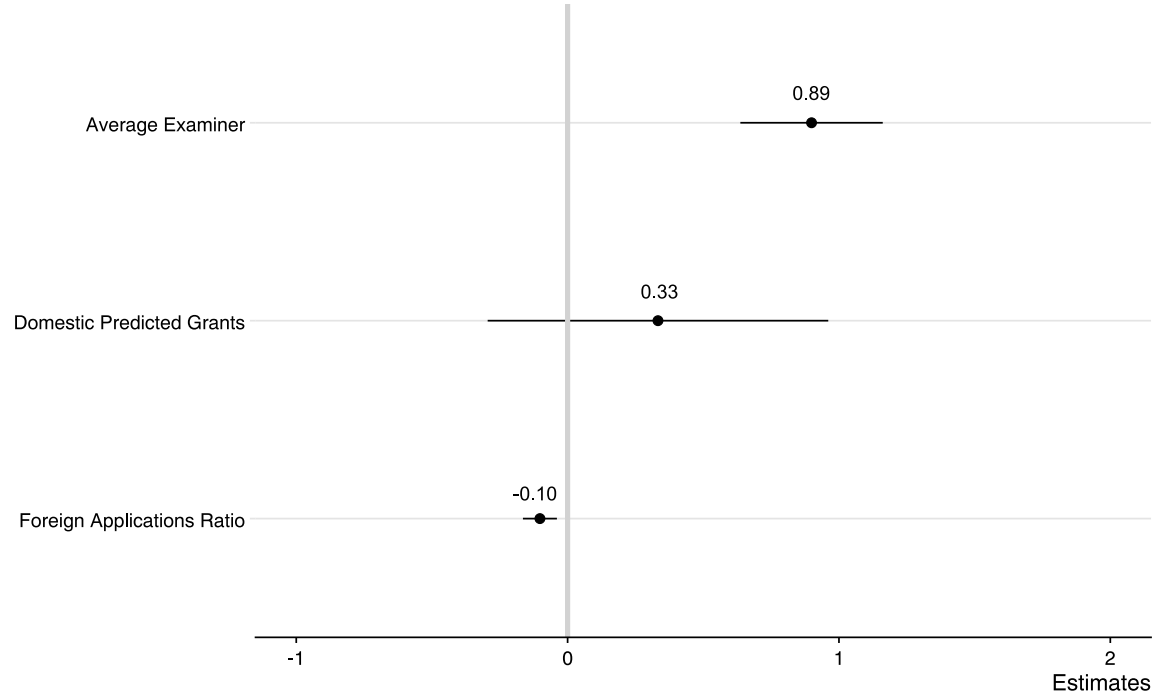


Fig. 2.4 Estimates from model predicting domestic patent grants in the United States, 1945-1987

Source: The data are from Griliches 1998.

All of this suggests that the U.S. patent system in the postwar decades suffered from an administrative crisis that delayed the farreaching legal change that the drafters of the 1952 Patent Act had in mind. While I do not want to deny that anti-patent sentiment in courts and antitrust divisions played a role as well (see Kihara 2000; Scherer 2009), I have tried to show that a lack of legal-technical expertise put legal initiatives more generally on hold. In particular, legal-technical expertise with the potential to simplify patent examination remained limited; examiners had to rely on abstracts and indexes from commercial intermediaries that were only available in certain technology areas. In the next chapter, I will show that broader legal initiatives generally coincided with the availability of private legal-technical expertise in technology areas like mechanical and electrical engineering.

2.4 Even More Failed Projects

The USPTO's numerous failed projects would likely have been less dramatic for law-making had legal-technical projects at the transnational level been successful. Key legal-technical projects at the transnational level were originally not initiated by patent offices, but by an association of patent lawyers and agents that brought together national associations from

different countries. The International Association for the Protection of Industrial Property (AIPPI) (1997) was established as early as 1897 and had ever since promoted the worldwide harmonization and strengthening of patent rights. In the 1950s, AIPPI decided for the first time in its history to concern itself not just with the revision of the Paris Convention - the key international patent treaty -, but also with the development of international cooperation in the field of patent information (Bogsch 1988: 171).

The one-stop-shop for all of AIPPI's patent-related lobbying efforts was an international organization: the "United International Bureaux for Protection of Intellectual Property" (BIRPI). BIRPI had been set up in 1893 by the signature countries of the Paris Convention in order to administer the newly agreed upon treaty. The fact that BIRPI is largely unknown today has to do with a simple name change: its much more widely known successor is the World Intellectual Property Organization (WIPO) - established as self-funding United Nations organization in 1967. Unlike its predecessor, WIPO (2021c) lists the "coordination and development of global IP infrastructure" and the "provision of IP information and analysis" among its key strategic goals.

Back in 1954, AIPPI released a public statement recommending for the first time international cooperation in the field of patent information. Arpad Bogsch (1988: 171), who later became WIPO Director General, translated the central passage of this statement into English:

> The Congress [of AIPPI] recommends that the International Bureau for the Protection of Industrial Property at Berne [that is BIRPI, which then, and until 1960, was in Berne rather than in Geneva] should study [the original says veuille bien etudier, that is 'should kindly study'], through a committe of experts ... the necessary steps to enable the International Bureau to furnish to any interested party information concerning patents and patent applications ... and to secure, at reasonable cost, access to such information by members of the public.

The main objective of the AIPPI's recommendation was, according to Bogsch, to collect information about patent rights that applicants were acquiring in different countries under the Paris Convention. Doubtlessly the most important right for foreign patenting, created by the Paris Convention, has been the so-called "priority right": it essentially allows an inventor to extent a patent on an invention for which she has already applied for a patent in country A, to countries B, C, and D. The only condition for filing subsequent patents on the same invention was that these subsequent applications were filed within the so-called "priority period". The idea behind the AIPPI recommendation was the establishment of an identifier that allowed patent lawyers and agents to remember the invisible links between a given "priority application" in country A and subsequent applications in countries B,C and D. This is how Bogsch (1988: 171) understood the AIPPI debate:

> It was clear then, as it is today, that the most practical means for identifying the patent and the patent applications claiming (more or less) the same invention of the same inventor or inventors, and generally, the same applicant, is to require that applicants indicate, in all their applications in which they claim priority under the Paris Convention, the country, date and serial number of the first application, that is, the application whose filing date, in the subsequent applications, is claimed as the date from which the priority right applies.

To put the whole idea in less legalistic terms, one could say that the AIPPI wanted to link documents that claimed protection for the same invention in different countries. National patent offices were therefore advised to print not just the date of the foreign application whose priority was claimed on new national applications, but also the serial number of the priority application. Between these two seemingly minor legal-technical changes lay more than forty years: the printing of a priority date had already become mandatory as early as 1911 (Bogsch 1988: 171).

As usual, BIRPI included the AIPPI recommendations in the preparatory document for the Paris Convention review conference in Lisbon in 1958. The first recommendation, the printing of serial numbers on patent documents, was immediately adopted and added in Article 4d of the Paris Convention. The second recommendation, however, the establishment of an international documentation center by the BIRPI, was not successful. The idea had been that national patent offices should either self-publish punch cards containing the country, publication date, serial number, and name of the applicant, or should send punch cards to BIRPI to be published centrally (Bogsch 1988: 172). The implementation of this second recommendation would likely have constituted a milestone in how patents were processed in the postwar decades, but was not adopted.

If we believe Bogsch, the financing of a new international documentation center could not be secured. Apparently, a majority of government delegations shared the criticism raised by the Austrian delegation, which considered the ongoing maintenance costs of the project too high and also rejected the argument according to which the international documentation center would pay for itself after initial investments. The Lisbon conference thus did not lead to an early institutionalization of direct international cooperation with respect to patent information: AIPPI and BIRPI plans for an international documentation center were neither adopted nor implemented (Bogsch 1988: 172).

While financial constraints were the most important reason why public legal-technical expertise remained underdeveloped in the postwar decades, there were also political and technical considerations that prevented the buildup of public legal-technical expertise. An informal working group between national patent offices, established in 1961, called "Interna-

tional Cooperation in Information Retrieval among Examining Offices (ICIREPAT)", had to abandon its plans of "moving from (...) monodimensional classification systems to a global polydimensional indexing system" (Schoch-Grübler 1995: 86). Harold Pfeffer (1974: 358), a participant from the United States, which had initiated ICIREPAT, described the failure of its "Shared Use Program" as follows:

> It is unfortunate that the Shared Use Program has not had as great acceptance among the cooperating offices as had been expected. This has resulted in delays in expanding the program to more significant proportions. However, this lack of acceptance is not due to any fault in system analysis, system design or procedures, which have been very carefully and painstakingly built up under extremely difficult conditions. Nor is it due to any lack of desire to cooperate on the part of offices which have committed themselves to contributing toward mutually agreed upon necessary goals. In most instances this lack of acceptance can be ascribed to budgetary and manpower problems resulting from various national economic and political pressures and changes of policy. Patent offices, after all, are very small cogs in the overall machinery of governments. In some cases there have been conflicts between different systems covering the same field. In other cases there have been large variations in the degree of need among the offices for mechanized systems in particular fields, so that there were grave questions as to the justification of mechanizing in areas where the cost/benefit ratios were adverse or marginal.

Basically, the historical narrative presented thus far suggests that the buildup of public legal-technical expertise remained stuck in the postwar decades, both at the national and the transnational level. If companies nowadays have few problems to protect inventions in different countries, this must have something to do with either legal-technical expertise assembled by the private sector or with legal-technical expertise assembled by patent offices in more recent decades. I will explore both possibilities in chapters 3 and 5. Even at this early stage, however, I am able to say with confidence that cooperation and expert trust between patent offices was, on its own, insufficient to overcome cultural and institutional boundaries (see Drahos 2010). If this had been the case, then interoffice projects, like ICIREPAT, should not only have been more successful, they also should have played an essential role in getting later legal-technical projects implemented. Yet, while there are indications that ICIREPAT "provided a communication network for exchange of ideas and information on all levels of patent office operation" (Pfeffer 1974: 360), there are no indications that much public legal-technical expertise was actually assembled. According

to Albrecht Krieger (1968: 165), a German civil servant, it was expected that it would take twenty years or longer to construct a patent documentation system for all technology fields, though progress in some technology fields would make it possible for the German Patent and Trademark Office (GPTO) to unburden examiners in these fields earlier.

2.5 Deferred Examination and Its Consequences

One legitimate objection against this narrative could be that the failed projects described thus far should have led to the collapse of small and mid-sized patent offices. If legal-technical expertise was really as important for examining patent applications as suggested, how could small and mid-sized patent offices which were frequently targeted by foreign companies have handled the growing number of duplicate applications? In concrete terms, how could a relatively small patent office, like the patent office of the Netherlands, have examined as many patent applications as the USPTO?

The answer is that, unlike the USPTO, nearly all small and mid-sized patent offices switched to an application system called "deferred examination". By deferred examination, patent officials essentially mean something like a "quick and formal" examination of an application that is performed by patent examiners before they embark on the actual, more detailed examination. The introduction of deferred examination procedures arguably reduced the immediate burden on examiners because applicants could prematurely abandon applications that began to look technically, economically or strategically unattractive after some time had passed (Krieger 1968: 171-173). It is important to remember that it could often take 3-4 years or more until patents were finally granted (Brunk and Demack 1987: 119); after so many years, technological advantages, markets, or competitive struggles had often already evaporated.

With the introduction of deferred examination, patent offices and companies were essentially allowed to put applications on hold for a few years, but in return had to assess the novelty of inventions against a much larger amount of documents. Previously, companies had typically been unaware of what inventions others were working on and where others intended to patent these inventions. Deferred examination drastically changed this by demanding the "universal publication" of patent applications submitted in the examination process.

After deferred examination had first been introduced in the Netherlands in 1964, it was closely watched by patent officials in Germany who were similarly overwhelmed by a growing examination backlog. They successfully convinced members of parliament, after a joint field trip to the Netherlands, to adopt deferred examination in Germany as well. The reasons listed in support of deferred examination in the legislative process were nearly

identical to the reasons provided in the Netherlands (Krieger 1968: 173-175). The adoption of deferred examination in 1968 looked almost like a textbook case of what neoinstitutionalist theoreticians call "normative isomorphism": lawyers connected by professional networks promoted legal norms that were already in use elsewhere (see DiMaggio and Powell 1983; Dobbin et al. 2007).

The claim that deferred examination became a practically taken-for-granted solution to patent offices in many countries is supported by the fact that Japan soon also adopted deferred examination even though the procedure had not improved the validity of patents as much as its legislative supporters had hoped. While its implementation apparently reduced the immediate burden with which national patent offices were confronted, it also created - through the "universal publication" of abandoned applications -, even more information that had to be searched and monitored.

Stuart Kaback (2002: 138), a prominent information specialist and employee of Exxon-Mobil, described the effect of "universal publication" on companies as follows:

> The Dutch began the shift to universal publication of patent applications in 1964. Germany did the same in 1968, with the added fillip of pouring out over the course of a few years their huge backlog that had caused them to switch to universal publication in the first place; at least the Dutch never saddled us with that. It took Japan, though, to really turn the patent world on its head by coupling universal publication with the Japanese practice of having very narrow patent claims scattered over multiple documents, rather than multiple claims in a single document. They started their new system in 1971, and soon they were publishing 100 000, 200 000, nearly 350 000 Kokai each year. All this along with their unique numbering system based on the year of whoever was Emperor at the time; the patent world has never been the same.

Even before Japan had taken these steps, Pfanner had warned that deferred examination could merely be a transitory solution. He warned that the overall amount of documents that examining patent offices were required to search, and that a growing number of formerly non-examining patent offices wanted to search in order to grant more valuable patents, was only becoming larger. He wrote that the

> ideal solution - the fast allowance of legally certain patents with a minimum of personnel costs -, can over the long-term only be achieved if the gigantic and uneconomic duplication of work for industry and patent offices related to the filing of 10 or 20 patent applications on one and the same invention, as well as

> the execution of 10 or 20 granting procedures by just as many patent offices in different languages, can be reduced. (Pfanner 1969: 336)

Of critical importance in achieving this "ideal solution" was, in Pfanner's and ultimately WIPO's view, a series of legal and legal-technical changes which I will describe in more detail in chapter 5. It is important to note that practically all of these changes depended on devices and concepts that were already in use in the private sector, I will proceed with an analysis of private legal-technical expertise in the next chapter.

2.6 Conclusion

The implications of this chapter are threefold. First, weak patent rights in high income countries during the postwar decades cannot be satisfyingly explained with the presence of an anti-patent attitude. While U.S. judges and economists were doubtlessly critical of patent monopolies, they were only partially successful in preventing patent rights changes. After all, the "patent-friendly" 1952 U.S. Patent Act was passed during a time in which the anti-patent sentiment was supposedly at its height. What slowed down efforts to strengthen patent rights in practice was less an anti-patent sentiment than an administrative crisis that hit the USPTO, as well as other examining patent offices. The prominent patent law scholars Friedrich-Karl Beier and Joseph Straus (1977: 399) write that "[t]he operations of the examining patent offices became so critical that a near breakdown of the patent system almost ensued in the middle sixties."

Second, neither patent offices nor international organisations could assemble legal-technical expertise that effectively resolved the administrative crisis. Even the oldest and largest patent office in the world, the USPTO, did not make much progress despite numerous mechanization and information projects. On the one hand, its leadership lacked the vision and resources to pursue sufficiently large internal projects, on the other hand it focused on unproven technologies and became obsessed with examiner productivity. Patent offices that followed similar strategies to the USPTO, like the German patent office, made similarly little progress. Patent offices that made more progress, like the Japanese Patent Office, systematically combined private and public legal-technical efforts early on (see chapter 7).

Third, the administrative crisis did not anywhere lead to the actual breakdown of patent offices: the latter mostly came up with interim solutions that subsequently diffused through professional networks. The introduction of deferred examination temporarily removed some of the most worrying information pressures on patent offices as it gave applicants the possibility to abandon applications that had become technically, economically or strategically less valuable. Deferred examination procedures allowed patent offices to keep operations

running since few applications had to be very thoroughly examined. At the same time, patent offices did not get into a position in which they could have increased the validity and thus the attractiveness of stronger patent rights. The publication of applications at an earlier stage meant that much more prior art became available than before. This actually depressed the worth of stronger patent rights for some time.

What this means with respect to the main question of this work is that patent rights remained generally weaker in the postwar years than they could have been because attempts to resolve language and classification differences through the buildup of legal-technical expertise mostly failed.

Chapter 3

The Buildup of Legal-Technical Expertise in the Private Sector

The struggles of national patent offices to develop legal-technical systems were closely watched by multinational companies. In particular, company scientists who had only recently claimed expertise in the processing of patent information were on the constant lookout for new devices. These "information specialists" doubted whether their own, already large companies were large enough to finance the processing of a growing mass of patent documents in different languages and classifications.

Practically all efforts by information specialists are well documented in specialized journals. This stands in stark contrast to how they are covered in the academic literature: Efforts by information specialists are almost entirely ignored by most economists, sociologists, and legal scholars. Henry Smith (2007: 1779), an expert on the economics of intellectual law, for instance, writes that patenting in a system with strong enforcement mechanisms "only requires monitoring a simple on/off signal." Clarisa Long (2004: 523-524), who has written even more extensively on the information costs of patenting, concurs, but at least concedes that there is "an audience likely to be familiar with the technology [...] and thus more tolerant of incurring the relevant information costs".

Why companies developed a "tolerance for incurring information costs" is the main question in this chapter. Unlike Smith and Long, I do not take it as a given that companies with limited resources are able and willing to process masses of foreign patent documents. While information processing might seem like a reasonable thing to do from today's perspective, this view was not shared by all company lawyers and research department leads in the postwar decades. If we believe information specialists, company lawyers and researchers were, rather, quite likely to ignore patent information. Or, to put it in the words of legal scholars: they were not willing to incure the relevant information costs.

My argument in this chapter is that companies became more tolerant of incurring information costs because information specialists came up with devices, concepts, and arrangements that translated, summarized, and linked vast amounts of patent information. In this, they were supported by elite company lawyers who welcomed legal-technical breakthroughs in a situation in which legal harmonization made very little substantive progress (see chapters 2 & 4).

As I will show, information specialists experimented with legal-technical representations and corresponding governance arrangements to stabilize demand for their services in multinational companies. They were, in other words, not so much interested in legal harmonization at first as in their own status in multinational companies. To defend that status, information specialists worked on what looked to them like practically feasible solutions to the administrative crisis and watched legal harmonization efforts from a distance.

3.1 Failed Projects and Multinational Companies

It is no exaggeration to say that information specialists felt threatened by foreign patent documents piling up in the immediate postwar years. This still rather small group of former scientists had spent many years to carve out a slightly higher status within multinational companies by abstracting and indexing patent documents instead of "ordinary" scientific documents (see Zimmerman 1965). While scientific documents could be processed effectively if only a few technical characteristics were summarized in abstracts and indexes, the processing of patent documents required the precise specification of relationships between knowledge sources available in a particular technology field. Without this knowledge, it was, according to information specialists, impossible for lawyers and scientists to properly prepare for patent examination and court proceedings (Danilof 1956: 176).

The information specialists' claim to fulfill critical legal tasks lost, however, a great bit of plausibility in the immediate postwar years when both patent lawyers and scientists began to simply ignore available patent abstracts and indexes (Danilof 1956: 177). Ignorance seemed, then as now, the most straightforward response to an excess of patent information. This is not all too surprising if one looks into the history of other "information professions", like company librarians and business journalists. Time and time again, information professions attempted to organize information masses on behalf of higher-status professions like lawyers and doctors; and time and time again, it proofed too difficult. If organizing information would not have been difficult at all, lawyers and doctors would likely not have vaccated the respective task in the first place (see Abbott 1988, 1998).

The problem that information specialists faced was that processing capacity was difficult to establish given the fundamental uncertainty about future prospects of investing in information (see Arrow 1974, chap. 2). Managers and executives often grew impatient with legal-technical projects that cost more than expected and routinely underinvested in such projects. This meant that information specialists faced declines in demand due to an inability to process information, but were also not successful in acquiring resources to address the problem with new technologies. Patent information specialists, in particular, were caught between patent lawyers who lost interest in outdated tools, and managers and executives who fixated upon the budget.

A few leading information specialists, however, offered not only a more precise diagnosis of what had caused the postwar decline in the demand for processed patent information, but also a treatment. The arguably most consequential diagnosis and treatment was presented by Hildegard Danilof, a trained chemist and patent information specialist employed by the German chemical giant BASF. According to Danilof (1956: 176-177), there were three essential information problems that BASF's small team of patent information specialists encountered on a daily basis:

First, patent positions could generally only be identified with original patent documents or a well-organized card index; unlike scientific documents, patent documents required a precise recording of small, potentially legally relevant details.

Second, official patent classifications systems, like the U.S. patent classification system, were much too crude to work with. According to Danilof, official classification classes were too broad to be of much use. In order to find patent documents similar to an invention of interest, it was necessary to sift through many unrelated documents grouped together in the same class. Information specialists had to either reclassify foreign patent documents in order to prepare foreign applications, or even worse, they had to use different national classification systems side by side; both strategies required time and money.

Third, there was a perceived deterioration in the quality of abstracts and indexes that multinational companies purchased from already existing commercial intermediaries. Danilof complained that commercially available abstracts and indexes had increasingly lost legal-technical value and were now merely useful for "information purposes". To be more useful in legal procedures, these abstracts had to be complemented with details from original patent documents. In addition, information specialists had to acquire abstracts and indexes from a range of intermediaries that specialized on different sets of countries. Under these conditions, it seemed nearly impossible to guarantee the processing of all relevant patent documents.

The fact that even information specialists in large multinational companies felt overwhelmed by these problems, and had difficulties to stay within budgets, explains, according

to Danilof (1956: 177), why "documentation centers were no longer used in line with their importance". During a meeting of the industrial property rights subgroup of the German Chemical Society in 1955, Danilof suggested two ways out: 1) interfirm cooperation within the chemical industry and, if necessary, wider circles, and 2) the use of mechanical aids. Danilof, in other words, delivered an early proposal for resolving the administrative crisis that plagued both national patents offices and corporate information experts.

3.2 The Beginnings of Private Cooperation

Danilof's prosposal for cooperation was mainly directed at patent information specialists of European chemical companies who had, like herself, claimed jurisdiction for tasks that did not fit neatly into either research or patent departments. This did not mean, however, that cooperation across company boundaries took only place in Europe. There were quite similar cooperative efforts in other parts of the world as well. In the United States, for instance, patent information specialists from major chemical and oil companies began to work together under the umbrella of the American Petroleum Institute (API) (see Brenner 1987). Moreover, there was and still is a long-established professional patent information service: the Chemical Abstracts Service (CAS). I will later describe the services based in the United States and Japan in more detail. I begin here with the cooperative project initiated by Danilof and her European colleagues because this project ultimately became the launching pad for fundamental changes in the buildup of legal-technical expertise in Europe, North America, and East Asia (Bogsch et al. 1987; Schoch-Grübler 1995; Suhr 2004).

The eventual success of Danilof's proposal is quite astonishing, given that it was met with a considerable amount of scepticism in the beginning. Company executives were not enthusiastic about sharing what seemed like critical strategic information with information specialists from competing companies. The fact that this nonetheless happened can, according to Claus Suhr (BASF) (1967: 1300), be attributed to an intervention by influential company patent lawyers who regularly exchanged ideas in a group called the "Comité Privé". This group supported not just Danilof's proposal, but also founded a working group that actively prepared a cooperative project in the area of patent information. Based on this prepatory work, in 1957, thirteen European companies founded a working party that later called itself the Patent Documentation Group (PDG) (Suhr 2004: 41).

Practical cooperation between the thirteen PDG member companies began with the exchange of patent abstracts that information experts had previously only created for their own companies' patents. BASF patent information experts in Mannheim, Germany sent, for instance, abstracts of all BASF patents to patent information experts of the Societe

Rhone-Poulence in Saints Fonts, France - and the other way around. Figure 3.1 illustrates the geographical distribution of PDG member companies in 1967. It is easy to see that the early PDG member companies were geographically close to each other, yet came from countries with different languages (French, German, English, Italian).

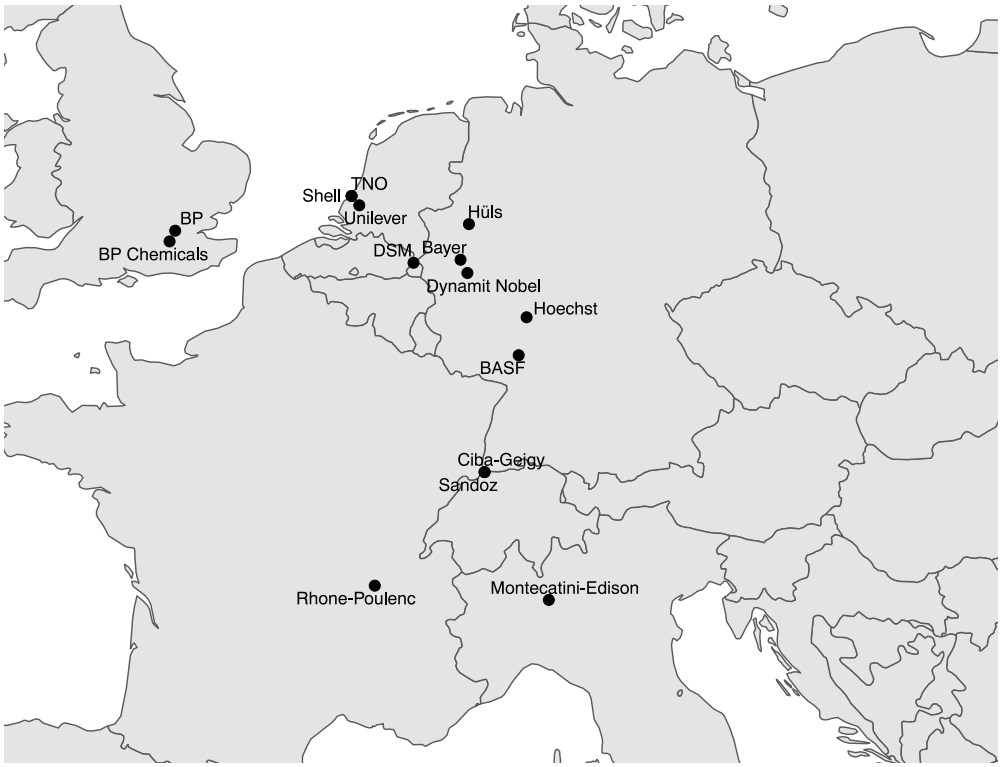


Fig. 3.1 Geographic distribution of PDG member companies
Source: The data are from Suhr 1967: 1300.

After this initial exchange of existing patent abstracts, participating information specialists decided to jointly cover as wide a spectrum of chemistry as possible. More specifically, they planned to process publications of examined and unexamined patent applications from Belgium, Germany, France, Great Britain, Austria, Switzerland, and the United States. They would, however, only cover publications if their content appeared relevant to the majority of PDG member companies; they would, for instance, not cover electronic or mechanical publications. It was quite difficult at first to figure out what exactly was relevant to whom, and how the work should be divided. The ultimate solution was to assign the work of processing patent documents to individual member companies based on technical interests and language preferences (Suhr 1967: 1300).

In addition to pure abstracting work, some PDG member companies took over higher-level tasks. Patent information specialists from Farbwerke Hoechst, for example, began work on a private classification system that converted technical fields in the official classification systems of individual countries into a uniform private classification system. This system served as the basis for the PDG's internal division of labor. Information specialists in PDG

member companies began to process a given patent publication if this publication had been assigned to them by the Hoechst classification system (Suhr 1967: 1300).

The flowchart in figure 3.2 illustrates how exactly the "cooperative processing" of patent information worked. When patent information specialists in a PDG member company were sifting trough newly released patent documents, and discovered that a given patent document was equivalent to an earlier document by the same applicant that had been published in another country, they were required to notify other PDG member companies by sending around an "equivalence notice". If it was, by contrast, not possible for information specialists to find an equivalent patent document, they were required to prepare a new abstract for the patent document in question and to distribute copies of this abstract among PDG member companies. An exemption was only made for patent documents whose subject matter was of no interest to any of the participating companies. In such a case, information specialists sent around negative notifications (Suhr 1967: 1300).

To understand the institutional logic behind private legal-technical efforts, it is helpful to know what private patent abstracts and equivalence notices looked like. These abstracts and notices were standardized in form and content and were, much like European patent applications years later, drafted in German, English, and French. They contained not just bibliographic details, such as the name of the inventor, the name of the applicant, the priority, and the publication date, but also a detailed summary of the underlying invention complete with chemical formulas, response profiles, and other prespecified items. The abstracts generally had to be drafted in a way that would enable patent lawyers to grasp the full scope of the patent claims contained in original patent documents (Suhr 1967: 1300). Note that WIPO (1994) explicitly warned that official abstracts printed on original patent documents should not be relied upon to resolve legal disputes. They were and still are supposed to be used for information purposes only.

Abstracts created by patent information specialists were used by both company patent lawyers and scientists. Scientists, in particular, had difficulties to make sense of original patent documents prepared by and for patent lawyers. To get them to report new inventions within companies - a process most scientists loathed -, patent lawyers had increasingly come to rely on information specialists who prepared abstracts not just to transfer and translate patent documents, but also to keep legal complexities and arcane language hidden. In essence, the abstracts that information specialists created enabled scientists to focus on the information that seemed most relevant for their scientific work, and patent lawyers to focus on tasks that seemed most relevant for their legal work.

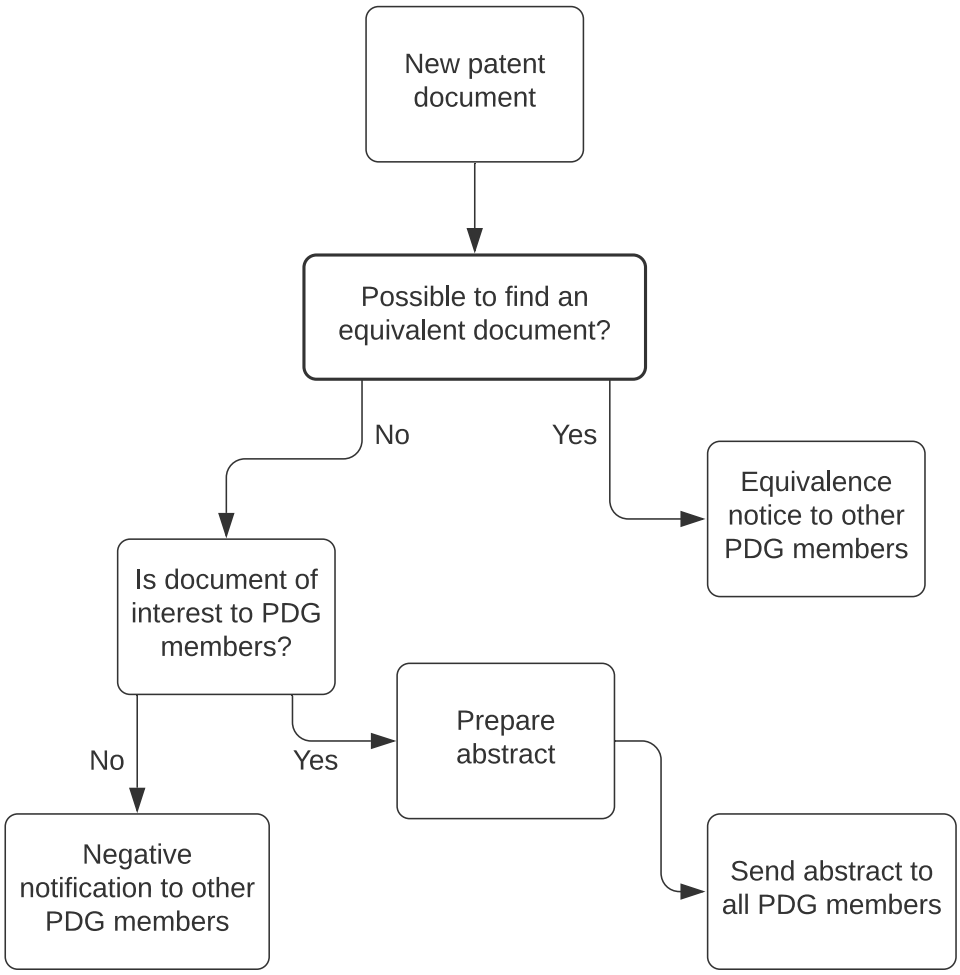


Fig. 3.2 The PDG abstracting workflow

To sum up briefly, cooperation in interfirm networks created a hitherto unknown amount of legal-technical expertise. Arguably, the PDG information specialists were particularly successful in assembling legal-technical expertise because they responded to an essentially transnational challenge with transnational expertise building. Ursula Schoch-Grübler (BASF) (1995: 86), a later PDG president, described the early PDG activities as follows:

> Very early on, industry, unable to cope with the sheer volumes of the paper patent collections, started compiling their own abstracts according to strict abstracting rules. Moreover, they also established the principle of abstracting only one member of a patent family - the so-called basic case - and found that this was sufficient for searching purposes. Further rationalisation was achieved when in 1957 a number of European chemical companies began to cooperate in the Patent Documentation Group and shared the workload.

The PDG's activities were perhaps overlooked by scholars because the formation of a longterm project between industry competitors must have appeared rather unlikely. How could a dozen of competing companies agree on a specific set of devices and then continue to work on those same devices for decades, when patent office projects were failing? The first answer is that information specialists could, despite their competing employers, more easily agree that legal-technical devices did not have to be available for many areas of technology or even countries to be useful; the tasks that patent offices set themselves were arguably more difficult to accomplish than what private information specialists sought to accomplish.

The second answer is that the social structures of multinational chemical and pharmaceutical companies in the postwar years were conducive to the development of cooperation between information specialists. Several multinational companies had just given information specialists more tasks, which were now simultaneously coming under threat, as patent offices faced a major administrative crisis. This crisis made it plausible for information specialists to see cooperative projects as true common interest projects that were likely to succeed because all participants wanted them to succeed. The initially informal agreements between PDG members reinforced this impression, inasmuch as it was not possible to replace contributions to the club good with financial payments. PDG information specialists made sure that new members would be able to make equivalent contributions to the club good by requiring for admission the maintenance of a well-coordinated patent information system that covered a broad spectrum of patent documents (Suhr 1967: 1300).

As I have mentioned, the coordination between information experts from major European chemical and pharmaceutical companies was at first not based on a complex legal construct but merely on an informal "gentlemen's agreement". Potential adjustments to common work

procedures were discussed during yearly PDG conferences as well as during spontaneous working group meetings. These meetings were important for sharing experiences and for forming new working groups addressing previously unknown issues. The project in general was, according to Suhr (1967: 1300), based on "mutual trust as well as the willingness of each partner to take each other's needs into account without overly stressing nationalistic or company interests." If one believes Suhr, the PDG became something like a "public", i.e. a network in which indivdial interests were temporarily suppressed (Mische and White 1998: 705).

Unlike in the examples for publics given by sociologists Harrison White and Ann Mische, however, the suppression of individual interests in the PDG did not further the production of a common good - high quality patent information for everybody -, but the production of a club good - high quality information for participating companies. It is important to emphasize that these private efforts were largely independent from efforts of patent offices and international organizations to establish international cooperation in the field of patent information. If the latter efforts had been more successful, they would likely have led to the early provision of patent information as a global public good.

3.3 Successes and Failures of Private Projects

While the PDG project laid useful foundations from the perspective of information specialists, the number of patent documents that needed to be abstracted also grew. To get a sense of the challenges posed by rapidly increasing document numbers, it is instructive to compare the PDG's efforts to efforts by the Chemical Abstracts Service (CAS). The CAS was and still is a division of the American Chemical Society (ACS) - the main professional society of U.S. chemists. It was founded as early as 1907, and had since then supplied chemists in the U.S. and abroad with abstracts of patents and scientific documents. It began first as a voluntary initative but gradually became more professionalized and commercially oriented. The patent abstracts prepared by the CAS were for a long time held in high esteem among information specialists in both the United States and Europe (Schofield 2004: 340-341).

This general attitude towards the CAS changed, however, during the immediate postwar years when leading information specialists complained about the "scientification" of CAS products. Stuart Kaback (2002: 138), a prominent patent information specialist, employed by ExxonMobil, wrote about the CAS of the postwar years:

> CA's document analysis in those days was based on what was actually done in examples, with hard data; information found in the claims was ignored. It could have been worse: I have been told on what I believe to be good authority that

> there was in those days a body of opinion at a high level of CAS management that believed that patents were of no value, and shouldn't be covered at all. I can't absolutely confirm that, but it's a frightening thought.

This quote suggests that information specialists in U.S. chemical and pharmaceutical companies felt similarly threatened by unprocessed patent documents as their European counterparts. Like in Europe, the preparation of legally relevant patent information seemed in danger due to a dramatic increase in patent documents. If we look at figure 5.7, we can see that the number of patent abstracts prepared by the CAS grew rather dramatically from the 1960s onwards. Just like the PDG, the CAS eventually also began to prepare equivalence notices that enabled the monitoring of duplicate chemical patents.

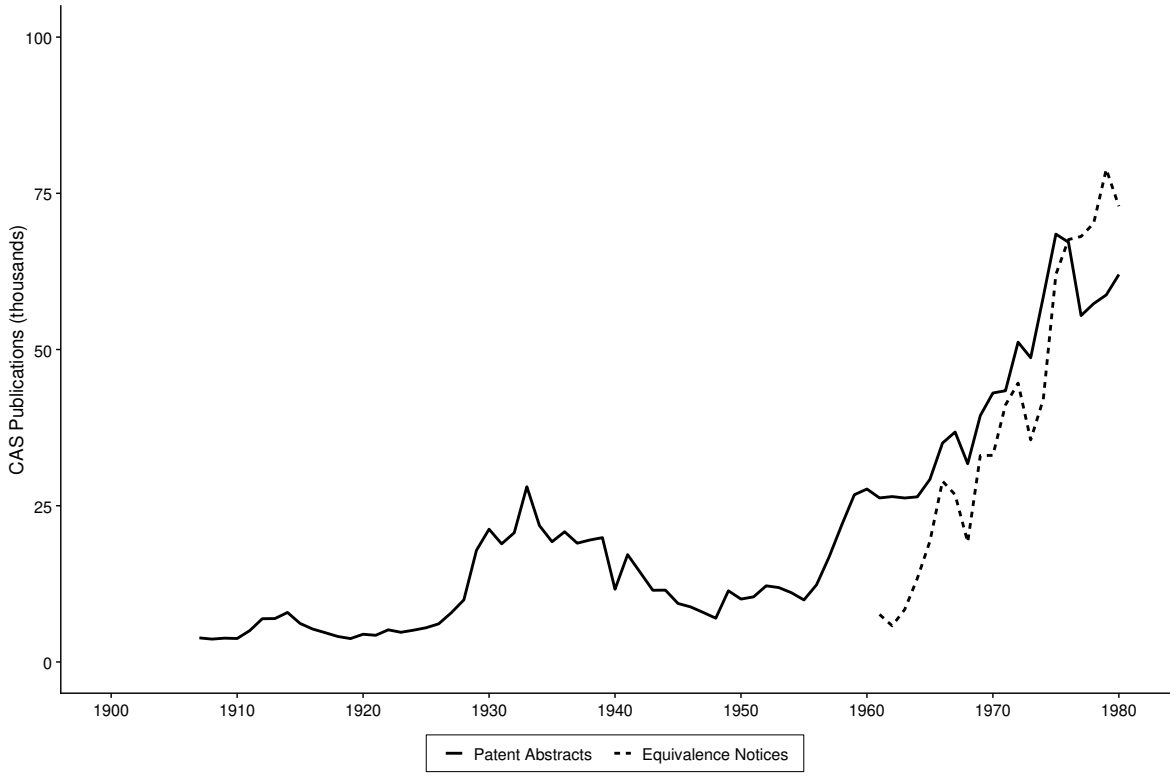


Fig. 3.3 Number of CAS publications, 1907-1980
Source: The data is from CAS 2008: 2-4.

If we compare the number of CAS patent abstracts and equivalence notices with the number of PDG patent abstracts and equivalence notices in the few years for which data is available, we can see that the PDG largely kept pace with the CAS. Figure 3.4 shows that the CAS abstracted 35,031 patents relevant for the chemical industry in 1964; the PDG "processed" 39,000 patents in the same year of which 24,000 patents were abstracted. The

PDG, moreover, created 15,000 equivalence notices for all 39,000 processed patents, while the CAS released 13,375 equivalence notices.

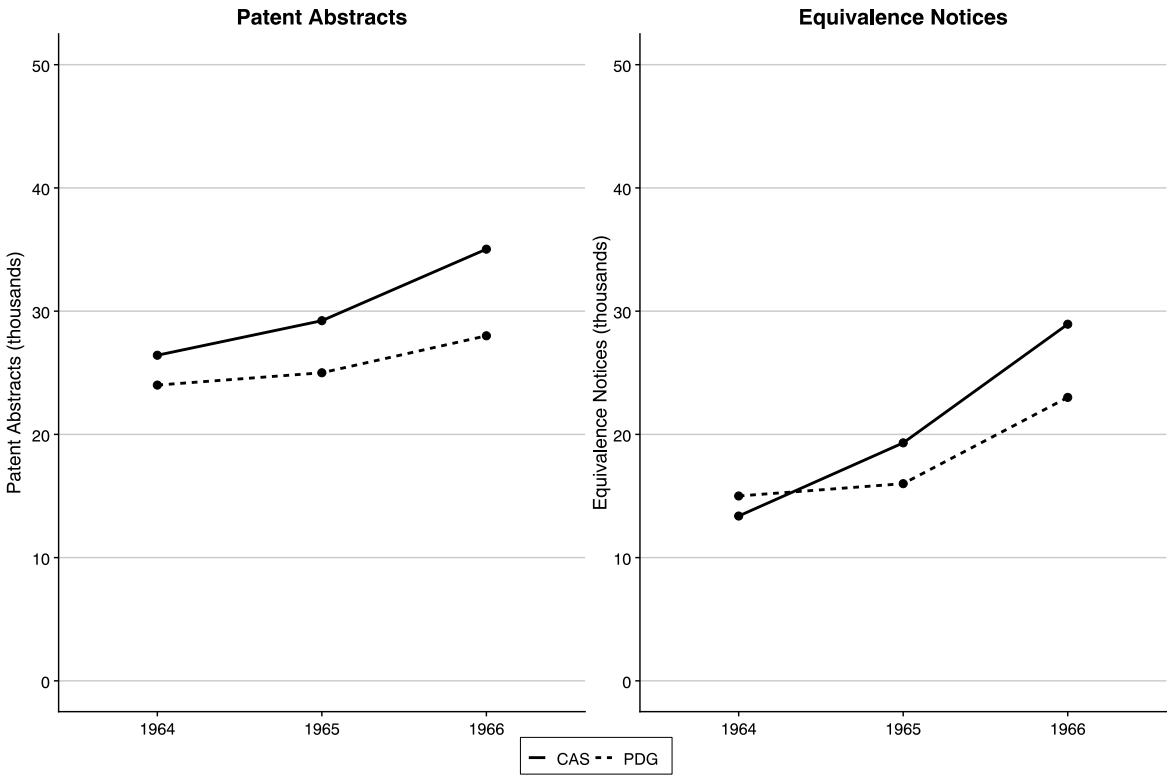


Fig. 3.4 Number of CAS/PDG patent abstracts and equivalence notices, 1964-1966
Source: The data is from CAS 2008: 2-4 and Suhr 1967: 1300.

Despite the apparent success of the PDG, the overall situation still remained far from ideal from the perspective of information specialists. They had begun to support cooperation projects because commercial intermediaries, like the CAS, could not cover patent claims as detailed and fast enough as desired. This meant that information specialists remained open to legal-technical systems and representations from commercial intermediaries when they met their requirements. This was precisely what Monty Hyams, an information specialist who worked for the British chemical company Pyrene, aspired to achieve. He founded a new commercial intermediary, Derwent, that sold patent abstracts and equivalence notices with sufficient quality to make the PDG and API reconsider their cooperative projects.

3.4 The Rise of Commercial Intermediaries

Similar to other information specialists I have quoted so far, Monty Hyams had begun his career as a research chemist and had transitioned into the role of a "patent manager". In

this role, Hyams regularly visited the British patent office where he identified passages in chemical patents that were of potential interest to his employer - the British chemical company Pyrene. He soon started a "side business" by passing the line numbers of passages to his father and several part-time employees who manually transcribed the respective passages. These transcripts were used by Hyams to create expert legal abstracts that were released in a weekly bulletin called the "British Chemical Patents Report" (Moore 2016: 5).

The number of subscribers to this report grew to over 300 in the first year and continued to grow substantially enough in subsequent years that Hyams could hire specialists in other countries. Hyams (1985: 365) paid specialists in other countries because they gave him access to patent offices that released patents earlier than the rather slow British patent office. Australia, for instance, published patents at an earlier date than the British patent office. Companies that wanted to outrun competitors were obviously interested in getting information about new patents as early as possible. In addition, patent releases in smaller countries, like Australia, had an important signalling value, according to Hyams. He followed an industry rule of thumb that said that companies would not bother to apply for a patent on an invention in Australia if the underlying invention was commercially and strategically uninteresting. In other words, he suspected that companies would find Australian patent information inherently useful to value equivalent British patents.

It seems that Hyams' former peers in large chemical companies confirmed his early coverage decisions as he was able to acquire more and more chemical companies as customers. He then immediately used the revenues from these companies to pay for the abstracting of patents from Germany and the Soviet Union - two "patent document sources" that had for cultural and institutional reasons been difficult to access for companies from Anglo-Saxon countries. Hyams and his still small network of abstractors gradually became a force in the nascent "patent information market" (Poynder 2000; Thomson 2006).

In 1955, after Hyams had founded his own company called Derwent, he stumbled upon yet another useful cross-country difference that he could exploit. He discovered that the Belgian patent office published patent applications right after it received them. In doing so, it differed from other national patent offices which, at that point, only published granted patents (Moore 2016: 5). The fact that important chemical inventions were routinely patented in Belgium made Belgian patent documents particularly attractive to Hyams. The only caveat was that the Belgian patent office only allowed in-house abstracting during its short opening hours. For that purpose, Hyams himself travelled to Brussels to abstract newly released patents documents in the reading room of the Belgian patent office. The timing could hardly have been better: Hyams was able to abstract patent applications that created a great amount

of media attention, such as the Ziegler process and the hovercraft. The Derwent subscriber basis grew to 800 subscribers (Poynder 2000; Thomson 2006).

Among Derwent's customers were, amongst others, PDG information specialists who became heavy users of the abstracts, but considered Derwent too small to compensate for patent offices failures on the one hand, and the overly scientific CAS on the other. Doubts about the availability of quality patent information under crisis conditions had provided the impetus for founding the PDG in the first place (Ochsenbein 1987: 92). The cautious stance adopted by information specialists from industry giants like BASF, BP and Shell was probably justified. Derwent was still a small family company in the 1950s that grew faster than expected due to the problems raised by duplicate patenting, Hyam's business acumen, and new duplication methods.

Despite its moderate size, Derwent had - by 1962 - abstracted more than a quarter of a million patents in the pharmaceutical industry alone. The respective abstracts were published in the "Pharmaceutical Patent Journal". One difficulty with these abstracts was that, much like many documents in government patent offices, they could only be searched by hand. To simplify the search of pharmaceutical patent abstracts, Derwent developed a solution with punch cards in which the holes in the punch cards referred to chemical structures. These cards made it possible for information experts to mechanically search for chemical structures and to immediately read the imprinted abstracts. This system thus already implemented ideas that were simultaneously discussed in national patent offices and international organizations (Poynder 2000; Thomson 2006).

Not unlike Derwent, patent offices and international organizations had decided to start with mechanization projects in chemistry and pharmaceuticals where classification problems seemed easier to solve than in electronical and mechanical engineering. The main hindrance for mechanizing patent examination in both public and private projects had been high up-front costs that both officials and managers did not want to stem. The up-front costs that Derwent faced for its pharmaceutical patent service (Farmdoc) were estimated to be about forty times higher than the costs for publishing the pharmaceutical patent journal (Poynder 2000). How did Hyams convince information experts and their managers to pay for the service?

If we believe the information experts who have written up Derwent's early history, Hyams arbitrarily restricted the number of Farmdoc subscribers to fifty. This artificial scarcity of subscriptions apparently sparked such an interest in the service that complaints about unfair competition were raised. Derwent historians explain with a wink that Hyams "reluctantly retreated" and gave companies what they wanted. Once more companies came to rely on Farmdoc, they began to demand other types of information from Derwent as well (Poynder 2000; Thomson 2006).

Even though Derwent had no previous experience with scientific literature, it soon began to offer patent and non-patent information to its subscribers. This was possible because a group of 14 German and 2 Swiss companies transferred its "ring code" and "code less scanning" to Derwent. These technologies had been developed in an interfirm cooperation project very similar to the PDG. After the handover in 1964, Derwent bundled these technologies in a new product called Ringdoc. With Ringdoc and Pestdoc, which came somewhat later, Derwent established itself as a patent information and literature service. It steadily expanded its product range and also added a service for agrochemical patents (Agdoc) and polymer patents (Plasdoc) (Poynder 2000; Thomson 2006).

While reading articles about Derwent and Hyams, it is impossible to miss how much his former peers admired his business acumen. And indeed, the ring code anecdote illustrates how he essentially tricked companies into investing in private information solutions. At the same time, we should not forget that important legal-technical expertise, like extended abstracts and equivalence notices, were collectively developed and refined by information specialists (Schoch-Grübler 1995: 86). Hyams "only" cleverly branded the linking of patent documents through equivalence notices as "patent families". The concept of a patent family for equivalent documents from different countries, however, caught on and is today closely associated with his name (Poynder 2000).

What also distinguished Hyams from other patent information entrepreneurs who tried their luck in the United States and Europe was experience and knowledge acquired in his work as a research chemist and patent manager. He sought to explicitly avoid disadvantages that arose from managing an "[o]peration [which] was getting too big for me to handle." (Hyams 2021a) To be more precise: he allowed the Canadian Thomson Corporation to acquire 50 % of Derwent. This arrangement turned out to be favorable for Hyams as he considered himself rather an information expert than a financier. Beyond these more personal considerations, the sheer size of the Thomson Corporation, one of the world's largest information companies, seemed to reassure customers and turned out to be important for political manoeuvres:

> The deal had a very good feel and I never regretted it. Having large company backing enabled us to invest in new technology, provided invaluable contacts and sources of advice, and massively reassured our customers. It also added to our credibility during the late '60s and early '70s during negotiations with national and international patent bodies over who should take the lead in a World Patent Index. (Hyams 2021a)

To sum up very briefly, during the years in which patent offices and international organizations experimented and a professional service like the CAS quarreled with the future of

patent information, Derwent pressed forward with its efforts to build a private patent and non-patent information service. As Derwent steadily increased subscribers and gained the support of the Thomson Corporation, it gradually began to look like a serious alternative to "cooperative patent processing" in groups like the PDG.

3.5 A Consumer-Led Revolution

Largely because of its growth, Derwent increasingly appeared like a viable alternative to the cooperative buildup of legal-technical expertise in which company information specialists in Europe and the United States were involved. Leading information specialists on both sides of the Atlantic gradually began to believe that Derwent could be trusted to develop industry-wide, transnational legal-technical expertise independent of patent offices and international organisations (Ochsenbein 1987: 92). By turning Derwent into the leading commercial intermediary, information specialists in Europe and the United States could hope to further secure their social standing in large chemical and pharmaceutical companies.

Derwent was at first prevented from realizing larger legal-technical projects due to large up-front costs. While Hyams got companies to invest more up-front than expected, Derwent still needed to generate revenues after its information products had been developed and distributions costs went to effectively zero. Derwent's situation was almost a textbook example of Kenneth Arrow's (1962) "information paradox" formulated around the same time. According to this paradox, the price of information goods that had initially been too high to produce anything dropped to practically zero once information goods had been brought into the world. Even though there were strategies for companies to make information goods artificially scarce, like limiting the number of subscribers, these strategies were insufficient to prevent the copying of existing information goods: a general drop in prices was typically unavoidable. That was, according to Arrow, why companies were under normal circumstances reluctant to invest in information, and why governments needed to step in.

I have already shown, however, that public investments in patent information were practically just as small as small private investments. Both patent office officials and company managers did not put sufficient amounts of money on the line. How could Derwent nonetheless stem larger and larger legal-technical projects in subsequent years? The most likely answer is that Derwent profited from the combined support of both private groups, like the PDG, and government agencies, like the USPTO and the newly founded European Patent Office (EPO). The PDG support for Derwent began with - what Derwent historians have called - a "customer-led revolution" (Thomson 2006). In essence, PDG information specialists approached Hyams and suggested that Derwent should begin with the development of a

"central patent index" (Poynder 2000; Thomson 2006). The fact that the initiative came from PDG information specialists, instead of from Derwent itself, partly explains why Hyams could charge unusually high upfront subscription fees. He later wrote about Derwent's high upfront subscription fees:

> So we at Derwent are convinced that our policy of upfront subscription fees is the only viable one in the long term, no matter how unpopular it may seem with some people at the moment. I feel certain that other quality database producers will be forced to follow suit, by imposing some form of subscription fee in addition to the hourly access charge. (Hyams 1985: 370)

The rather early arrangement between PDG information specialists and Derwent resolved the information paradox with respect to some but by no means all document sources information specialists were interested in. Keep in mind that Derwent covered at this point only chemical and pharmaceutical patent information for large companies. Hyams writes about Derwent's early package solution:

> Before the advent of online, as part of the overall high upfront subscription to our services, we had to provide magnetic tapes so that subscribers could make maximum use of the information provided. The tapes were supplied at low cost to the subscriber, being part of the overall package. The more the tapes were used inhouse, the more we liked it, since value was being derived from the service. (Hyams 1987: 149)

In light of the arrangement between PDG information specialists and Derwent, one could think that the transfers of abstracts and equivalence notices from PDG companies to Derwent meant the end of all cooperative information activities. Yet, this was not what happened. Instead of handing everything over and disbanding, PDG information specialists continued to work together; they, in fact, "expected intensified contacts with Derwent" and therefore found it "reasonable to restructure the PDG in order to improve both its organisation and representations." (Ochsenbein 1987: 92) The PDG gave up on direct cooperation, and became something akin to a knowledge sharing initiative and lobbying organization instead (Bogsch et al. 1987: 250). I will show in subsequent chapters that the PDG's intensified contacts with Derwent and other commercial intermediaries had a vastly underestimated impact on the legal-technical and legal development of patent protection worldwide.

3.6 Industry-Specific Solutions

Just like the "old" PDG, the "new" PDG was first and foremost an expert organization that brought together information specialists from large chemical and pharmaceutical companies. There were, at that time, no members from large mechanical and electrical companies. While there had been calls for cooperative patent processing in these industries, they had largely gone unanswered. An example for this is a call for cooperation in the area of automotive patent information that the German Association of Car Manufacturers (Verband der Automobilindustrie) (1970: 72) released thirteen years after the PDG had been founded:

> The exceptionally fast increase in the technical literature of all fields forces also the automotive industry to search for possibilities to supply employees in research and development with comprehensive, high-quality information. Of course, several large companies have established documentation departments a number of years ago. Yet in the future, cooperation is urgently needed. Talks that were conducted by a small expert working group on industrial property indicated that such a cooperation should not just concern patent protection, but the whole automotive technology field. To this end, a working group "documentation" was founded with the aim to facilitate an exchange of views between participating companies; ultimately, the goal is to establish a documentation ring for automotive technology.

What this example suggests is that there was principally no lack of awareness for patent information in the mechanical and electrical industries. Efforts to establish cooperation projects came, however, rather late and were typically limited to specific industries and countries. In practice, large companies had apparently assembled internal legal-technical expertise, while small and mid-sized companies had found it rational to ignore a steadily growing amount of patent information (see Lemley 2001). Figure 3.5 presents the results of a survey, conducted in Germany in the 1970s, that demonstrates that the use of patent information for the purpose of monitoring R&D activities of competitors grew with company size. In other words, whereas only 1.7% of small companies routinely used patent information to monitor R&D activities, 65.5% of large companies had buildup the respective legal-technical expertise (Dreher 1978: 45; Greif 1982: 63).

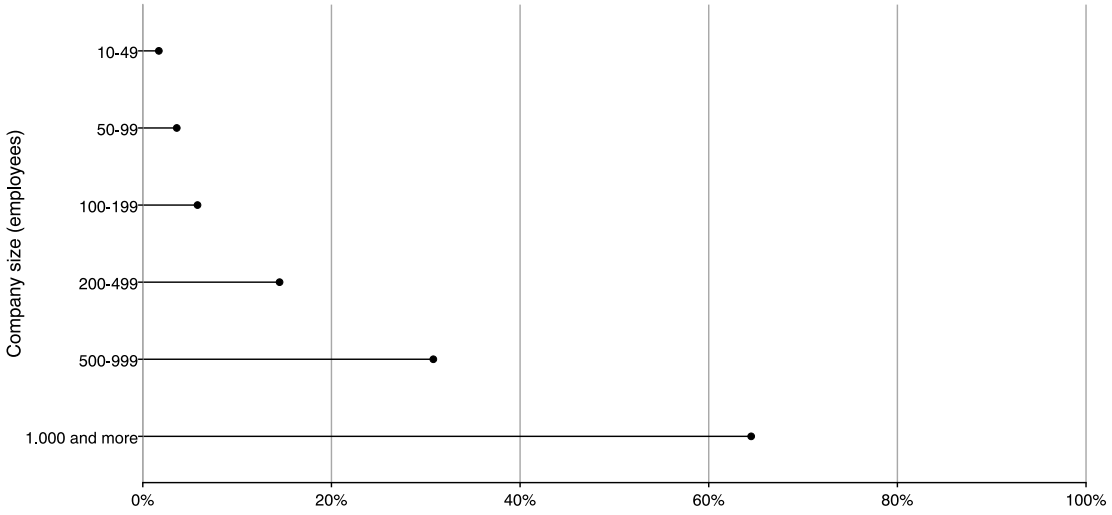


Fig. 3.5 Percentage of companies monitoring external R&D with patent information
Source: The data is from Dreher 1978: 45.

Smaller and mid-sized companies seemed to have had little choice but to hope that patent offices and international organizations would get their act together. And, in fact, some heads of patent offices in Europe and the United States did see their offices' legal-technical projects as projects from which small and mid-sized companies would profit the most if realized. The former director of the German Patent Office, Erich Häußer (1998: 7), revealed in a later TV interview that the buildup of public legal-technical expertise in the postwar decades had not just failed for technical and financial reasons, but also due to "the influence of large industry, particularly the chemical industry". Häußer (1998: 7) further told the interviewer that

> [t]he industry did not want it. The industry did not want an information system that is generally accessible. It wanted a closed-shop. It had spent a lot of money to develop its own information systems, and it did want to share the competitive advantages arising from these investments with the small "glue heaters".

While small and mid-sized companies that depended on patent offices saw little progress, the same cannot be said about large mechanical and electrical companies. In the mid-1970s, they were offered an alternative to building legal-technical expertise inhouse. Derwent began to add several non-chemical sections to the already existing Central Patent Index (CPI). The newly established interdisciplinary index was called the World Patent Index (WPI). The availability of the WPI led to a small reduction in the gap between large chemical and non-chemical companies. But the overall gap in information availability remained enormous.

In the two decades of its existence, Derwent had nearly exclusively processed chemical and pharmaceutical patent information. Stuart Kaback (1977: 144), a prominent information specialist who worked for Exxon at the time, had the following to say about the lack of progress in other technical fields:

> [T]he most elaborate retrieval techniques have been developed in areas in which there were sufficient subscribers, prepared to pay sufficient money, to finance the system. Derwent is an entrepreneurial venture, in business to make a profit. It has provided subscribers with just what they have been willing or able to pay for. At times one misses the refinements that might come from the support of government or of a prestigious scientific society, but, on the other hand, neither of these produced a Central Patent Index. It took Derwent, the entrepreneur, to do that.

Kaback's description of the postwar patent information situation is, together with Häußer's revelations, quite remarkable if one recalls the legal scholars I have quoted in the introduction. They have assumed that it was either not necessary to buildup legal-technical expertise because merely a simple on/off signal needed to be monitored, or that legal-technical expertise was necessary, but already a small audience was able to assemble a sufficient amount of legal-technical expertise. This is clearly not the case as otherwise there should have been successful legal-technical projects in all industries located in high growth, high protection countries. Finally, legal scholars believed that familiarity with a particular technology would somehow increase companies' tolerance for incurring information costs. In reality, there has been astonishingly little tolerance to incur information costs, particularly not among small and mid-sized electrical and mechanical companies.

3.7 Conclusion

What made chemical and pharmaceutical companies tolerant toward incurring information costs was not initiatives by patent offices, but initiatives by information specialists. For information specialists, the availability of legal-technical expertise had early on become a question of professional survival. They feared - rightly or wrongly - that an excess of unprocessed patent documents had led to a decline in the demand for their services. As a result, information specialists were willing to process patent documents together with peers from other companies, using devices and concepts they had previously developed independently. This unusual plan for cooperation between competing companies might not have been successful if higher-status groups in large multinational companies had opposed it.

Yet, company patent lawyers who had grown frustrated with legal initiatives to reduce the volume of duplicate patents actively supported efforts by information specialists.

Overall, then, companies with information specialists involved in cooperative projects gained access to legal-technical expertise and performed less work in-house. In contrast, companies without cooperative ties had little choice but to incur the full costs of creating patent abstracts and equivalence notices; they were essentially dependent on the very limited progress made by patent offices and international organizations. The purchase of abstracts and indexes on the "patent information market" became only later an option for companies that had not early on attempted to buildup legal-technical expertise.

Although these observations seem to suggest that companies' overall resources were the main factor in explaining tolerance towards incurring information costs, this is not the case. Just like other scholars, I find that company resources were necessary for initial investments in information specialists and their projects; but these investments were hardly sufficient as the example of large electrical and mechanical companies shows. These companies had nowhere near the amount and quality of patent information that large chemical and pharmaceutical companies had, despite substantial resource commitments (Kaback 1977; Schoeppel and Naetebusch 1995). What mattered most were expert organizations that information specialists had established early on. It was precisely because information specialists worked together in groups like the PDG that they could figure out legal-technical solutions for duplicate patenting as well as financial solutions for the "information paradox". The uncertainty associated with legal-technical investments typically resulted in severe underinvestments no matter how large company resources were.

It is certainly true that the governance arrangements described in this chapter were, for technical reasons, easier to establish between chemical and pharmaceutical companies than between mechanical and electrical companies; but while cooperation between information specialists from mechanical and electrical companies was made more difficult by technical differences, it was not made entirely impossible. By failing to take this fact fully into account, even the best economic studies tend to exaggerate the extent to which differences between "discrete" and "complex" technologies have influenced patenting behavior.

The argument presented in this chapter does not depend upon technology differences because they were not the main barriers for stronger patent rights; the main barriers were cultural and institutional differences. The critical point is that, regardless of technological differences, it would have been beneficial for companies if cultural and institutional differences had disappeared in some kind of commensuration process. A much broader availability of patent abstracts and equivalence notices would likely have enabled the adoption of stronger patent rights, even in the presence of large technological differences. I will show in chapter 7

that this is exactly what happened beginning with the 1980s. At first, however, I will discuss why harmonization was not as successful in the 1960s and 1970s as a focus on sophisticated lawyers and the malleability of law would expect.

Chapter 4

The Unexpected Success of Legal Compromise Solutions

While information specialists assembled legal-technical expertise, patent office and BIRPI officials made progress on the legal front: Beginning with the 1960s, patent office and BIRPI officials began to seriously discuss plans for regional and international application procedures. The idea behind these plans was to complement and, if possible, replace independent national application procedures with regional and international procedures (Harbers 1968; Pfanner 1969; PTC Research Institute 1970). In other words, companies should be put into a position in which they could file European and international patent applications instead of having to go through many independent national procedures.

This solution required no fundamental legal harmonization, but depended critically on the availability of legal-technical expertise which, at this point in time, was only available to large chemical and pharmaceutical companies. Without the kind of legal-technical expertise I have described in the previous chapter, it seemed unfeasible for patent offices to perform searches in different languages and classifications. Even large patent offices were hardly capable of examining applications in many different languages and classifications if there were no abstracts and indexes to rely on (Pfanner 1969: 338-339; Bogsch 1995: 10).

Of course, more fundamental legal harmonization with respect to languages and classification systems could still have avoided patent offices' and BIRPI's growing dependence on legal-technical expertise. There was, however, no political consensus that would have made English the only language in which patent documents were drafted, or that would have made the International Patent Classification (IPC) the primary patent classification (Bogsch 1995: 10). The only broadly acceptable way forward included the buildup of legal-technical expertise that did not require uniform national systems, but instead facilitated cooperation across diverse systems (see Halliday and Carruthers 2009).

My objective on the following pages is to examine why fundamental legal harmonization initiatives failed and how early patent strengthening took on a procedural character (Ginarte and Park 1997; Park 2008, 2021). In contrast to existing accounts, I will show that regional and international procedures did not become acceptable because of legal or political breakthroughs, but because of anticipated legal-technical breakthroughs.

4.1 Language-Based Mistrust

The starting point was the same for both legal and legal-technical initiatives: companies and patent offices were essentially overwhelmed by foreign applications. When patent office and BIRPI officials discussed new rules, they focused primarily on rules that avoided the examination of multiple applications for the same invention (Pfanner 1969: 336). Figure 4.1 illustrates that especially patent offices of smaller countries, such as Canada, the Netherlands and Sweden, were flooded with foreign patent applications. The share of foreign applications in Canada in 1970 was 94%, in the Netherlands 87%, and in Sweden 76%.

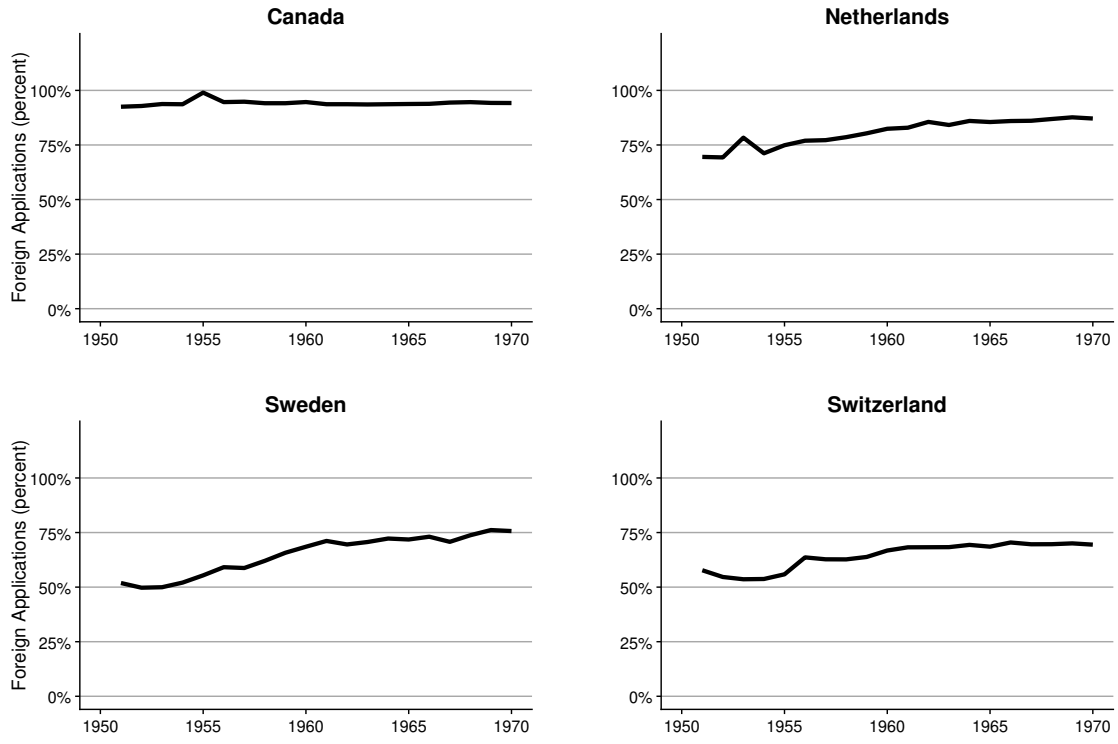


Fig. 4.1 Percentage of foreign patent applications in large countries, 1951-1970
Note: Missing values were imputed using linear interpolation.
Source: The data are from Federico 2011 and WIPO 2021b.

In comparison with smaller countries, the share of foreign patent applications in larger countries, like the United States, Germany and Japan, seemed tolerable: as figure 4.2 shows, 59% of patent applications in the United Kingdom in 1970 had foreign origin, 50% of applications in Germany, 23% of applications in Japan, and 30% of applications in the United States. Still, as demonstrated at the beginning of the last chapter, "examining offices" of all sizes were under pressure and even came close to breakdown in the mid-1960s (Beier and Straus 1977: 399). The pressure for smaller countries was merely especially high, which likely explains why the Netherlands was first to experiment with transitory solutions such as deferred examination.

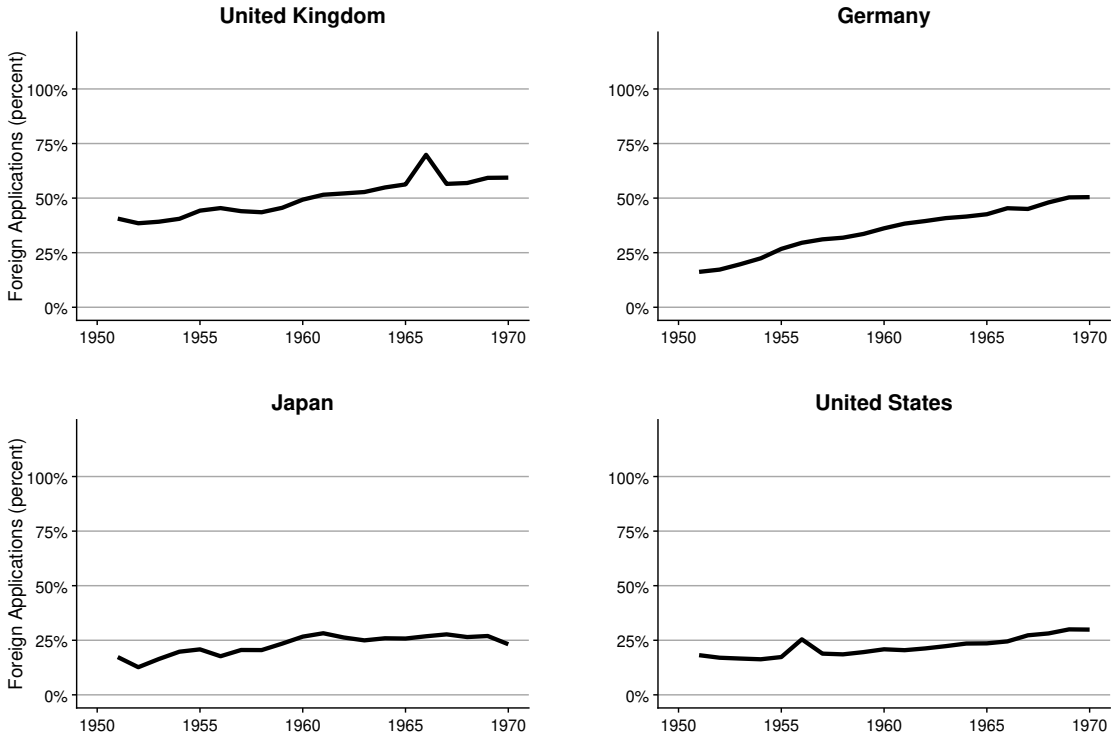


Fig. 4.2 Percentage of foreign patent applications in small countries, 1951-1970

Note: Missing values were imputed using linear interpolation.
Source: The data are from Federico 2011 and WIPO 2021b.

Naturally, not every foreign application was a duplicate application; but foreign applications were generally more likely to generate difficulties given that the prior art was never as readily available as in the case of domestic applications (Weissman 1973: 617). The first concrete plans to address the problem of rising foreign applications began to circulate in the 1960s and proposed the introduction of a single "European patent" and a single "Scandinavian patent". These plans reflected an implicit consensus among patent office officials:

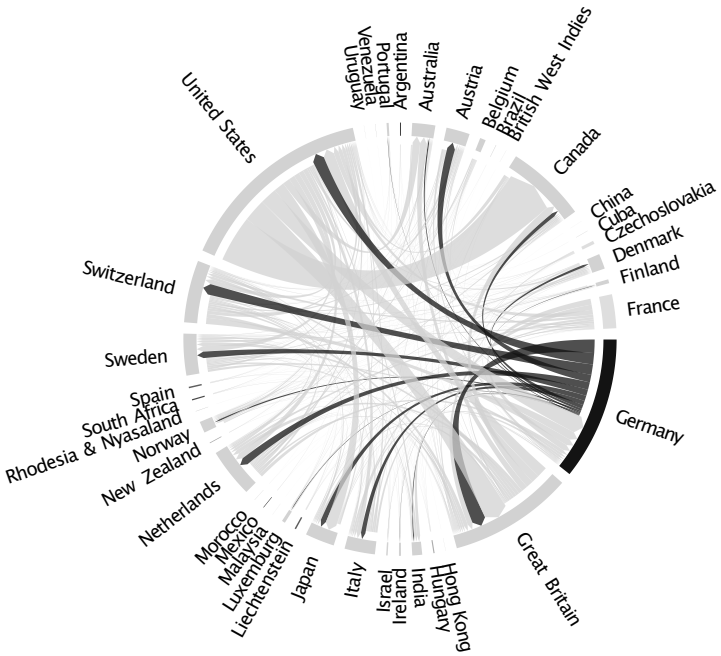
any replacement of national examination procedures should first be attempted by groups of smaller countries with similar economic and political goals (Pfanner 1969: 336).

The replacement of examination procedures among large countries was supposed to only proceed cautiously. Klaus Pfanner (1969: 336), government director at BRIPI, explained that "the goals pursued on the global level (...) had to be more modest because of existing differences in economic and patent systems". In his opinion, the primary goal at the international level "could not be an international patent, but only that certain steps that were necessary for acquiring patent protection were combined through an international procedural system with binding effect for several states." (Pfanner 1969: 336)

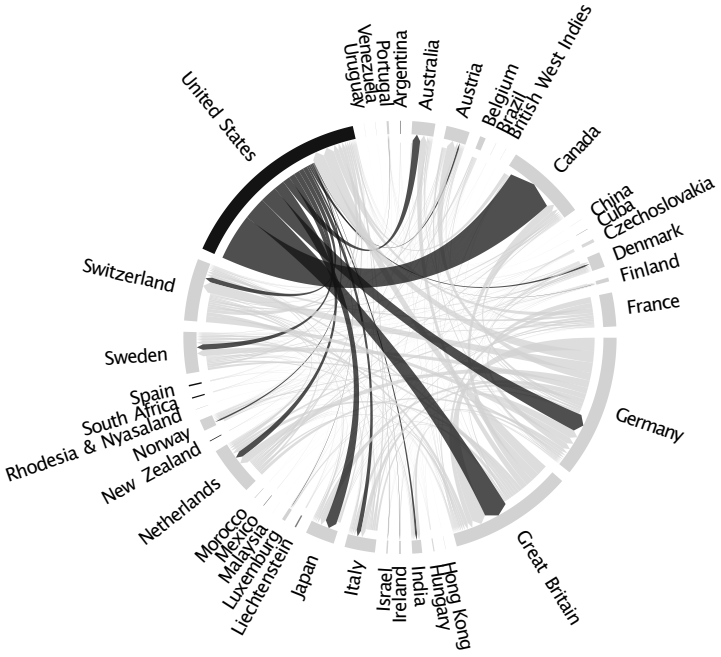
An essential reason for this rather restrained approach was, according to long-time WIPO General Director Arpad Bogsch, that countries insisted that patents which would be valid in their territory were made available in the national language. Bogsch (1995: 10) explained:

> [S]ubject to certain exceptions - a country usually does not trust the judgement on patentability of a patent office other than its own. This lack of trust is also partly connected with the problem created by the multiplicity of languages, since the examiners of - say - the German Patent Office are less likely to understand alread granted patents (to be searched) in the Japanese language than those in the German language, and vice versa.

The continued relevance of "language-based distrust" made it legally and politically difficult, if not impossible, to establish an international patent that would be considered valid in all countries of the world. Even companies based in Germany and the United States, large exporting countries, tended to file disproportionately many applications in culturally and institutionally similar countries during the postwar decades. Figure 4.2 a) shows that companies based in Germany sent nearly as many patent applications to German-speaking Austria and Switzerland as to the United Kingdom and the United States. Of course, this partly reflects that German companies were more likely to sell products and set up shop in neighboring countries than overseas. Yet, U.S. companies, which were already deeply entrenched in European markets, were apparently similarly hesitant to send applications to countries with different languages and classification systems. Figure 4.2 b) suggests that companies based in the United States sent far more patent applications to Canada and the United Kingdom than to Germany and Japan.



(a) Germany



(b) United States

Fig. 4.3 Network of foreign patent applications, 1951-1961

Source: The data are from Federico 2011.

To further assess the plausibility of Bogsch's concern about language-based mistrust, I have estimated the effects of language differences on bilateral patent applications in what economists call gravity equations - see Technical Appendix 2. The gravity equations were separately estimated for 54 countries in each year between 1951 and 1961; they include measures for 1) language difference, 2) spatial distance, and 3) the sharing of a border. Figure 4.4 shows continually negative effect of language differences on patent applications between country pairs. This negative effect of language differences, which is consistent with Bogsch's insistence on language-based mistrust, seems to have slightly declined over time.

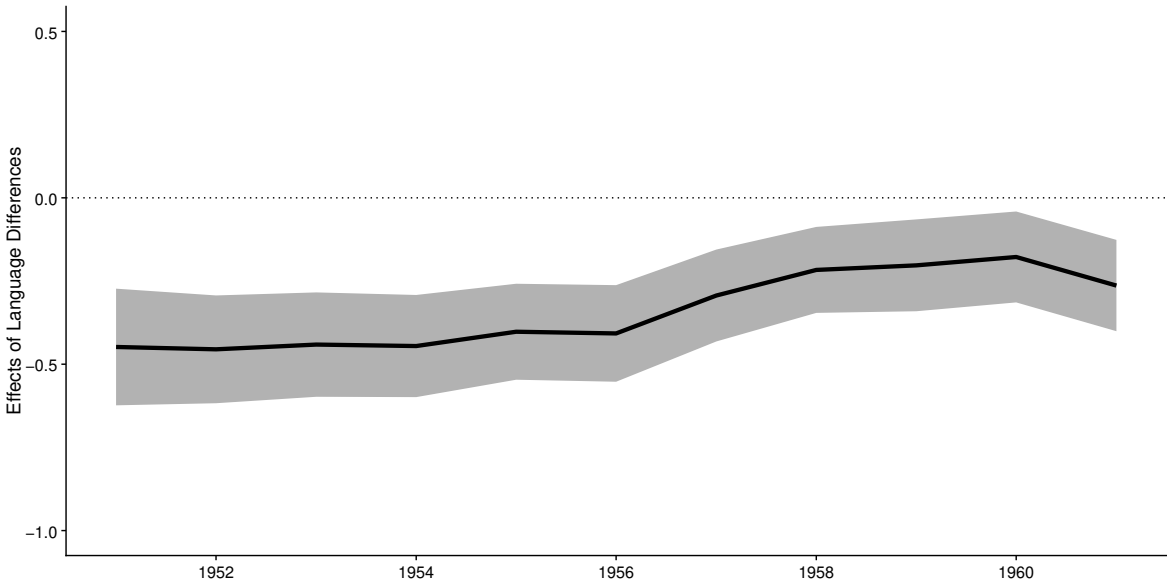


Fig. 4.4 Gravity estimates from model predicting bilateral patent applications, 1951-1961

Note: 95 percent confidence intervals are shown as grey bands. The model includes controls for spatial distance, common border (contiguity), and colonial relationship (not shown). Included countries: Argentina, Australia, Austria, Belgium, Bermuda, Brazil, Canada, Switzerland, Chile, China, Columbia, Cuba, CZSK, Denmark, Egypt, Spain, Finland, France, United Kingdom, Greece, Hong Kong, Hungary, Indonesia, India, Ireland, Iceland, Israel, Italy, Japan, Lebanon, Sri Lanka, Luxembourg, Morocco, Mexico, Myanmar (Burma), Malaysia, Netherlands, Norway, New Zealand, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Sweden, Tunisia, Turkey, Uruguay, United States, USSR, Venezuela, Western Germany, South Africa

Source: The data are from [redacted]

Language-based mistrust could in theory have been overcome by corporate lawyers who supported legal harmonization initiatives. Yet, such harmonization initiatives were quite often stopped in their tracks by lawyers in private practice. The best example for this is a legal harmonization initiative by industry-oriented government lawyers within the United States during the Johnson Administration; this specific initiative failed due to fierce resistance by lawyers in private practice who found harmonization in favor of "European rules" unacceptable at that point in time.

Giles Rich (1967), former patent lawyer and judge at the U.S. Court of Customs and Patent Appeals, complained in a speech at the "The Lawyers Institute" that

> there is too much concern in The Report [of President Johnson's patent commission] with "harmonization" of the U.S. patent systems and the systems of Western Europe, with a view to the utopian dream of a world patent system. The only justification for harmonizing our system with theirs is that it would be to our national advantage. This could be for two different reasons:
>
> (1) that Europe's systems are better than ours from the standpoint of national progress in useful arts; and (2) even if they are not, it is to our national advantage to become more of an integrated part of some sort of international or common market type of system.
>
> I think we are a long, long way from a world, or even a Western European federated, system – except in such collateral technical aspects as central searching or central information storage and retrieval. We therefore should not rush or depreciate our system merely for the sake of harmonization.

In the end, the plans of President Johnson's patent commission were abandoned and even the U.S. Patent Commissioner Edward Brenner (formerly an Exxon vice president) was replaced in what Business Week (1968: 57) called a "bloodless coup". Brenner had apparently sought to "bring Washington's patent laws into tune with those of other countries" (Business Week 1968: 57). His successor, William Schuyler, by contrast, had been "partner in a large Washington, D.C., patent law firm" and was "the spokesman of opponents of patent law change". Business Week (1968: 57) wrote about him that as "chairman of the conservative American Bar Asssn.'s Patent, Trademark & Copyright Committee he has fought against the more far-reaching proposals for patent reform bills as well as some plans for closer international patent cooperation."

Prominent patent lawyers and judges who clang to national exceptions were, however, not the only opponents of more fundamental legal harmonization. Michael Meller (2000: 606), an outspoken supporter of a world patent system, explained that "patent offices around the world did not wish to see any diminution of their importance with reduced work in their respective countries". And as if that was not enough: "governments around the world did not wish to see their income from the patenting process and subsequent maintenance fees in their countries diminished in any way." (Meller 2000: 606)

This means there were a number of reasons why language-based mistrust between countries could not easily be overcome; vested interests in national rules made it difficult for patent offices and international organizations to establish a legal and political consensus

for the harmonization of national patent rights. In the absence of harmonized procedures, the filing and examination of foreign applications remained practically difficult for both patent offices and companies. Given these constraints, BIRPI officials essentially followed Rich's (1967) recommendation and began to focus on "collateral technical aspects".

4.2 The International Application Procedure

The fact that patent offices continued to mistrust each others' patentability assessments explains to some extent why BIRPI officials believed they needed to simultaneously pursue legal and legal-technical initiatives. BIRPI officials began to restart work on legal-technical projects nearly at the same time as they began work on the Patent Cooperation Treaty (PCT). The PCT plan was, in essence, a plan for a legal-procedural system that would give companies the opportunity to file an "international application" in a single language at a single patent office (Bogsch 1995; Pfanner 1969).

The international application was conceived of as preliminary patent application at the international level that could later be split into multiple national applications. For this to work, companies only needed to "designate" different countries in the international application. Basically, they needed to provide a list of countries in which they intended to acquire distinct patents for the same underlying invention.

To give a more concrete example, figure 4.5 shows in the left column that the Reynolds Metals Company filed an international patent application for ultrasonic treatment based on an earlier "priority application" in the United States. This international application lists all "designated" states in the right column: Austria (AT), Australia (AU), Brazil (BR), Switzerland (CH), Germany (DE), France (FR), Great Britain (GB), Japan (JP), the Netherlands (NL), Norway (NO), Sweden (SE).

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau EP.0035545

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3: G01N 29/02	A1	(11) International Publication Number: WO 81/00768 (43) International Publication Date: 19 March 1981 (19.03.81)

(21) International Application Number: PCT/US80/01048
(22) International Filing Date: 13 August 1980 (13.08.80)
(31) Priority Application Number: 074,800
(32) Priority Date: 12 September 1979 (12.09.79)
(33) Priority Country: US

(71) Applicant: REYNOLDS METALS COMPANY [US/US]; 6601 W. Broad Street, Richmond, VA 23261 (US).

(72) Inventor: MANSFIELD, Thomas, L.; Route 5, Box 156D, Louisa, VA 23093 (US).

(74) Agent: GIRARD, Arthur, L.; Reynolds Metals Company, 6601 W. Broad Street, Richmond, VA 23261 (US).

(81) Designated States: AT, AU, BR, CH, DE (European patent), FR (European patent), GB (European patent), JP, NL, NO, SE.

Published
With international search report

(54) Title: PROBES FOR THE ULTRASONIC TREATMENT OR INSPECTION OF MOLTEN ALUMINUM

(57) Abstract

Special probes (1) for the ultrasonic inspection or treatment of molten aluminum. Such probes employ a special working tip (5) which is made essentially of titanium and is capped with a coating of aluminum by a vacuum vaporization process. Also described is a process for making such probes.

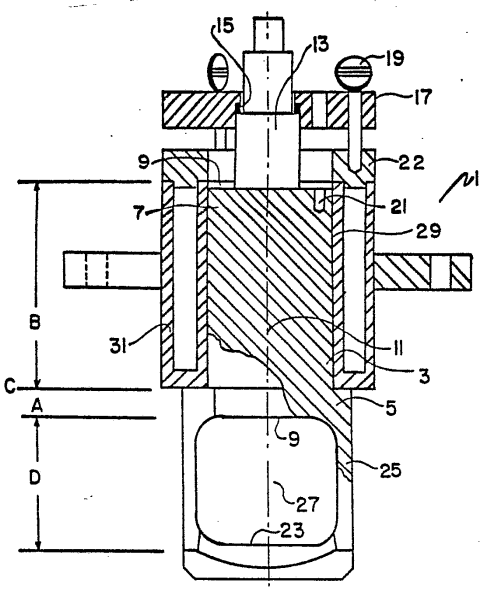


Fig. 4.5 Example of a PCT application, 1981

The PCT is frequently likened to a superhighway for patent applications: it has allowed companies to file foreign applications without preparing different national applications and, more importantly, without triggering the costly creation of distinct national search reports. The trick was to replace a large number of national search reports with a single international search report. BIRPI officials essentially layered the international application procedure on top of existing national application procedures (Drahos 2010; Pfanner 1969).

Figure 4.6 illustrates what the planned PCT system looks like. Everything began and still begins with an international application filed with the receiving offices, which could be national or regional patent offices, or BIRPI. The international application was then supposed to be transmitted to so-called international search authorities (ISAs), i.e. to large patent offices capable of carrying out uniform searches and preparing opinions. When the ISAs had completed reports and opinions, they were supposed to transmit them to BIRPI. Finally, based on the communicated search reports and opinions, the designated offices had to ultimately grant national or regional patents for the same underlying invention (see WIPO 2020).

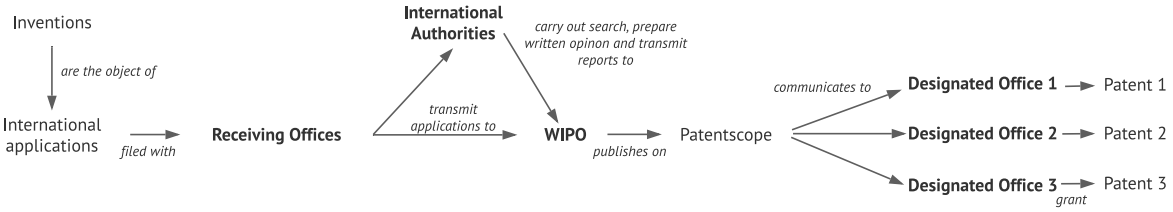


Fig. 4.6 The PCT system

Source: Adapted from WIPO 2020.

The key piece of information or expert statement around which this legal-procedural system has been structured is the search report. The point of each search report is to identify as much prior art as possible. From a purely legalistic point of view, it appears possible that patent examiners can find all prior art for a particular invention: your mouse trap is either novel in the history of the universe or it is not. In practice, however, novelty assessments depend directly on factors such as examiners' skills, devices, concepts, and, of course, the time allocated for each search (Bessen and Meurer 2009; Jaffe and Lerner 2007; Lemley and Sampat 2012; Rai 2009).

No matter how much time patent offices allocate for a search, however, patent examiners are ultimately forced to "satisfice" (see Simon 1956) and submit a search report to the applicant - be it on the national or the international level. As figure 4.7 illustrates, the final product - the search report - again looks in essence just like a list of patent documents that

claim "dangerously similar" inventions; the applicant can use this list to reformulate claims or to abandon the application altogether. Basically, applicants can withdraw applications for economic and strategic reasons, which I will discuss in more detail below.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/080008

A. CLASSIFICATION OF SUBJECT MATTER
IPC: B25C 5/06 (2006.01)
USPC: 227/8
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S.: 227/8, 120, 121, 123, 127, 128, 131

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST (DERWENT, USPTO, USPGPUB, JPO, EPO) - electromagnet?, magazine?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y A	US 4,375,867 A (NOVAK et al.) 08 March 1983 (08.03.1983), column 3, line 65 - column 4, line 49, and figure 3	1 and 2 -------- 3 and 5-15 4 and 16-20
Y	US 4,183,453 A (BARRETT et al.) 15 January 1980 (15.01.1980), column 1, lines 40-49; column 2, line 40 - column 5, line 2; column 6, line 34 - column 7, line 7; and figures 5-7	3 and 5-10
Y	US 3,041,614 A (D'HAEM et al.) 03 July 1962 (03.07.1962), column 4, line 76 - column 5, line 23	11-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 January 2015 (05.01.2015)	09 January 2015 (09.01.2015)
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Patent Examiner Telephone No. (571) 272-4300

Fig. 4.7 Example of an international search report

Before I get into filing strategies, I want to stress that even though BIRPI officials promised to simplify foreign patenting, they did so by requiring more, not less comprehensive search work from patent offices. In order to prepare international search reports it was no longer enough to rely on patent and scientific documents from a handful of countries: documents had to come from a larger pool of countries. The PCT required the partial realization of one of the longstanding fictions of international patent law, namely that patent offices would really assess the universal novelty of inventions. If we believe eminent patent lawyers, this had previously been a fiction "given the fact our patent Examiners and Classifiers do not generally posses foreign language capability." (Meller and Riddles 1988: 868)

In order to reduce the search work required from examiners, BIRPI officials included rules that defined precisely which documents, from which time period, as well as which types of non-patent documents, had to be considered in the search process, and which documents could safely be ignored. This legally specified set of documents - the so-called PCT minimum documentation - contained, despite all precautions, several million documents. About one million documents was added on top of the existing pile each year (Bogsch 1995: 10). What this meant was that the preparation of international search reports was not a task that could be handled by small national patent offices lacking any substantial document collection.

And indeed, not every patent office was seen as capable of preparing international search reports: only so-called "international search authorities" (ISAs). Potential ISAs, according to Pfanner (1969: 338), were the International Patent Institute (IIB) in The Hague as well as large national patent offices in Munich, Moscow, Tokyo, and Washington. What these patent offices had in common was that they had substantial document collections and each employed at least more than one hundred patent examiners.

BIRPI itself was ascribed the task to forward the search report and the application to all PCT contracting states designated in an international application. BIRPI also had to publish both the international application and the international search report until 18 months after the priority date. It was only after the applicant had also paid fees in the designated contracting states and after necessary translations had been supplied that the application process in a narrower sense was completed, and the examination process began (Pfanner 1969: 338-339).

4.3 A Midway Solution

Already at the early planning stage, the PCT looked like the system that Peter Drahos (2010: 60) later criticized as "[a] procedure, another procedure and yet more procedures". One important reason for this was the language-based distrust between countries described above. This distrust made it impossible to grant foreign patent rights without a series of complex

national and international procedures. Another reason was that BIRPI officials intentionally wanted to give applicants more time to assess country-level applications decisions. Klaus Pfanner (1969: 337) explains the BIRPI reasoning as follows:

> The advantages of the PCT plan for an applicant are primarily that an international application that he files at his own patent office reaches the same effect in several patent offices of his choice, and that he has from the day of filing 20 month (and by using the international examination procedure even 25 month) available before he has to hand in translations and pay fees in other countries. He has therefore more time to think if and where it would be profitable to file for protection. To make this decision, he can - no matter from which contracting state he is from -, rely on an international search report of high quality, maybe even on an international examination report. These reports will make it easy for him to assess the value of his inventions.

The international search report that Pfanner mentions here was thus strategically and economically useful: it allowed companies to give up applications that seemed no longer valuable or to file applications that were more speculative to begin with. International search reports, as well as international examination reports, provided useful overviews over what potential competitors were up to. International examination reports, more specifically, could be requested after the application procedure had ended. Much like the international search report, the international examination report was to be prepared by a large patent office or the International Patent Institute (IIB). From a practical perspective, examination reports were seen as preliminary patentability assessments that the IIB or large patent offices carried out as international search authorities (ISAs) (Pfanner 1969: 338). In the course of such preliminary examinations, ISA examiners checked more thoroughly whether the underlying invention could indeed be considered novel, non-obvious, and commercially usable. They thus did the same work national patent examiners did during a national examination procedure, with the key difference that they by default considered information from more countries.

One objection against the narrative presented thus far could be that patent offices had long been obligated to examine inventions for universal novelty. After the first patent offices had been established in the nineteenth century, it had no longer been acceptable to grant patents for inventions that someone else had already patented in another country (see David 1993). Yet the fact that this was no longer acceptable did not mean that patent offices had sufficient information available to stop it. Michael Meller (1997: 220) notes that particularly "the Japanese have long been using their language as a shield vis-á-vis foreigners"; this, obviously, made it difficult for foreign patent examiners to know what was patented and not patented in Japan and created language-based mistrust.

Apart from the example of Japan, most real-world assessments of novelty and non-obviousness remained effectively limited to documents from a few countries. Because of cultural and institutional differences, it was simply too costly for patent offices and companies to monitor the entire patent literature, let alone the non-patent literature. Under these conditions, BIRPI officials attempted to decrease the costs of patent offices and companies while maintaining national patent systems. If we believe Arpad Bogsch (1995: 10), then the PCT was essentially a compromise: "a midway between a single procedure for the whole world (a utopia) and as many procedures as there are countries (the situation in 1970)". The early agreement on this compromise solution was, for Bogsch (1995: 10), "indispensable for the success of the PCT. It is, indeed, the explanation of its success."

The PCT was signed in 1970s after four years of consultations under the auspices of BIRPI. One of the key reasons for the success of the consultations was, according to Bogsch (1995: 11), that the United States - the leading technology and patent nation -, at the time really wanted the plans to be implemented. Bogsch claims that he, and the later "overthrown" U.S. Patent Commissioner Edward Brenner, had sketched the first ideas for the system in 1966 in Washington. He also emphasizes the exceptional interest large U.S. companies had taken in the adoption of the plans. This is consistent with archival material from the United States Patent Office that demonstrates great willingness among U.S. companies to sponsor a diplomatic conference for the adoption of the PCT in Washington. Among the generous donors were Monsanto, Xerox, Hughes Aircrafts, Texas Instruments, Chevron and Dow Chemical (see Banner 1970).

The fact that patent office officials from Western Europe supported the PCT plans from the get-go should not come as a surprise given that plans for a European Patent Convention (EPC) had already made the rounds in the 1950s. The respective planning had, however, come to a temporary standstill. If one believes Bogsch (1995: 11), the PCT plans were important to revive plans for a European Patent Convention (EPC). The pressure to act had not gone away, but had increased further due to the interrupted growth in foreign patent filings. According to Bogsch (1995: 11), "[t]he overburdening of the national patent offices was a real and great problem at the time."

In summary, it can be said that patent officials from international organizations and government representatives could at least temporarily agree that national patenting procedures had to be complemented or replaced, but were not yet sure with what system exactly, except that a single procedure for the whole world was out of reach. The PCT was in many ways a legal compromise in need of legal-technical concretisation.

4.4 Decentralized vs. Centralized Examination

The existence of broad support for an international procedure did not mean that government representatives also agreed on legal-technical aspects. This can be seen in the controversy over the question whether there should be a single or multiple international search authorities. In the original PCT proposal, BIRPI officials had left open whether patent searching should be centralized or decentralized. A decentralized solution would have meant that the International Patent Institute (IIB) in The Hague, as well as the patent offices in Munich, Moscow, Tokyo and Washington became search authorities (Pfanner 1969: 338)..

This proposal for a decentralized search system was criticized by representatives of Western European companies and government officials who argued that only a centralized search system operated by a single international organization could guarantee the necessary quality and uniformity of searches. They essentially wanted to make the International Patent Institute (IIB) the one and only international search authority (Bogsch 1995: 12). From this point of view, no other international organization or national office had as much capacity to perform international searches as the IIB. And indeed, unlike large national patent offices, the IIB had already carried out searches on behalf of France, Belgium, Luxembourg and the Netherlands (OECD 2004: 38); it could therefore claim unmatched experience in vetting patent documents in different languages and classification systems.

The opponents of a centralized system objected that the IIB proposal would require staff and system growth in The Hague, which could be avoided if the treaty would rely on national patent offices instead. By putting the search burden on more shoulders, the PCT experiment became presumably less risky. Centralization opponents also argued that the IIB proposal did not get rid of the practical problem that many inventions were first filed and searched nationally, and were only later "refiled" abroad. What this meant was that many searches that had been completed at the national level in Washington, Moscow, Tokyo or Munich would have to be repeated at the international level. This need for double searching seemed to be in open conflict with the overarching goal of avoiding duplicate work (Pfanner 1969: 338-339).

Naturally, there were not just economically minded objections against the centralized solution, but also political ones. For government representatives from the Soviet Union, Japan, and the United States, the IIB was simply too far away and too unknown. It seemed implausible to assign the task of international searching to a distant, unfamiliar European organization when patent offices in the Soviet Union, Japan, and the United States possessed large internal document collections and staffs. The fact that the IIB was short of staff and systems at the time did not help the centralization cause either. Particularly worrisome for Japanese and Russian officials seemed to have been that it was not clear whether international

patents applications could even be filed in Russian and Japanese. Respective language capabilities would first have to be established in The Hague (Pfanner 1969: 339-340).

The decentralized solution was, in sharp contrast, far less controversial, but not exactly free of problems, either. For starters, there were concerns about the uniformity of searches. It was far from clear how national patent offices with different operating languages and classification systems were supposed to generate uniform search reports (Pfanner 1969: 340). To do so, they would have to search much more information than they had had to search in searches under national patent laws. Furthermore, supporters of the decentralized solution overlooked that their favored solution made it necessary to achieve similar examination capacity as the IIB in not just one but several offices.

If one considers language challenges that came with millions of patent documents from a large number of countries, then it was not immediately clear why independent patent offices should have been as good at this task as the IIB. Even though a decentralized solution made it possible to assign applications to patent offices which examined in the respective languages, this did not simplify the task of identifying documents in third-party languages and classifications. To put it differently: while it was easier for USPTO examiners to examine English documents instead of Japanese documents, it was not easier to assess the general patentability of English documents against Japanese, Spanish, French, Italian or Korean documents. To be able to do so, the USPTO and other large patent offices would have to become much larger: they essentially would have to become all as large as the IIB under the centralized solution.

4.5 The Problem of Uniform Documentation

Given that the decentralized solution ultimately prevailed, it is relevant to ask why resource constraints of individual patent offices did not carry as much weight as resource constraints of the IIB. According to Pfanner, the reasons for this were neither strictly economic nor political but legal-technical. He specifically argued that prospective international search authorities could resolve language and organization problems with the help of abstract services:

> The tasks of an international search authority will only be transferred to a facility if it guarantees to possess the minimal documentation in is examination material. It further has to demonstrate that its examination material organization and its language processing capabilities are sufficient to search the entire minimal documentation (language skills of examiners, full text translations, or abstract services in a commonly accessible language). (Pfanner 1969: 338-339)

In addition to abstract services, which could be accessed even if internal patent office operations were in complete disarray, like in the case of the USPTO (see Weissman 1973), the great hope was that a series of future technological developments would resolve problems that stood in the way of a decentralized solution. Pfanner (1969: 339) promised leading patent lawyers a series of technical advances:

> The problem of uniform documentation will be solved automatically if the envisaged efforts to create a uniform system of mechanical documentation with the help of electrical computers and other mechanical information mediums will be successful. The database then available can be fed by all producers of technical information relevant for patenting purposes; it will be possible to use this database either via interconnected calculation machines in different locations or in decentralized calculation centers where information will be duplicated without additional expenses.

Essentially, Pfanner argued that copying patent information from a centralized database would allow patent offices the implementation of a decentralized solution. This somewhat paradoxical sounding argument becomes sensible if one recognizes that the implementation of a decentralized solution hinged on the question how patent documents in different languages and classifications could be searched in individual offices.

If searching issues could be resolved with the help of a centralized, digital database, then the resistance against a decentralized solution would crumble, particularly in light of existing legal and political reservations against a centralized solution. This was actually what happened: the European supporters of the centralized solution gradually switched over to the decentralized solution (Bogsch 1995: 12). They insisted, however, on incorporating a potential future shift to a centralized solution in the PCT text. Paragraph 16(2) of the PCT still states: "if, pending the establishment of a single International Searching Authority, [...]".

From a more general point of view, the PCT consultations show how international legal agreements can be influenced by legal-technical expertise that is rarely if ever mentioned in public and academic debates. While it remains true that legal and political coalitions were central, it appears equally true that expectations about legal-technical expertise altered how patent office and BIRPI officials argued and bargained. In other words, legal and political coalitions made a centralized solution unacceptable, yet a decentralized solution should have been similarly out of reach. That this was not the case can most plausibly be explained by the fact that abstract services already processed a substantial amount of patent documents, and that more advanced public systems seemed in reach.

4.6 More Than Just Standardization

It is easy to confuse an argument that stresses the importance of legal-technical expertise with an argument that stresses only standardization in legal documents. Where exactly the differences between both arguments lie can be nicely illustrated by an example of another rejected PCT proposal. The proposal in question suggested that applicants should continue to file applications with national patent offices which would then be subjected to an international search. Much like the legal-technical proposal discussed above, this proposal promised considerable cost savings, but without requiring uniform patent systems (Bogsch 1995; Pfanner 1969).

The main problem BIRPI officials had with this proposal was that it asked patent offices to accept patent applications as priority-establishing within 12 months, even though they had been prepared according to foreign laws and were only available in foreign languages. This was unacceptable for most government representatives; the latter also rejected suggestions to extent the priority period from 12 to 24 months which would have given domestic companies more time to study foreign applications. Particularly lower income countries were not interested in further extending a priority period that already seemed to mostly benefit foreign companies. Without the support of low income countries, however, it was not possible to reach the unanimity required for changing the Paris Convention (Pfanner 1969: 339-340).

Beyond that, it was questionable whether the execution of an international search was even possible in view of patent applications that differed in form and content. The proposal assumed unprecedented progress in the standardization of patent documents that went above and beyond what lawyers and government officials had achieved in half a century of legal harmonization. In comparison to the enormous standardization efforts that would have been required by such a proposal, it seemed "much easier to create a system of international applications that sits beside national laws, but does not touch them, and to agree on uniform rules on form and content only with respect to this system" (Pfanner 1969: 340).

In practical terms, this meant that minor changes, like the introduction of standardized regional and international patent documents, were seen as sufficient. These standardized regional and international patent documents had the advantage of complementing or replacing national applications in different languages and classifications. They could be abstracted and indexed by commercial intermediaries, and added to existing legal-technical systems which now covered national, regional and international patent positions.

For now, it is sufficient to reiterate that the availability of legal-technical expertise had become a non-negotiable condition of regional and international application procedures, and thus for broader patent strengthening efforts. The reason for this was that proposals that claimed to work without legal-technical expertise turned out to be politically unfeasible.

To put it bluntly: "globalist" BIRPI officials, patent office representatives, and corporate executives placed their bets on a proposal with legal-technical expertise at its center because "territorialist" lawyers in private practice and their clients could agree on legal-technical harmonization, but not on a global patent system.

4.7 Institutional Complementarities

The PCT proposal ultimately appeared like the most rational way forward for both BIRPI officials and government representatives. Yet this does not mean that there were no alternative approaches under discussion. While Bogsch (1995: 11-12) claims to have revived plans for a European Patent Convention (EPC), it is also true that plans to create a European patent procedure were sporadically viewed as a viable alternative to the PCT plans. Bogsch and his fellow BIRPI officials thus felt the need to constantly reassure government representatives that both projects pursued different objectives, but were, in fact, complementary.

The PCT was, according to Pfanner (1969: 341), best seen as "international start-up up support for national examination procedures". This meant that the PCT required the use of legal-technical expertise on behalf of countries in which a lack of examination capacity constrained foreign filings. The European plans, by contrast, required the "concentrated" use of legal-technical expertise in a regional patent office - the European Patent Office (EPO) - in order to replace national patent procedures that increased the costs of foreign filings. Pfanner (1969: 341) consequently characterized the European plans as "regionally limited replacement of national examination procedures".

With the benefit of hindsight, it is possible to explore whether the PCT actually provided start-up support for national examination procedures and whether the EPC really replaced national patent procedures. The application numbers depicted in figure 4.8 are indeed consistent with the idea that the EPC replaced national examination procedures. Apparently, foreign applications in European countries drastically decreased after these countries became members of the European Patent Organization (established by the EPC). In both larger European countries, like France, Germany, and the United Kingdom, and smaller countries, such as the Netherlands, Switzerland, and Sweden, the number of foreign patent applications went down. Bronwyn Hall and Christian Helmers (2019) have recently shown in a quantitative study that all these foreign applications did not disappear into thin air but were replaced by an applicant shift towards EPO fillings.

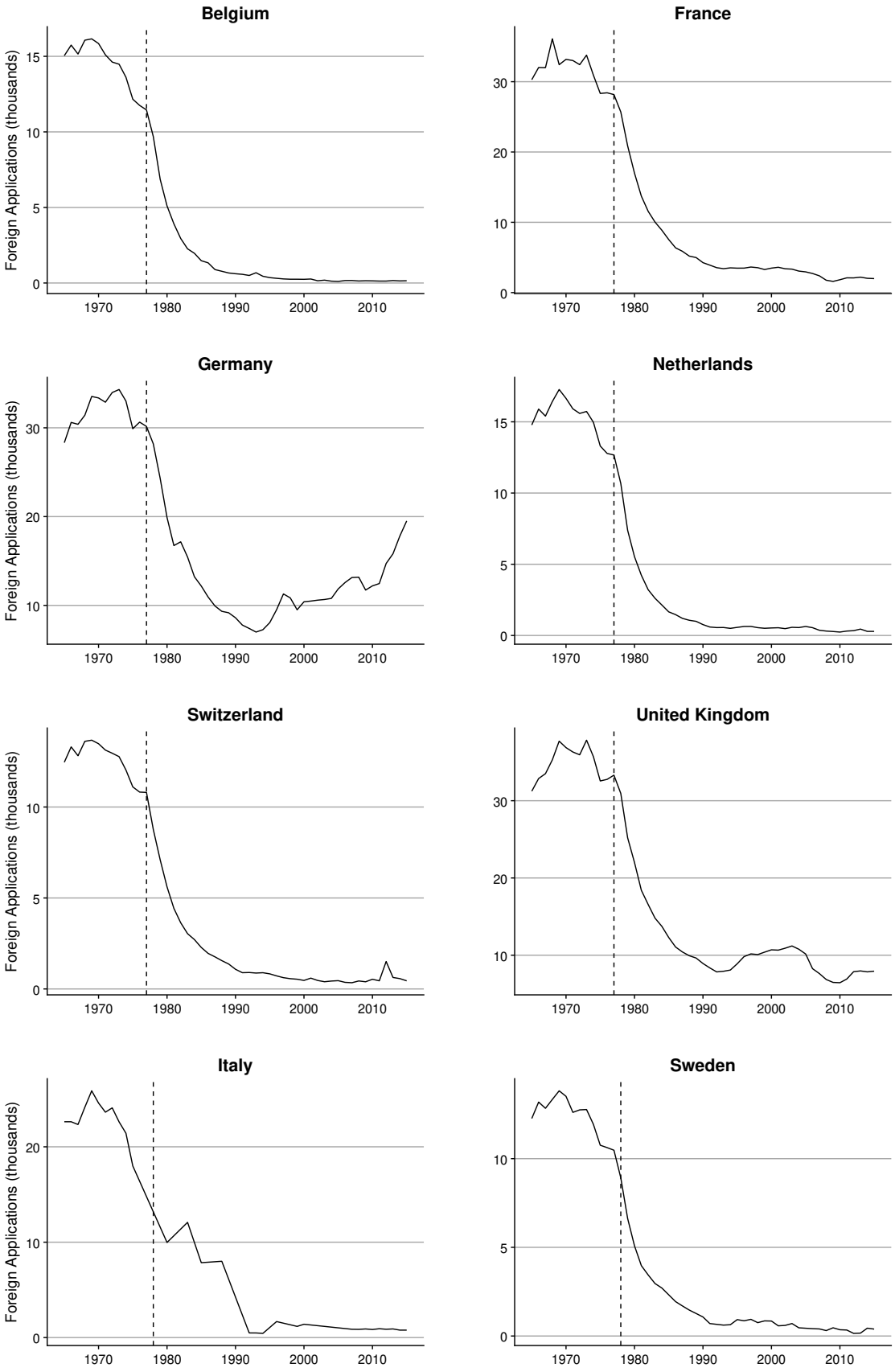


Fig. 4.8 Foreign patent applications and EPC membership, 1965-2015

Note: The dotted vertical line marks the year in which a country joined the EPC.
Source: The data are from WIPO 2021b; 2021f and EPO 2021.

Much like it seems possible to spot an EPC "replacement effect", it seems possible to spot a PCT "startup support" effect. Figure 4.9 suggests that countries with previously little or no examination capacity, such as Vietnam, China, Indonesia or India, saw after short transitory phases sharp increases in foreign patent applications. Of course, these increases cannot easily be linked to the PCT specifically, given that countries typically became PCT members as part of broader "patent strengthening packages" (Ginarte and Park 1997; Park 2008). While the 1994 TRIPS agreement, for instance, contains no explicit reference to the PCT, it demands that "World Trade Organization members must recognize the principles set forth in Articles 12 to 19 of the Paris Convention." (Erstling and Boutillon 2006: 1585) This required, among other things, the buildup of examination capacity to an extent that was hardly possibly in a short time period without also becoming a PCT member.

For my purposes, it is sufficient to have illustrated why Pfanner could plausibly tell fellow patent lawyers that complementarities between the PCT and EPC plans existed. For him it was obvious early on that companies wanted startup support to patent inventions in large countries with limited or no examination capacity. It seemed, on the other hand, equally obvious that companies from the United States, Japan, and Europe itself were overwhelmed with multiple applications procedures in relatively small European countries. The EPC promised to replace these different procedures with a single European procedure. In addition, it seemed attractive for companies to use both PCT and EPC in the same application process, i.e. to designate EPC member states in a PCT application (see figure 4.5).

4.8 PCT, EPC and Legal-Technical Expertise

Support for the PCT and the EPC was, as Pfanner acknowledged, first and foremost dependent on legal-technical breakthroughs. In order to develop the legal-technical expertise that would allow large patent offices to search the PCT Minimal Documentation, Pfanner and his BIRPI colleagues became not just engaged in legal initiatives, but also in legal-technical initiatives.

Already in 1964, BIRPI officials had established a committee with the title "International Committee of Novelty Examining Patent Offices". The main task of this committee was the development of a new patent information service. An ad hoc advisory group for this committee was formed by directors of the Austrian, German, and French patent offices. Also present at meetings was the leadership of the IIB in The Hague.

In essence, Europe's preeminent patent officials began early on to work on a plan for a patent information service that would not be controlled by individual companies or professional associations. The overriding goal of the planned service was the unification of

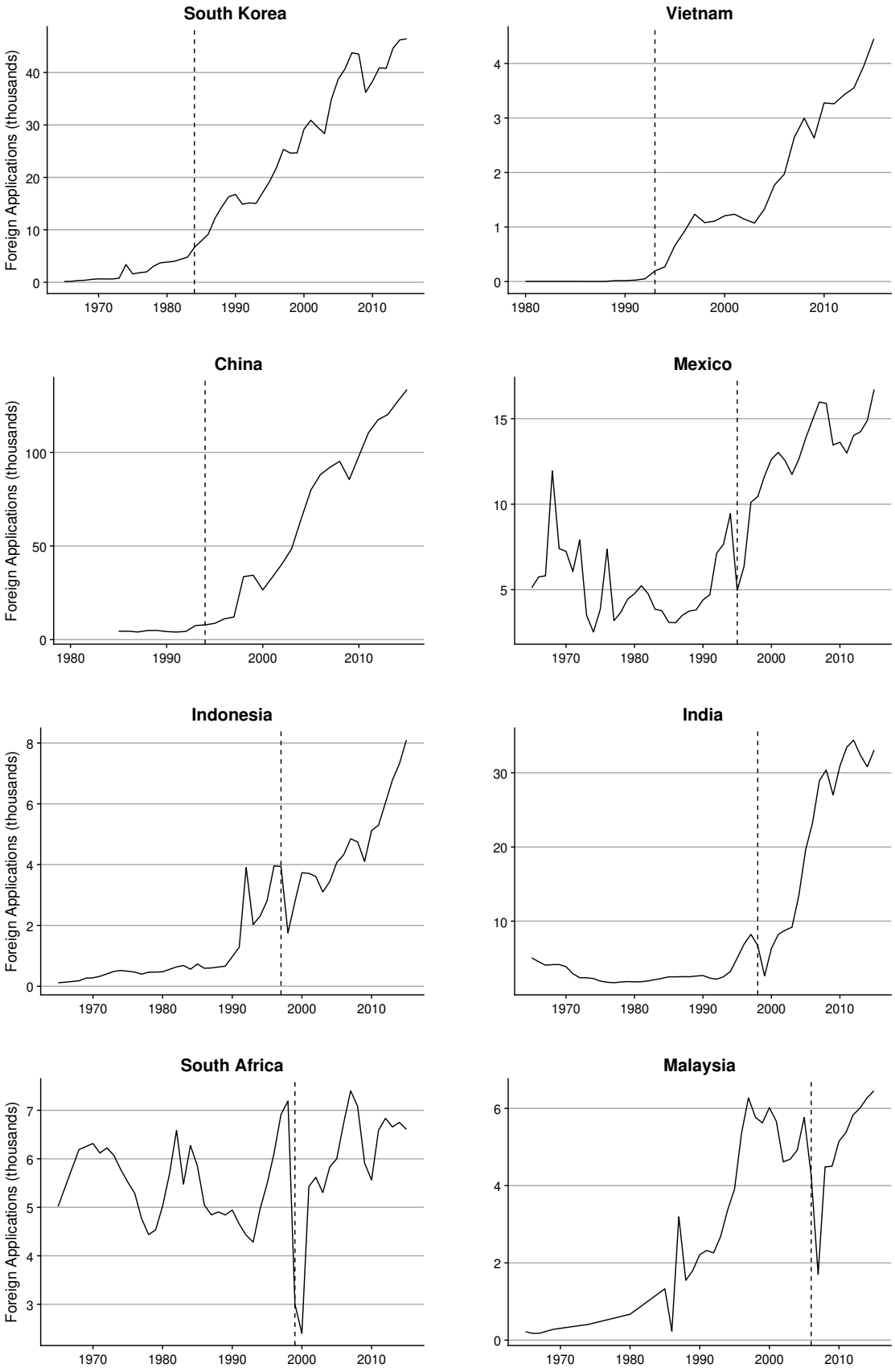


Fig. 4.9 Foreign patent applications and PCT membership, 1965-2015

Note: The dotted vertical line marks the year in which a country joined the PCT.
Source: The data are from WIPO 2021d; 2021f.

national information systems, which was seen as a crucial step on the way towards PCT and EPC implementation.

In the next chapter, I will discuss how the plan for this uniform patent information service evolved in practice. While doing so, it will become clear how uniform patent information services, regional and international application procedures, and efforts to strengthen patent rights became interconnected. Knowing precisely how information services, application procedures and strengthening efforts were linked will allow me to test the impact of legal-technical expertise on the adoption of stronger patent rights in chapter 7.

4.9 Conclusion

Efforts to fully harmonize national patent laws during postwar years failed. Rather than converge on a truly global patent system, national governments kept language requirements and other institutional barriers largely in place. Because these barriers were kept in place, patent office and BIRPI officials remained interested in a solution to the still very real information crisis. This solution was the PCT: an international treaty that gave national patent offices the possibility to effectively concentrate growing amounts of search work in larger patent offices.

The concentration of search work in several large patent offices, so-called international search authorities, would hardly have been possible without legal-technical expertise, i.e. without a network of information specialists, technical systems, representations and standards that linked millions of documents from different jurisdictions (see Drahos 2010). Yet, there was practically no public legal-technical expertise available when PCT and EPC were first formulated and discussed.

The only legal-technical expertise that came close to fulfilling the criteria that patent office and BIRPI officials had in mind was the legal-technical expertise assembled by corporate information specialists and commercial intermediaries. The next chapter will show how initiatives by patent office and BIRPI officials to develop EPC and PCT "support tools" unfolded within an information environment that was heavily shaped by corporate information specialists and commercial intermediaries.

Chapter 5

Cooperation and Competition between Intermediaries

In the previous chapter, I have argued that the PCT plans depended on the availability of legal-technical expertise. I have supported this argument with statements by eminent BIRPI officials who publicly insisted that the PCT required the creation of a "uniform system of mechanical documentation" (Pfanner 1969: 339).

Whether such a uniform system was really necessary for enacting the PCT can, of course, still be questioned given that efforts by patent offices and BIRPI to assemble legal-technical expertise continued to fail. Economists who have studied USPTO mechanization projects argue convincingly that these projects made little progress in the years before and after the PCT entered into force (see Jaffe and Lerner 2007, chap. 5). Comparable efforts in Europe seemed to have lagged even further behind (see Beier and Straus 1977).

What most accounts of mechanization projects overlook, however, is an increasing reliance on private abstracting and indexing. It is an open secret that commercial intermediaries supplied not just multinational companies, but also patent offices and BIRPI with "uniform documentation" from a steadily growing number of countries (Hyams 1978; Schoch-Grübler 1995). Moreover, existing accounts of mechanization projects tend to neglect public projects that patent office and BIRPI officials developed in response to private projects at the transnational level.

One reason for this neglect could be that private and public projects became increasingly interconnected through efforts by information specialists; the latter selectively established cooperative and competitive ties between their own companies, commercial intermediaries, patent offices and BIRPI. This rather intricate network that emerged in the process likely made it difficult for scholars to understand whether and how legal-technical expertise was

actually assembled; it could, further, have obscured the impact of legal-technical expertise on patent law-making more generally.

5.1 The BIRPI World Patent Index

BIRPI prepared a plan for a new public project, the so-called "World Patent Index", after consultations with ICIREPAT and five IT companies (Bull Philips, IBM, ICL and Univac). According to Arpad Bogsch, these IT companies were brought in to explore possibilities offered by a computerized approach. He wrote:

> [W]e were, by then, convinced that not paper cards but computers would have to be used and because we wanted to know what the technical possibilities and costs would be. We also knew that responses to individual questions must generally be instaneous to be of real value. (Bogsch 1988: 172)

This public index project was not developed in a vacuum but in competition with private projects, which had already created thousands of abstracts on paper cards (see USPTO 1966). The challenges BIRPI officials saw in setting their project apart can be illustrated with quotes from a presentation of the planned index before patent lawyers and information specialists in New York. The BIRPI and IIB (1966: 1) brochure distributed beforehand described the planned World Patent Index as follows:

> BIRPI and the International Patent Institute are currently studying the question of establishing an international service which would make it possible in respect of the millions of patents granted and patent applications published anywhere in the world:
>
> * to identify all those which are based on the same priority, claimed under the Paris Convention
> * to indicate, in each case, when there is a reported change in the legal status (grant, cancellation, expiration, etc.),
> * to identify all those which show the same applicant, patentee, or inventor,
> * to list all those which relate to a given branch of technology

The presentation of the index project in New York revealed that patent lawyers and information specialists were generally interested in the identification of equivalent patents, and hoped to use the planned index alongside commercial systems to monitor competitors

in as many countries as possible. At the same time, however, they complained about the absence of titles and abstracts that BIRPI did not want to supply. Here is Bogsch's answer to a question by one of the participants:

> A VOICE: I agree that it would be almost impossible to feed this [abstracts, titles etc.] into the computer. Would it be possible to have just a few lines, just a few lines?
>
> DR. BOGSCH: I do not think so. Not for us. In that case we would have to have specialists in all the technical fields. I repeat, it is possible, of course, and it is done by all the abstracting services today, but it would, for us, be practically impossible. First of all, we would have to hire a technical staff which can make intelligent summaries. Secondly, there would be an enormous language problem, because we could not furnish you the abstract in the original language, so not only would the whole thing have to become an abstracting service for 650,000 patents, but also a translation service. (Bogsch et al. 1966)

The fact that patent lawyers and information specialists put emphasis on titles and abstracts underlines their importance in everyday sense-making efforts. Apparently, patent lawyers and information specialists were as interested, or even more interested in "qualitative" information than in "quantitative" information. The BIRPI World Patent Index was supposed to include nearly all quantitative patent information one could wish for, yet this was not enough for patent lawyers and information specialists. Here is another extract from the BIRPI and IIB (1966: 3) brochure:

> In respect to a patent, the following data would be fed into the system:
>
> * the name of the country granting it,
> * its number (the "patent number"),
> * its date,
> * the date and the serial number of the application,
> * the classification of the patent according to the international and / or national classification,
> * the name(s) of the patentee(s),
> * the name(s) of the inventor(s),
> * the country, date, and, where available, the serial number, of the application on which the priority claim is based ("first application")

What seemed important for patent lawyers and information specialists, however, was mainly the availability of information about the "legal status" of patent applications. According to the presentation by Bogsch et al. (1966), the index would contain information on whether a company had filed an application in a particular country and whether this application had been published. Having such information was generally considered useful in determining the value companies ascribed to inventions. If a given company sent applications for an invention to more countries, the underlying invention was considered more valuable than an invention that produced fewer international applications (see Kaback 2002).

The plans for the World Patent Index also promised to reveal whether competitors had filed oppositions against granted patents in different countries. Assuming a patent led to an opposition and survived the opposition, it could generally be considered more valuable than a patent that was not opposed by competitors. Patents could, of course, also be ascribed less value if they were withdrawn or rejected, which was supposedly also revealed by the index. Finally, the index was described as helpful in continually identifying patents after they had been reclassified by patent offices - a major technical issue.

Despite all these promises, however, the development of the World Patent Index could not be publicly financed. Apparently, a survey among member states indicated that "the funds necessary for the initial investment cannot be obtained from Government sources" (Bogsch 1988: 173). To understand why governments were unwilling to finance the index, it is helpful to look more closely at the proposal. It contained an estimate according to which the index required the processing of more than a million new inventions from over eighty different patent offices within the first ten years. These one million inventions would further have to be classified into more than 40.000 IPC subgroups. Such a large collection of documents could only be processed with computer systems that required large continuous investments and had not been used for such a purpose yet (BIRPI and IIB 1966: 3).

Because of the necessary investments, BIRPI officials expected that the index could not be financed by governments over the long term and had to become self-supporting. The survey mentioned above had shown that the average yearly income of the 24 patent offices, that had responded to the survey, was only around 1.4 Million U.S. dollars (Hyams 2021b: 2). For BIRPI officials this was too little to pay for the development and maintenance of the index. In addition, there was also an objection against the planned index from two leading pharmaceutical companies: they argued that the planned index would make it easier for "industrial pirates" to figure out in which countries companies had avoided protection, abandoned existing patents, or where protection had ended (Hyams 2021b: 2). Similar concerns had already been raised at the meeting in New York:

> Now, there are many advantages to be gained from this index that all of us from our side of the fence make use of. But what about the ones that can give aid and comfort to the enemy, so to speak? Would this not make it a little more easy for such a person to see where is this invention not protected, not where it is protected, but where isn't it protected, so that he can have a little more freedom to operate. This is of some concern to us in the drug industry because of certain lack of patent laws, etc., in certain countries. (Bogsch et al. 1966)

This statement illustrates that patent lawyers were indeed afraid that patent information became too easily available. Yet, at the same time, there is little evidence that piracy concerns were behind the general unwillingness to finance the index project. The discussion of the planned index in New York as well as internal letters between USPTO officials point towards worries about project financing, not towards larger concerns about industrial piracy.

5.2 Commercial Intermediaries vs. Government Corporations

Difficulties to finance the WPI did not spell the end for BIRPI officials' plans. Instead, the Conference of Representatives of the Paris Union authorized BIRPI to enter into negotiations over index development with commercial intermediaries (Bogsch 1988: 173). In a rather intransparent award process, BIRPI leadership selected the U.S. company Leasco for the development of the WPI. Leasco's consultant, Jim Terragno, one of the co-creators of the original WPI idea, had been in close contact with top BIRPI officials for a long time. The Leasco proposal was scheduled to be presented at a committee meeting in June 1969 in Geneva (Hyams 2021b: 3).

What was curious about this proposal was that Leasco seemingly planned to build the index together with Derwent without telling BIRPI. Apparently, Terragno had asked Derwent founder Monty Hyams to work with Leasco on the index, but was supposed to keep the cooperation secret. The secret plan, however, soon became public, and the committee instructed the BIRPI director Georg Bodenhausen to "invite Leasco and Derwent to make an offer ... which would be joint by Leasco and Derwent or would be made by one of them, securing, however, the full cooperation of the other" (Bogsch 1988: 173).

Derwent reacted to the official invitation by rejecting the idea to work with Leasco. If one believes Hyams (2021b: 5), the cooperation with Leasco was unacceptable to the Thomson Organisation, Derwent's powerful parent company. The Thomson Organisation, a publishing and oil conglomerate under the control of Canada's richest family, was not pleased about

the participation of Robert Maxwell - notorious British publisher and recently appointed Leasco director (see Preston 2021) - against which the Thomson Organisation had earlier initiated a Board of Trade complaint in England. Because of Derwent's withdrawal, Leasco automatically received the contract but quickly had to abandon the project. It seemed to never have possessed the expertise to build the World Patent Index in line with BIRPI's specifications (Hyams 2021b: 6).

A few years later, in 1971 to be precise, Derwent sent its own offer for the development of an index to BIRPI. It had decided to take this step after the former U.S. Patent Commissioner, Edward J. Brenner, who was now a Derwent consultant, had encouraged Hyams to present a new proposal (Hyams 2021b: 6). Derwent's proposal was assessed by a subgroup of the Paris Union in June 1971, which decided that

> no decision should be made in respect of the Derwent proposal without an exploration of alternatives to it, in particular whether solutions, other than contracting with private enterprises could be found. (Bogsch 1988: 173)

This decision seemingly bought the IIB in The Hague time to work on an alternative proposal. Its representatives had announced during the subgroup meeting that they wanted to develop a counterproposal to Derwent's proposal. Later in 1971, the Austrian government announced that it, too, wanted to get into the race. The Austrians declared that they would be prepared to found and finance a new institute in Vienna (Hyams 1972: 2-3). Remember: it had been the Austrian delegation which had strongly criticized the idea of an international documentation center as too expensive in the late 1950s, even under the condition that all Paris Union countries would chip in (Bogsch 1988: 172). Now, it was suddenly prepared to stem a large share of the initial costs for precisely such a center on its own!

A bidding war was about to begin: government representatives from France and the Netherlands supported the IIB in The Hague, government representatives from Germany and the Soviet Union supported the institute in Vienna, and finally, government representatives from the United States supported Derwent. Hyams freely admits that he tried to divide and conquer the field by suggesting to the Austrians - who in his opinion had the weaker of both public bids - to strategically bundle microfilming activities with Derwent. The Austrians declined, perhaps because they saw Derwent as key competitor in this complementary area of patent indexing. They hoped to fulfill the requirements set by the executive committee by establishing a strongly computer-oriented government corporation (Hyams 1972: 2-3).

The requirements that the executive committee released in September 1971 read indeed exactly like the Austrian proposal:

> First, ‘the system to be adopted should, from the beginning, be apt for identifying not only patent families but also patent documents belonging to the same classification unit.’
>
> Second, ‘the system to be adopted should, from the beginning, cover the vast majority if not the totality of the patent documents which will issue.’
>
> Third, ‘it is desirable that the system to be adopted should provide for the possibility of furnishing copies of the patent documents.’
>
> Fourth, ‘the arrangement should be such that it requires no risk and no cash outlay by any national office, and it should make the furnishing of data in machine-readable form by national Offices merely highly desirable but not indispensable.’
>
> Fifth, ‘ultimate responsibility for the system should rest with an organization (private or public) with which all Governments and industry can maintain relations on an equal footing.’ (Bogsch 1988: 173)

Particularly the last point was, according to Bogsch (1988: 173-174), responsible for the ultimate acceptance of the Austrian proposal. The Executive Committee voted in March 1972 for plans to establish a government corporation and against the IBB and Derwent plans. Financial considerations that had previously dominated the debate in the Executive Committee were seemingly muted as the Austrian government guaranteed both the continuous financing and quality of the new index. Why exactly the Austrian government was ready to give such a farreaching guarantee after it had opposed earlier plans for an international documentation center is unclear. Hyams (1972: 2-3) complained in a letter to the Thomson Organization about personal gains of Austrian patent officials in the "patent printing market", but it was impossible for me to verify his accusations.

5.3 Establishing an International Documentation Center

An agreement between the former BIRPI, now called the World Intellectual Property Organization (WIPO), and the government of Austria was signed in Mai 1972. In the agreement, the government of Austria committed itself to establish a company under Austrian law with the name "Gesellschaft zur Errichtung und zum Betrieb des Internationalen Patentdokumentationszentrums, Gesellschaft m.b.H." (Company for the Establishment and Exploitation of the International Patent Documentation Center, Ltd.). Since the midst of the 1970s, the company and its databases are known under the abbreviation "INPADOC" (Bogsch 1988: 174).

The first step that the newly founded government corporation took was the construction of a "patent family service" (PFS). This service was supposed to tie together as many equivalent patent documents as possible. If one entered the United States patent document US3770991, for instance, the service would show the equivalent German patent document DE2252085, the equivalent Japanese document JP48099536, the equivalent Brazilian patent document BR7207411, and so on (Pilch and Wratschko 1978: 71).

The second step was the addition of a patent classification service. This service split the entire available patent literature into 51.436 subfields. For instance, after typing in B650 81/22, a subfield in the International Patent Classification (IPC), one would see all patent documents classified under this subfield. Since B650 81/22 grouped together all patent documents related to "storage containers", the database would show patent documents like FR2338008 (Etui Etanche Pour Baigneur), GB1429823 (Contact Lens Storage), and BR5501332 (Embalagem com Canais Comunicantes para Desumificacao de Produtos Higroscopicos) (Pilch and Wratschko 1978: 72).

The third and final step was the setup of an applicant and inventor service that listed publications associated with a particular applicant or inventor. If one typed in the applicant name "Clupak, Inc.", for instance, one saw documents like AU60731/73, DE2350483, FI46869, CY865, and so on, together with bibliographic details. This applicant service made it possible to systemically monitor competitors, as promised by WIPO officials. The inventor service, moreover, allowed the systematic monitoring of inventors who had developed patentable technologies for companies or universities (Pilch and Wratschko 1978: 72).

Unlike Derwent, however, which employed information specialists to prepare extended abstracts and indexes, manual interim steps were avoided by INPADOC from the start. Apart from the original data acquisition, all processing steps were computer-aided (Pilch and Wratschko 1978: 69). In line with Bogsch's earlier comments on the BIRPI World Patent Index, INPADOC did not become an abstracting and translation service for 650,000+ patents.

That it would principally have been possible to prepare abstracts and indexes is illustrated by the example of Japan. Already in 1971, the Japanese Ministry of Trade and International Industry (MITI) had, together with the country's private sector, set up the "quasi-governmental searching and commercial data base generating organization, JAPATIC." (Kalikow 1983: 34) This organization took over very similar tasks to INPADOC but also assembled abstracts and indexes. To be more specific: it used large-scale computers to provide access to Japanese patent publications beginning in 1955 and US patent publications beginning in 1968 (Nagamura 1981: 185-187).

The JAPATIC files contained considerably more detailed patent information than the INPADOC files. They consisted of 28 items of bibliographic data for Japanese patents, as

well as of technical abstracts, keywords, JAPATIC classifications and keywords for Japanese unexamined patent applications. A similar wealth of information was not available for foreign patent documents that were made available to English-speaking examiners in the Japanese Patent Office (JPO). JAPATIC's U.S. file consisted of merely "13 bibliographic data such as number, date, patent classification, title of invention, applicant, and inventor" (Nagamura 1981: 186-187).

INPADOC was, in contrast to JAPATIC, a higher-level project that amassed quantitative patent information that could reliably be gathered from a larger number of patent offices and national documentation centers. Indeed, JAPATIC became INPADOC's partner in Japan where it provided exclusive accesss to INPADOC's services. (Otani 1975: 73) JAPATIC services in Europe were likewise offered exclusively through INPADOC, after both organizations had entered into an agreement in 1975 (Nagamura 1981: 188-189).

These were all important steps in making bibliographic details of patent documents more broadly available, yet did not supply end-users - patent offices and companies - with actionable qualitative information. Even if end-users had abstracts and indexes of international applications available, the abstracts had generally limited legal value and the indexes were not particularly helpful without legal context. Nakamura (1981: 187) writes about the JAPATIC abstracts that "[e]ach abstract is made by summarizing technical content of the specification and differs from those abstracts which publish only claims". In other words, patent offices and companies remained dependent on legally-oriented Derwent and CAS abstracts despite problems like "lower abstract quality for Japanese publications" (Kaback 1977: 146).

A clear upside of ignoring qualitative legal information was, however, that INPADOC and JAPATIC could assemble very large databases in relatively short periods of time. Wolfgang Pilch and Hartmut Wratschko (1978: 70), both INPADOC, wrote about their center:

> At the beginning of 1974 there were 100,000 documents, at the beginning of 1975 2.5 million, and at the beginning of 1978 nearly 5.5. On an average of every 8s of a working day, a patent from one of the 45 countries is added to the INPADOC database in one of 14 different languages.

Figure 5.1 shows that by far the most patent documents came from Japan and Germany, which had inflated their document collections through the introduction of deferred examination. Remarkably, "only" 235.859 patent documents came from the United States. This can largely be explained with the U.S. government's refusal to introduce deferred examination; unexamined U.S. applications could simply not be collected and did not become prior art. Furthermore, precisely because the U.S. had not switched to deferred examination, it had produced a large examination backlog that slowed down document processing in general.

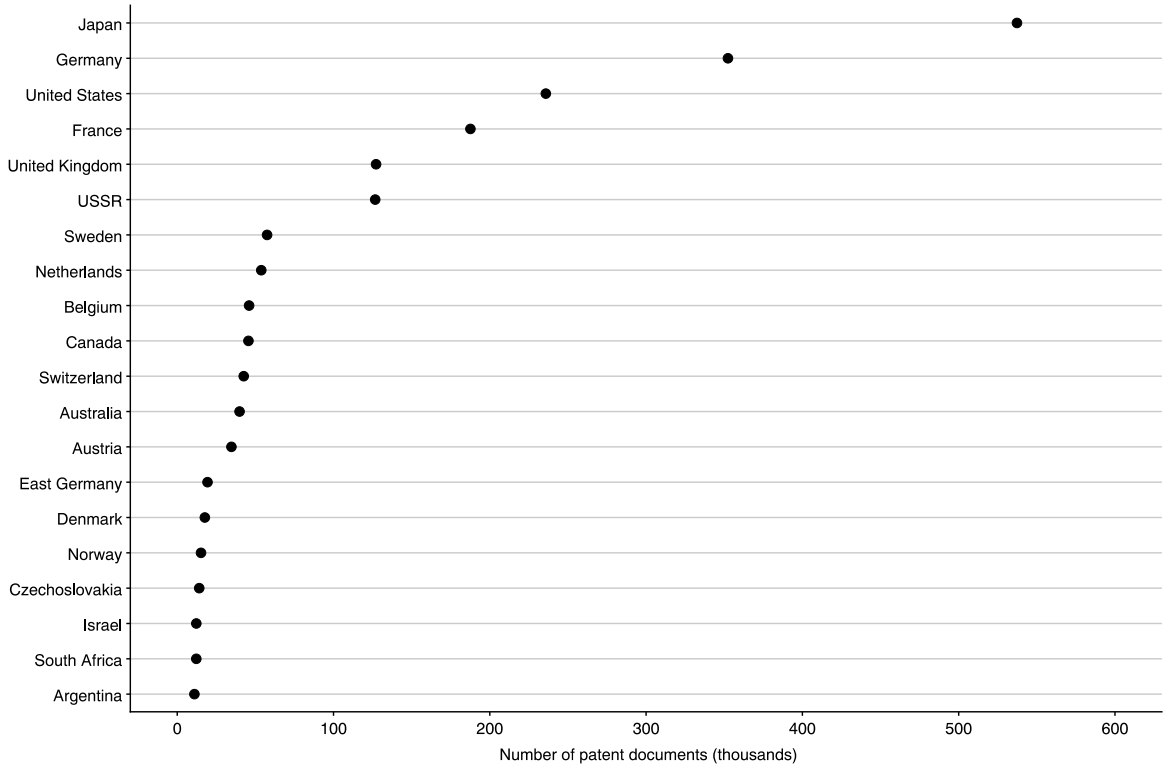


Fig. 5.1 Patent documents collected by INPADOC, 1976

Source: The data are from Pilch and Fux 1976: 99.

At the lower end of the figure, we see countries like Sweden, the Netherlands, and Belgium, each with under 100,000 patent documents, and countries like Canada, Australia, and Switzerland each contributing less than 50,000 patent documents. The smaller document numbers from these countries point to generally lower domestic patenting activity. It is worth noting, however, that surprisingly many documents were collected in socialist economies. The USSR, East Germany and Czechoslovakia systematically assembled patent information from abroad to facilitate technology transfers (Beier and Straus 1977: 401-402).

What is important to bear in mind is that the list of countries covered by INPADOC services was not identical with the list of countries in which services were actually used. According to Pilch and Fux (1976: 100), INPADOC services in 1976 were only used by the "patent offices of Australia, Denmark, Finland, France, Japan, Norway, Austria, Sweden as well as by International Patent Institute in The Hague". In other words, the use of INPADOC services remained largely limited to patent offices and companies in high income countries.

While the INPADOC services were supposed to be usable "without large technical and organizational difficulties in developing countries" (Pilch and Fux 1976: 99), they were not constructed with the interests of "technology importers" in mind. Theoretically, the

INPADOC services could have made it easier for middle and low income countries to get rid of international patents within the scope of existing laws. But no service useful for this purpose was developed. This can at least partly be explained by politically-motivated decisions against a service that would explicitly be useful for compulsory licensing purposes in middle and low income countries. The following statement comes directly from the office of the U.S. Patent Commissioner:

> [I]t was also agreed that should BIRPI take on any of the judgement functions involved in determining, for example, whether a patent was being worked, or whether evidence of working required to be submitted to a national patent office was sufficient, or whether some national compulsory licensing provision has or has not been violated, it would most likely, be practicing law. Thus the proposed service by BIRPI should be so formulated that the occurrence of judgment determinations on issues of working or compulsory licenses are minimized. (USPTO 1966)

In summary, it can be said that, via INPADOC, patent offices and companies gained access to enormous data collections. The legal status of patent applications, in particular, became much easier to track down than in the immediate postwar decades. At the same time, however, INPADOC stayed for both financial and political reasons away from manual translation and abstraction work. INPADOC services simplified the identification of equivalent patent documents, but these equivalent documents were not linked to an extended abstract that also translated and explained underlying inventions. Patent documents were, moreover, not indexed under a uniform indexing system. On top of all this, the availability of INPADOC remained limited: patent offices and companies from high income countries quickly gained access, but those in middle and low income countries did not.

5.4 Multiple Documentation Centers

During the years in which the INPADOC project matured, Derwent had been everything but inactive. Hyams had already in March 1972, after the chance to reach an agreement with the Austrians had grown slim, decided to develop Derwent's own World Patent Index (DWPI). In a letter to the Thomson Organization, Derwent's parent company, Hyams laid out his strategy:

> I therefore decided that attack would be the best weapon, and sent out letters to the larger Patent Offices on the 30th March announcing that we would be setting

> up our own computerised world-wide documentation center to be fully operative by January 1st 1973.
>
> In my letter of the 30th March, I asked the various Patent Offices whether they would be prepared to exchange any material which they had in machine-readable form, either for money or for goods, so as to help me set up the necessary computer base. (Hyams 1972: 3)

Because Hyams's letters to patent offices did not achieve the desired effect, he personally visited the patent offices of the Soviet Union, Belgium, and Germany. The patent officials he met all admitted that they had machine-readable material available, but did not want to share it at this point - due to their allegiance with the planned Vienna institute. The important exception was the USPTO, which was, according to Hyams (1972: 4), in an "entirely independent position" and "would consider any sort of exchange arrangement which we can come up with." Unfortunately, for Derwent, the USPTO had not particularly much to offer: only about half of its material was available in machine-readable format.

From Hyam's (1972: 4) perspective, the USPTO was still a useful ally as most European patent officials were on the side of the Austrians, and some European patent officials, namely the French and Dutch, still secretely hoped the IIB proposal would prevail. There was generally an astonishing degree of uncertainty about the implementation of the WPI given that key legal decisions had been made. It is fair to say that key legal decisions had in no way resolved legal-technical issues up to this point.

The way to respond to this uncertainty was, according to Hyams (1972: 5), to act as fast as possible: he wanted to build a database that would be available as early as January 1973, and would cover the last five years. He confidently told the Thomson Organization that the initial production costs of 50.000 pounds could be recovered from the sale of the index alone. Subsequently, Derwent would be the only commercial intermediary in the world in possession of a "tape".

Hyams (1972: 5) hoped that the Derwent tape would quickly become essential for patent offices and companies keen to access patent information on newly available online terminals. Just for sales and maintenance purposes, he wanted to make updated tapes available on online terminals in London, New York, Washington, Tokyo, and somewhere on the European continent. He knew that some of the largest Derwent subscribers had already acquired online terminals.

The Thomson Organization was closely involved in the decision-making process not merely for financial reasons, but because Hyams (1972: 5-6) wanted to use their influence on the ministerial level; due to the way the negotiations with BIRPI and the Austrians had went, he had begun to believe that decisions were being made above the "patent office level".

With the Thomson Organization, his chances of exercising influence on the ministerial level appeared considerably larger.

5.5 A Closer Look at Derwents' World Patent Index

Derwent successfully launched its own World Patent Index (DWPI) in 1974, a year later than Hyams had hoped for. The newly launched index was in essence an extension of the Central Patent Index (CPI) that Derwent had already released in 1970 following the PDG's "customer-led revolution". Table 5.1 shows that Plasdoc (Polymers), Farmdoc (Pharmaceuticals) and Agdoc (Agriculturals) each formed one section in the new DWPI.

ID	Chemical Sections	Basics
A:	Plasdoc (Polymers)	32600
B:	Farmdoc (Pharmaceuticals)	9000
C:	Agdoc (Agriculturals)	5100
D:	Food, Fermentation, Detergents, Cosmetics, etc.	10800
E:	Chemdoc (General Chemical)	19400
F:	Textiles, Paper, Cellulose	9600
G:	Printing, Coating, Photographic	7800
H:	Petroleum	5100
J:	Chemical Engineering	10400
K:	Nuclear, Explosives, Protection	2500
L:	Glass, Refractories, Ceramics, Electrochemistry	12500
M:	Metallurgy	18000

Table 5.1 Chemical sections in the DWPI, 1977

Source: The data are from Kaback 1977: 144.

In contrast to the CPI, the newly released DWPI now also added sections for non-chemical patent documents. Table 5.2 shows that patent documents for general, mechanical, and electrical patents were added in the form of six non-chemical sections.

ID	Non-Chemical Sections
P1-P3	Human Necessities
P4-P7	Performing Operations
Q1-Q4	Transport, Construction
QS-Q7	Mechanical Engineering
R1-R3	Instrumentation
R4-R5	Electrical Engineering

Table 5.2 Non-chemical sections in the DWPI, 1977

Source: The data are from Kaback 1977: 144.

As might be expected, the coverage numbers were uneven to say the least. While the Plasdoc section contained around 32,600 documents in 1977, the hybrid section "Nuclear Explosives, Protection" contained not more than 2,500 documents. According to Kaback (1977: 144), a leading information specialist, not many companies were interested in all sections. Most companies purchased Chemdoc and the Chemical Engineering sections, few purchased all CPI sections, and very few purchased all DWPI sections.

The six non-chemical subsections sections of the DWPI were classified with the help of the International Patent Classification (IPC). This meant that the assignment of documents to non-chemical classes in the index was as imprecise as the assignment of documents by national patent offices. To put it differently: Derwent specialists did not invest substantially more time and effort in indexing engineering documents than patent examiners. They focused on those classes that most of their customers cared about (Kaback 1977: 144).

In sharp contrast to the "underclassification" of mechanical and electrical engineering documents, the processing of chemical and pharmaceutical documents seemed practically complete. Kaback (1977: 145) claimed that the chemical DWPI sections enabled him and his colleagues to reliably monitor all newly released chemical patent documents worldwide. Derwent indeed seemed to check for as many patent documents as possible whether there were equivalents (Gardner 1995). INPADOC, by contrast, necessarily limited all of its activities to patent documents from PCT contracting states (see Pilch and Wratschko 1978).

Derwent also seemed to be considerably faster in an environment in which speed mattered. Within four to six weeks after the publication of patents from central countries, the patents were published in so-called WPI gazette. They were available for each mechanical and each chemical section of the index. Kaback (1977: 145) considered it exceptionally helpful that

patents from each country were covered at the same time, as it had previously been difficult to puzzle together documents that patent offices published at different points in time.

Figure 5.2 gives us an impression what a "listing" in the WPI gazette looked like. The asterisk in the first line tells us that the listing refers to a "basic patent", not an equivalent. In the upper right hand corner, we find a specific code for the patent applicant as well as the accession number of the underlying patent, alongside the original French patent number.

SLMB ★ 83684/45 ★FR 2296-858
Dipmeter measurements in boreholes – for determination of angle of dip and azimuth of strata traversed by borehole (BR240876)
SOC PROSP SCHLU 30.12.74 US 537998 (30 12 74 US 537310)
H01 R11 +R19 (03.09.76) G01c 09 G01v 03/18

Fig. 5.2 Random DWPI listing

Source: Adapted from Kaback 1977: 144..

The second row contains a new, more informative title of the underlying patent, formulated by Derwent specialists. The reason why the new title was considered more informative was that the shorter original title "Method and Apparatus for Dip Measurement" applied to a potentially large number of documents. No matter what laymen may think, Kaback (1977: 145) considered the much longer Derwent title far more informative: "Dipmeter measurements in boreholes - for determination of angle of dip and azimuth of strata traversed by borehole". Basically, DWPI titles were intentionally long so that they could be used as early available "mini-abstracts".

Derwent condensed patent information in its gazettes as much as possible. The acronym BR240876 behind the Derwent title means that the patent was first published in Brazil on August 24, 1976. The patent owner was "SOC PROSP SCHLU", which is short for "Societe de prospection electrique Schlumberger", a French oilfield services company. The numbers that follow are the first and last priorities of the patent. Finally, we can see in the last row the Derwent classes (H01;R11;R19) in which Derwent specialists have sorted the patent; Derwent indexing work in the chemical sections was arguably both more precise and more complete than either the IPC or national classification systems (Kaback 1977: 145).

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A1

DEMANDE DE BREVET D'INVENTION

(21) **N° 75 39466**

(54) **Procédé et dispositif de pendagemétrie.**

(51) Classification internationale (Int. Cl.²). **G 01 V 3/18//G 01 C 9/12.**

(22) Date de dépôt ..... **23 décembre 1975, à 14 h 46 mn.**

(33) (32) (31) Priorité revendiquée : *Demandes de brevets déposées aux Etats-Unis d'Amérique le 30 décembre 1974, n. 537.998 aux noms de Christian M. Clavier, Vincent R. Hepp et Alex C. Dumestre et n. 537.310 au nom de Vincent R. Hepp.*

(41) Date de la mise à la disposition du public de la demande ..... B.O.P.I. — «Listes» n. 31 du 30-7-1976.

(71) Déposant : Société dite : SOCIETE DE PROSPECTION ELECTRIQUE SCHLUMBERGER, résidant en France.

(72) Invention de : Christian M. Clavier, Vincent R. Hepp et Alex C. Dumestre.

(73) Titulaire : *Idem* (71)

(74) Mandataire : Roger Le Cren. Service Brevets Schlumberger.

D Vente des fascicules à l'IMPRIMERIE NATIONALE, 27, rue de la Convention — 75732 PARIS *CEDEX 15*

Fig. 5.3 First page of abstracted patent document (FR2296858)

To show how Derwent compressed information, we can compare the WPI listing above with the first page of the 86-page long original patent document (FR2296858). Figure 5.3 shows that it provided only a short, vague title for the underlying invention (Procédé et dispositif de pendagemétrie). It further fails to mention the first publication in Brazil (BR240876), which means that information specialists and lawyers still had to figure out that both documents were, in fact, equivalent. There was also evidently no more precise classification available than the IPC to declutter searching.

The WPI gazette in which listings appeared were a so-called alerting format, available to subscribers around 5 to 6 weeks after a patent document had been published. As table 5.3 shows, it was only the first among many alerting formats that would be made available to subscribers. With time passing, the alerting formats became more and more detailed - "the fog lifted" so to speak. After the initial WPI gazette, subscribers received still relatively short alerting abstracts that were only grouped according to country. Later, subscribers were sent longer basic documentation abstracts which were also grouped according to country and subject. Figure 5.4 below illustrates that alerting abstracts and documentation abstracts contained a substantial degree of additional information.

Format	Features
WPI Gazette	Only Headings
Alerting Abstracts, Country Order	Short abstracts, sorted by country; with reabstracted equivalents
Alerting Abstracts, Classified	Same short abstracts, in broad subject groupings; with examined equivalents reabstracted
Basic Abstract Journal	Documentation abstracts, sorted by country; manual code index available
Basic Abstract Profiles	Subgroupings of large sections, primarily from Plasdoc and Chemdoc, plus catalysis

Table 5.3 DWPI alerting formats

Source: Adapted from Kaback 1977: 146.

CUST. H09 ★84719X/45 ★US 3988-121
Fire - lighters of cellulose power and wax compsn. – with partial surface cooling of mixt. of cellulose powder (...)
CUSTOM RES & DEV 09.01.76-US647948 (19.02.74 US443565)
E14 (26.10.76) C101 05/02 C101-11
A firelighter table consists of (a) a mixt. contg. a wax with m. pt. 115 – 200 ° F (119-180 ° F) and a cellulosic wood power which forms 40-80 wt. % of the mixt., (...)

(a) Alerting abstract

84719X/45 H09 E14 CUST-19.02.74
CUSTOM RES & DEV ★US 3988-121
09.01.76 US647948 (★443565) (26.10.76) C101 05/02 C101-11
Fire - lighters of cellulose power and wax compsn. – with partial surface coating of mixt. of cellulose powder (...)

Fire kindling tablets are claimed comprising (a) a mixt. of a wax of m. pt. 115-200 ° F (119-180 ° F) with 40-80 wt. % of cellulosic powder, and (b) on the surface of the tablet, (...)

ADVANTAGES
The tablets ignite easily and burn for a sufficient time to kindle logs or other natural synthetic solid fuels. (...)

DETAILS
The cellulosic powder may be from wood (prefd.), leaves, straw, nuthulls, shells or rice hulls, in a particle size of 50-500 (50-200) US mesh. The prefd. amt. of cellulosic powder in mixt. (a) is partic. 50-75 wt. %. The wax may be natural animal or mineral wax, petroleum wax (prefd.) of synthetic wax. (...)

Example
A 1:1 mixt. of 100 mesh wood powder and 138 °F melting paraffin Wax was compressed at 700 psi for 9 seconds to form a tablet with dia. 1.29 inches and length 0.9 inch. A mixt. of lauroyl peroxide and wood powder was introduced before and after the wood powder-wax mixt. (...)

(b) Documentation abstract

Fig. 5.4 DWPI abstracts
Source: Adapted from Kaback 1977: 146.

If we believe Kaback (1977: 146), then country groupings were mainly useful for patent lawyers who were not just interested in patent documents as such, but also in the country-level strategies of competitors. Subject groupings, by contrast, were mainly useful for chemists and engineers because they eliminated equivalents that were essentially irrelevant for R&D. Sociologically speaking, Derwent performed an increasingly large share of the "boundary work" (Allen 2000) for which information specialists had earlier claimed jurisdiction in large companies. Derwent created not only "boundary objects", like patent abstracts, through practices like translation, transfer and transformation, but also made sure that abstracts remained technically usable for chemists and engineers on the one hand, and legally relevant for lawyers on the other (see Bechky 2003; Kellogg 2014; Star and Griesemer 1989).

What is remarkable is that despite all the "boundary work" that Derwent performed, it could seemingly never do enough for scientists and lawyers. Apparently, both patent lawyers and scientists found the different abbreviations and formats confusing and even claimed that the abstracts were still far too long to be read carefully (Kaback 1977: 146). Difficulties like these were addressed in "subscriber meetings" between Derwent and information specialists in which the latter represented scientists and lawyers (see Simmons 2004).

A typical topic of such meetings, besides alerting formats, would be "retrospective information retrieval". While the delineation of existing patents with Derwent "manual codes" worked already fairly well, according to information specialists, it could be improved much further. They wanted to have as many manual codes as possible in order to increase "recall precision". The simplest way to use manual codes in practice was via manual code cards that had to be filed and sorted. This was laborious, but apparently greatly simplified searching in comparison with microfiche, INPADOC's prefered technology. Further improvements in retrospective information retrieval were achieved with the precise coding of chemical structures in Derwent's on-line file (Kaback 1977: 146-147).

This fairly deep dive into the details of Derwent's abstracting and indexing activities illustrates how fast and interconnected private patent processing became during the later 1970s. Economists who have looked at the weak processing capabilities of patent offices and WIPO can be forgiven to have missed the sophisticated use of abstracts and online files to search patent information twenty years before the World Wide Web protocols popularized the everyday use of the internet. It is difficult to imagine that information specialists in large chemical companies could rely on precisely coded chemical structures in online files, when examiners of large patent offices still searched by hand with the help of rather broad classification systems.

Don McMaster (2005: 153-154), an advisor to the Canadian Intellectual Property Office (CIPO), described public patent information processing before the 1980s as follows:

> Prior to 1980, patent offices mainly processed patent applications in paper format, using microfilm as a backup, and disseminated published patents through patent office public search rooms and regional patent libraries [5]. In the public search rooms, the publications normally were classified into search files by technical classification (e.g. International Patent Classification (IPC). (...) [P]atent search files could only be searched in one location and were expensive to maintain because of the need to re-file the search files based on new classifications as technology changed.

The emerging gap between public and private legal-technical expertise is why patent offices and WIPO in reality relied not just on their own devices, concepts and arrangements. Just like the USPTO relied on private abstracts and indexes to deal with foreign patent information, other patent offices did so as well (see Hyams 1978; Schoch-Grübler 1995). Otherwise it would not have been possible to implement the PCT and the EPC. While the INPADOC services certainly helped patent examiners to deal with equivalent patents, they were not helpful in the analysis of the actual content of patent documents.

After the launch of the DWPI, Hyams was so sure of the importance of Derwent's services that he continually suggested to WIPO and patent office officials that they should openly cooperate with Derwent. Here is an excerpt of a speech he gave during a patent information symposium in Munich:

> Derwent is in the unique position, vis-a-vis the patent offices - of being both a major customer and a major supplier. It would therefore make commercial sense for us to work in close cooperation - but alas, we are still living in a world of bureacractic and ideological fantasy. (Hyams 1978: 154)

Hyams could afford to take such an aggressive stance because Derwent's databases were not just perceived as complete and timely, but also began to cover a much larger number of patent documents. Kabak (1977: 143) writes that Derwent added around 231,500 basics and around 247,500 equivalents in 1977 alone. According to Paul Gardner (1995: 92), Managing Director of Derwent, the yearly number of basics had been below 100,000 in the years before 1973, but had then rapidly increased, to above 200,000 each year since 1974. An important reason for this increase was that Derwent finally caught up with publication practices of large patent offices. In particular, patent documents from the Japanese chemical and engineering industries received more attention in the 1980s and 1990s.

Figure 5.5 shows a rapid increase in the number of patent documents covered in the DWPI chemical and non-chemical subsections. The visible increase in the non-chemical subsections was in all likelihood boosted by the addition of non-chemical patent documents from Japan. While Derwent had covered chemical patent documents from Japan since 1963, it had not covered electrical patent documents and other non-chemical patent documents. If one looks at how the number of non-chemical basics in the DWPI evolved, it appears to have increased when coverage of electrical patent applications from Japan was added in 1981, and when coverage of other non-chemical patent applications from Japan was added in 1995.

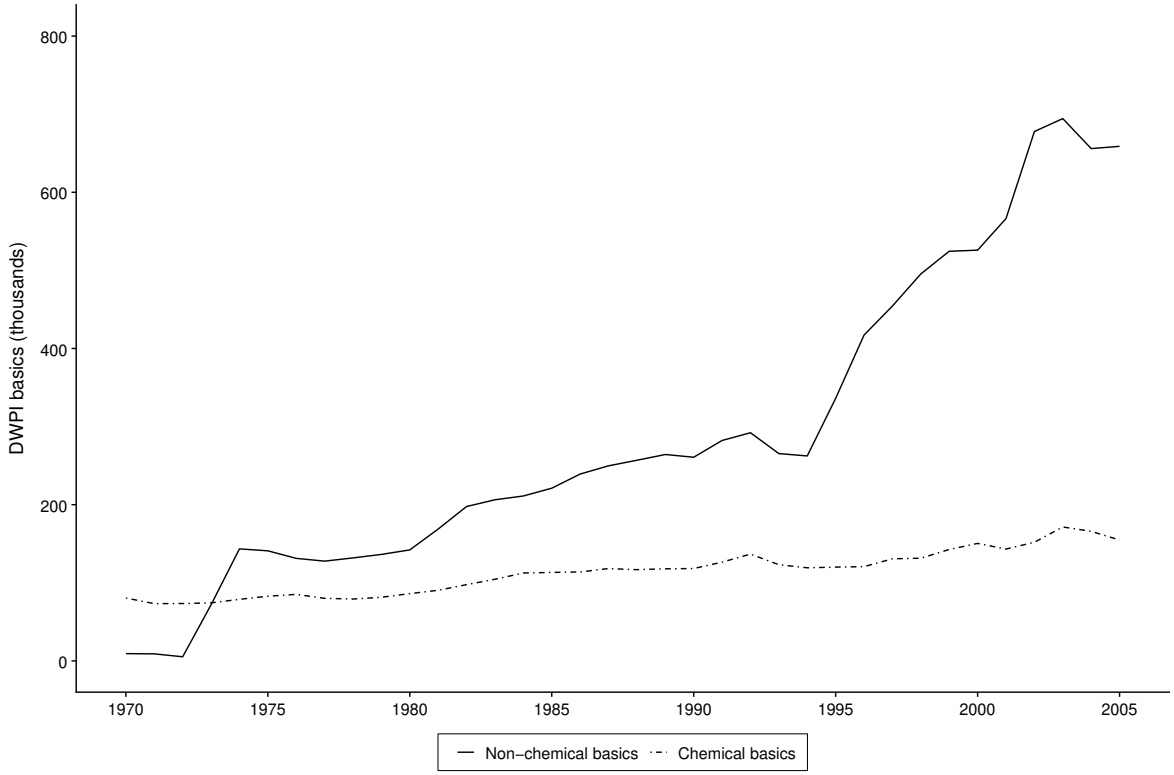

Fig. 5.5 DWPI basics, 1970-2005

Source: The data are from Gardner 1995: 92.

The processing of patent documents from countries and technology fields, which had previously been difficult to process, made the DWPI not just interesting to patent offices in high income, but also in low and middle income countries. Hyams (1978: 154) addressed government representatives in Munich the following way:

> A word of hope for the developing countries. Now that the Derwent patents file are available on-line, all you need is a telephone line, a terminal and a set of Derwent abstract bulletins. With the minimum of instruction, you will be able

> to carry out all the patent watching and searching activities you are likely to require remarkably cheaply, not in the distant future but right away; and - most important of all - with complete independence.

The overall costs of setting up legal-technical systems indeed dropped with the availability of the DWPI. Unlike before, it was no longer necessary to create and maintain large document collections in order to assess domestic and foreign patent applications. This drop in information costs did, however, not mean that patent searching and monitoring became suddenly affordable to patent offices and companies in low and middle income countries. More than a decade later, Nancy Lambert (1999: 452), an information specialist in the employment of Chevron, still stressed the difference between commercial (online) databases and newly available public (internet) databases, as well as the importance of information specialists who knew how to use both:

> [Y]ou have a database that costs $100,000 or more per year just for the privilege of paying fairly steep online costs to search it and display patent references. But sometimes you get what you pay for.
>
> Professional patent searchers are the only people who know both Internet and online databases in depth. We are the only ones who understand their vital differences, who know when the more expensive indexed databases are essential to answer a patent question. End-users are very poor judges of the quality of their own searches; they cannot know what they did *not* get from an Internet search.

The suspicion that the arrival of the DWPI was not enough to supply low income countries with "all the information they needed" is also supported by the fact that patent offices of low income countries are to this day depended on Access to Specialized Patent Information (ASPI), a public-private partnership administered by WIPO. The sheer existence of something like ASPI, which claims to provide "free or low-cost access to sophisticated tools and services for retrieving and analyzing patent data" (WIPO 2021a), suggests that a lack of access to commercial databases is still a problem for patent offices and companies in low income countries: they generally failed to assemble the legal-technical expertise necessary to scrutinize specific patent decisions, as well as industrial policies more generally. Instead, they simply had to trust the searches that international search authorities would make on their behalf. What this means is, of course, that it was very likely not "expert trust" that formed the basis of early interoffice cooperation, but a lack of legal-technical expertise.

I will show in chapter 7 how precisely Derwent's country-level activities influenced changes in national patent law-making. For now, it is sufficient to note that Derwent, which

was still closely controlled by PDG information specialists, became a central commercial intermediary in a network between multinational companies, commercial intermediaries, patent offices and WIPO. While the 1970s also saw the emergence of government corporations and non-profit organizations, like INPADOC and JAPATIC, they did not offer the all-encompassing solutions that WIPO and patent office officials had hoped for earlier.

5.6 Competition and Cooperation

INPADOC and Derwent were, despite the large size of their projects, not the only intermediaries that developed devices, concepts, and arrangements for patent offices and companies. The initiatives of information specialists did not end with propping up Derwent. When Derwent's "coordinated indexing files" grew so large during the 1960s that the number of "false drops" increased dramatically, information specialists decided to do something about these files (see Lobeck 1974; Suhr 2004).

Taking the PDG's early cooperation project as a model, information specialists from large chemical companies decided to once again bundle indexing activities across company boundaries. The basis for this collaboration was a computer-based indexing and retrieval system, called GREMAS, that had been developed by Robert Fugman and his team at Farbwerke Höchst in Germany. In the beginning, the GREMAS system remained limited to the fields of molecular chemistry, compounds and reactions, and had the advantage of enabling some forms of Boolean search ("A but not B"). This seemingly minor improvement constituted, according to Claus Suhr (2004: 42), a BASF information specialist, "a big advantage over the 'primitive' coordinate indexing systems of the time".

There were other features gradually added to the GREMAS system: it could soon be used to get faster access to equivalents, which were more complete than those that could be purchased from commercial intermediaries. Moreover, information specialists with access to the GREMAS system would have the option to request abstracts and save search results within a database (Suhr 2004: 42). In many ways, GREMAS was exactly the sort of system that Vannevar Bush had promised U.S. patent office officials decades earlier: it had a memory that made it possible to make the experience of one search available to other searchers.

To maintain and extend the GREMAS system, information specialists from major chemical companies founded the Internationale Dokumentationsgesellschaft für Chemie (IDC) in 1967. This newly founded "documentation society" received all 800.000 datasets that the PDG had saved at this point. In addition, the IDC made use of Derwent tapes, as well as of tapes from other commercial services. Unlike the PDG, however, the IDC remained a local

initiative by information specialists from large German chemical companies (Bayer, BASF, Hoechst) (Lobeck 1974: 210).

It was, according to Suhr (2004: 42), this small size and high costs, together with the increasing success of commercial intermediaries, that spelled the end for the IDC in the 1990s. Like other organizations with similar ambitions, it became a victim of "Gresham's Law". While Gresham's law actually states that "bad money drives a good", Edlyn Simmons (Procter & Gamble) (2006) adapted this law to patent information to argue that lower quality indexing drives out higher quality indexing.

The GREMAS episode reinforces the idea that private legal-expertise was competitively sustainable when it was developed in border-spanning networks. To build legal-technical expertise independently, by contrast, seemed to be rather difficult. The history of the other leading commercial intermediary, the CAS, that I have neglected thus far, further underlines this point. My previous ignorance towards the CAS is not a judgement about its relevance, but has to do with the CAS management's postwar policy to process patent documents in analogy to ordinary scientific documents. This policy meant, among other things, that patent documents were not considered in the engineering index, only strictly technical documents (Kaback 2002: 138). On the initiative of Russell Rowlett, and other well known information specialists, however, the CAS changed course in the 1967 and began to develop more legally-oriented information products. For example, the scope of patent claims, which had long been ignored by CAS abstractors, became an important feature of new information products (Kaback 2002: 139).

Another reason why I have not looked more carefully into the CAS until now is that it can best be understood by comparing it to Derwent, its main competitor. While figure 5.6 illustrates that the number of CAS patent abstracts grew more slowly than Derwent's patent abstracts in the 1970s and 1980s, it has to be kept in mind that the CAS limited itself to the chemical and pharmaceutical industry. Apparently, both intermediaries were busy catching up with a large number of patent documents that national offices published following the introduction of deferred examination in the Netherlands, Germany, France, and Japan.

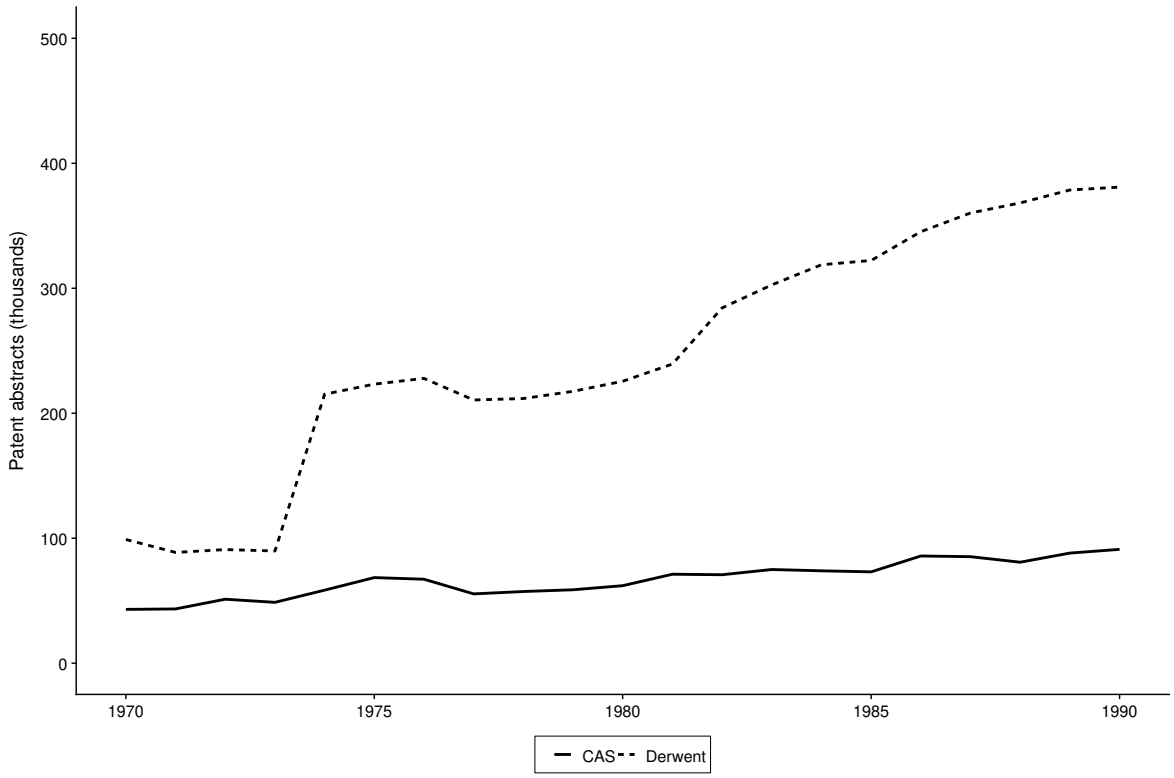

Fig. 5.6 CAS and Derwent patent abstracts

Source: The data are from CAS 2008: 3 and Gardner 1995: 92.

The processing of foreign patent documents was also clearly more difficult and costly for the CAS than it had been for Derwent: it not only needed to convert all existing patent files into machine-readable databases, which required around "25.000 hours of staff time" (Pollick 1981: 128), but also needed to add patent-specific information that had not been recorded before. These overwhelming difficulties had the consequence that plans for the computerization of patent processing were put on ice for nearly ten years (Pollick 1981: 128).

The tide turned, however, in 1977 when the CAS successfully negotiated an agreement with INPADOC. This agreement provided that the CAS received a backfile from INPADOC with 1.2 millions patent records in a machine-readable format; the agreement also stated that the CAS would receive new tapes each week that it could use to update its own file (Pollick 1981: 128-129). What this meant was clear: INPADOC, which had been established by governments in the mid 1970s, now propped up Derwent's main competitor.

Once the collaboration between INPADOC and CAS began, CAS employees no longer needed to search for basics and equivalents in chemical patent documents. Instead, they could select chemical entries in the INPADOC data files and identify corresponding basics and equivalents (Pollick 1981: 128). In other words, they could concentrate on the revision

of bibliographic details, as well as on abstracting and indexing activities. The collaboration with INPADOC made it possible for the CAS to compensate for previously insurmountable weaknesses in patent processing. A strength of the "new" CAS became the registry system which enabled very precise searches relying on chemical structures (Kaback 1989: 122).

Figure 5.7 suggests that the CAS was able to cover a growing amount of chemical and pharmaceutical patent documents with only a limited number of patent abstracts. A rapid increase in PCT member countries in the 1990s and 2000s seems to have mainly led to a surge in equivalence notices, but not to a surge in patent abstracts. The CAS had, with the help of INPADOC data files, regained some of its earlier strength, at least in the fields of chemical and pharmaceutical patent information. In the field of non-chemical patent information, by contrast, Derwent reigned supreme and also increasingly incorporated legal status information from INPADOC.

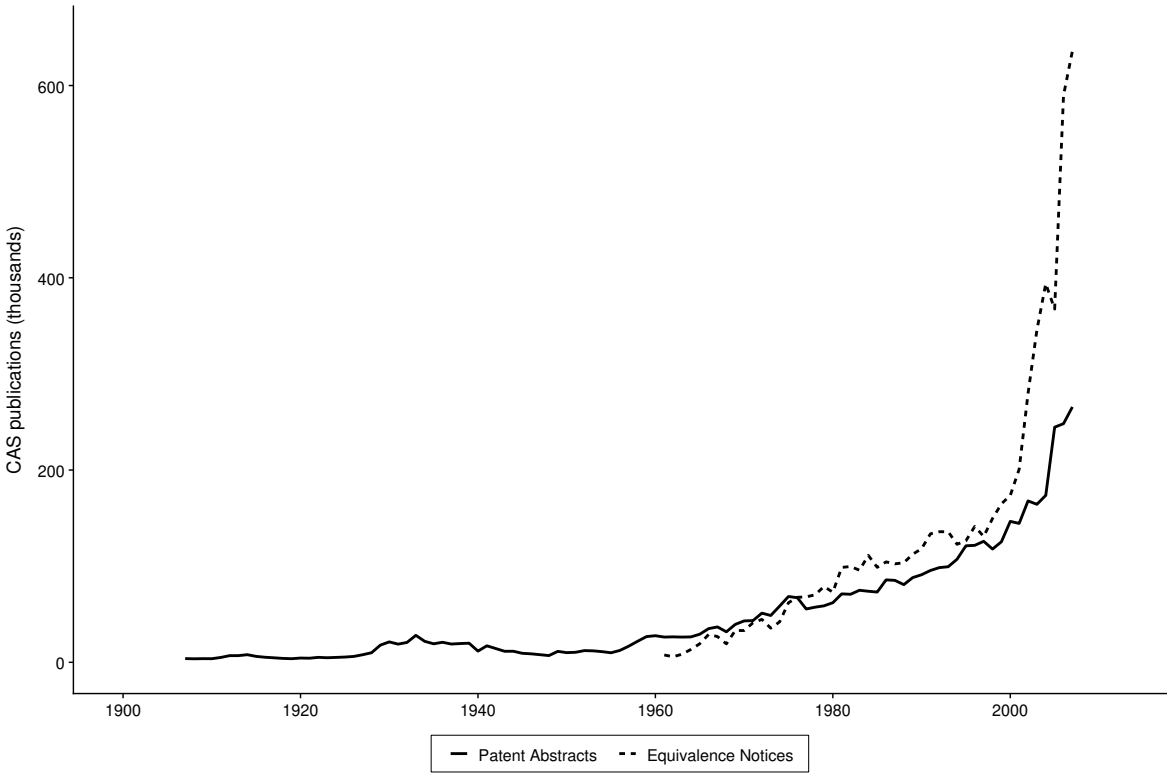

Fig. 5.7 CAS publications, 1907-2007

Source: The data are from CAS 2008: 2-4.

5.7 Conclusion

BIRPI officials and patent office officials have long pushed for a service that would solve the problem of uniform patent information. Rather than accept the abstracting and indexing tools that professional societies and entrepreneurs had developed, BIRPI officials and patent officials struggled to develop a "support tool" that would support the implementation of the PCT and the EPC. Neither BIRPI nor one of the large patent offices had such a support tool available when the PCT and the EPC were signed in 1970 and 1973 respectively.

Because Derwent had the most material and the fastest delivery, BIRPI officials and patent officials experts were naturally interested in its legal-technical expertise. Yet they did also not want to become too dependent on a single commercial intermediary. Thus, in response to a Derwent proposal for a support tool, the IIB in the Netherlands as well as the Austrian government were encouraged to make alternative proposals. The Austrian proposal to establish an international documentation center in Vienna, called INPADOC, was finally accepted by government representatives, and the databases with the same name began to grow dramatically in the mid-1970s.

If one looks more closely, however, the INPADOC services were ultimately not designed to replace the abstracting and indexing activities that Derwent and other commercial intermediaries were engaged in. Patent searching and examination continued to depend on legal-technical expertise from commercial intermediaries, and was not replaced but merely complemented by INPADOC. It was thus first and foremost commercial intermediaries that made it easier for companies and patent offices in high income countries to cope with a steadily growing amount of patent documents.

Moreover, Derwent, CAS and co. had, despite their success, to make sure that patent offices and WIPO actually supplied them with a growing amount of original patent literature. They were, in other words, similarly depended on patent offices and WIPO, as patent offices and WIPO were depended on them. This dynamic interdependence between commercial intermediaries, patent offices and WIPO was facilitated and exploited by information specialists organized in groups like the PDG.

I will show in the next chapter how PDG information specialists used uncertainty in the legal-technical implementation of the PCT and EPC to influence subsequent patent law-making in favor of commercial intermediaries and their own companies. Based on this analysis, I will demonstrate that the ability to cover a country increased the level of patent protection that was ultimately available to companies.

Chapter 6

Expansion of Expertise, Expansion of Rights

While the PCT and the EPC became effective at the end of the 1970s, there was no immediate shift towards stronger patent rights. The reason for this was, according to information specialists, that it remained uncertain how the PCT and EPC should be implemented in practice. Siegfried Hahnemann and Peter Kallas (1997: 119), both information specialists in the employment of BASF, wrote about the years after the PCT and the EPC became effective:

> Even well-experienced professionals in our field could not readily identify the consequences for patent publications that the various articles, rules and paragraphs of the treaties and laws would have.
>
> Nor is that all. When we turned to the patent offices and asked them various questions about matters of detail, we very soon noted that even they were not yet able to see clearly what would have to be done as a result of each of the new regulations.

This uncertainty was addressed, I argue, by information specialists who successfully lobbied patent offices and WIPO to develop PCT and EPC patent documents in line with their requirements. They effectively put commercial intermediaries, like the CAS and Derwent, into a position in which they could monitor patent positions in middle and low income countries without consulting national documents.

I will show that monitoring patent positions via PCT and EPC documents was an important step in strengthening patent rights transnationally. Because of international patent documents, it no longer seemed prohibitively expensive for companies to eventually acquire and enforce patents in a growing number of countries. Changes in coverage supported not

only the implementation of the PCT and the EPC, but also subsequent changes in national patent laws.

6.1 Regulatory Uncertainty and Expert Lobbying

Whether the implementation of the PCT and EPC supported the interests of information specialists and their companies was not entirely clear in the late 1970s. To deal with the ensuing uncertainty, information specialists began to debate implementation questions in groups like the PDG. The PDG was, as I have explained in chapter 3, at first a cooperation project by information specialists from a small number of European chemical and pharmaceutical companies who jointly abstracted and indexed patent documents. Later, after this work had been outsourced to Derwent, the PDG became a fairly large knowledge sharing and lobby organization. Figure 6.1 shows that the PDG grew from 13 member companies in 1957 to 23 companies in 1985, and finally reached 42 companies in 2019.

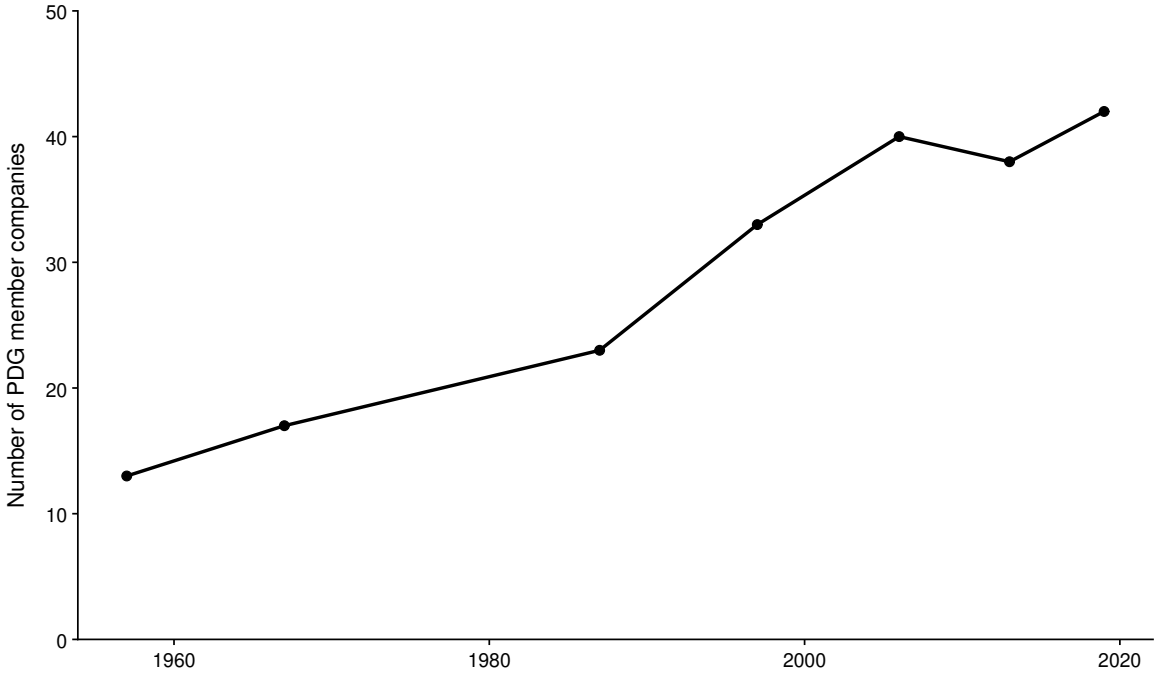

Fig. 6.1 Number of PDG member companies, 1957-2019

Sources:
1957 (13 companies): Suhr 1967: 1300,
1967 (17 companies): Suhr 1967: 1300,
1987 (23 companies): Ochsenbein 1987: 93,
1997 (33 companies): Hahnemann and Kallas 1997: 120,
2006 (40 companies): Philipp and Appleton 2007: 150,
2013 (38 companies): PDG 2013,
2019 (42 companies): PDG 2019.

While the PDG remained a primarily European organization, its impact on the implementation of patent laws worldwide should not be underestimated. The reasons for this are, on the one hand, its influence on the European Patent Office (EPO), which became the foremost "international searching authority" under the PCT (see Drahos 2010, chap. 4), and, on the other hand, its influence on European commercial intermediaries which became critical suppliers of patent information worldwide (Bogsch et al. 1987; Schoch-Grübler 1995).

The PDG's influence likely grew even further when it began to accept electrical and mechanical engineering companies as members. Figure 6.2 shows all companies listed as PDG member companies in 1967, 1987, 2013 and 2019. Most recently, the PDG had not only some of the largest multinational companies in the chemical and pharmaceutical industry as members (e.g. BASF, Shell, and Pfizer), but also some of the largest multinational companies in the mechanical and electrical engineering industry (e.g. Philips, Bosch, and Siemens).

As a side note: most PDG member companies are among the top 500 companies in the Orbis database, which includes more than 20,000 companies with an operating revenue over 500 million U.S. dollar. Herman Mark Schwartz (2021: 21) has recently shown that the top 500 Orbis companies in the "IPR sector", to which he counts chemical and pharmaceutical companies, as well as specific manufacturing companies, create 15.6% of all profits in the top 500, yet are only responsible for 8.7% of all capital expenditures. This, according to Schwartz, partly answers the economic puzzle why globally rising profit shares have generally not produced more investment (see Summers 2014). The numbers presented by Schwartz (2021: 23-24) suggest that IPR-intensive companies in general, as well as pharmaceutical companies in particular, invested substantially less than standard economic accounts would expect. I will show in chapter 7 how PDG information specialists, consistent with Schwartz's argument, increasingly oriented themselves towards the goal to raise corporate profits with as few capital expenditures as possible.

Fig. 6.2 PDG membership composition, 1967-2019

Sources:
1967 (17 companies): Suhr 1967: 1300,
1987 (23 companies): Ochsenbein 1987: 93,
2013 (38 companies): PDG 2013,
2019 (42 companies): PDG 2019.

Back in 1980, PDG information specialists agreed to establish a new working group for discussing the PCT, the EPC, and national patent law implementation. This working group was given the name IMPACT, short for "The Impact of New International and National Patent Laws on Documentation" (Ochsenbein 1987: 93). The principal function of the IMPACT working group was to analyse how new rules and procedures would affect existing abstracting and indexing practices. Among the critical questions was how official patent documents would change, and what this would mean for legal status monitoring. The IMPACT working group prepared analyses for all PDG member companies and explored joint responses. This explicitly also included consultations over "weaknesses in the publication process or user-hostile factors" (Hahnemann and Kallas 1997: 119). With user-hostile factors, information specialists typically meant increases in the price of official patent literature, as well as WIPO and patent office projects that were deemed "competitive" rather than "cooperative".

Despite fears about user-hostile factors, however, Hahnemann and Kallas (1997: 119) have characterized the work of the IMPACT working group as running "extremely fruitfully for a number of years, not just for us as users of the patent publications but also for the patent offices, database producers and hosts". This sentiment was apparently shared by WIPO and patent office representatives. Arpad Bogsch, now Director General of WIPO, said during the PDG's 30 Year Anniversary Colloquium:

> I wish to pay tribute to the PDG, its past and present officers and representatives in WIPO meetings, for their constant attention, for the constructive attitude and their wise advice, coming, as it did and does, from the superb experience its members have in the field of documentation. (Bogsch et al. 1987: 238)

He also mentions that PDG specialists participated in numerous meetings of the "WIPO Permanent Committee for Patent Information" - a public working group on patent information, founded in 1978. This was not an understatement: according to Bogsch (1987: 238), around 100 meetings took place between 1978 and 1987, each lasting about five days on average.

Paul Brändli, then President of the European Patent Office (EPO), who also attended the 1987 PDG Anniversary Colloquium, went even one step further and emphasized the strong influence the PDG had exercised in previous decades:

> For 30 years your group has played a leading role in Europe and the world in the development of patent information. You were the first users group to identify its needs, the needs of the big industrial companies and thus enabled you to stimulate the information industry sector. Several years of work in common with various database producers have resulted in a number of highly valuable information products and services. All of us must recognize that the present databases and

> online services have been strongly influenced by our group, and that the high level of quality reached by the patent information industry and specially the European patent information industry is strongly due to your action. (Bogsch et al. 1987: 238)

The PDG Anniversary Colloquium was only one among many PDG meetings in which WIPO and EPO representatives participated: representatives of both organizations were, in addition, "permanent guests" of the PDG IMPACT working group. One can imagine a typical PDG IMPACT working group meeting like this: representatives from WIPO, national patent offices, or commercial intermediaries presented new features or changes, which were subsequently discussed with 15 to 20 PDG information specialists (from around half of all member companies).

PDG information specialists specifically asked for the input of representatives from patent offices and commercial intermediaries to ensure "that proposals can be discussed from different standpoints and are picked up relatively quickly by whichever institution is responsible." (Hahnemann and Kallas 1997: 120) Joint discussions were apparently very helpful to review the feasibility of proposals and "highlight ad hoc problems in the implementation of desirable ideas and allow an estimate of the expense involved in solving a problem." (Hahnemann and Kallas 1997: 120)

If the PDG in its early years had relied on information specialists to directly process patent documents from different countries, the "new" PDG relied on information specialists to prepare "more than 450 'impact information sheets'" (Ochsenbein 1987: 93). PDG information specialists specifically appointed "country reporters" to monitor patent information released by national patent offices, WIPO, Derwent, and commercial intermediaries. Whenever something potentially significant in the transnational information environment changed, country reporters passed the news on to the IMPACT group, whose work subsequently formed the basis of joint consultations (Hahnemann and Kallas 1997: 120).

During actual IMPACT meetings, information specialists discussed changes in information availability as well as potential group actions. If commonly acceptable actions could be found, the meetings were used to prepare further legal and legal-technical steps. In analogy to existing models of transnational law-making, it is possible to identify three main phases of technically oriented transnational law-making (Quack 2007: 652-657). First, information specialists shared incidental solutions for legal-technical problems that they had encountered in everyday practice. Second, information specialists became engaged in the wider diffusion and standardization of these solutions, which required cooperation with commercial intermediaries. Third, information specialists brought in patent office and WIPO representatives when the solutions in question could not be implemented without changing laws.

6.2 A New 'Division of Labor'

Hahneman and Kallas (1997: 120-123) document in astonishing detail what changes IMPACT participants could easily get implemented, and what changes required lobbying campaigns. It was, for instance, apparently not too difficult for IMPACT participants to get complete priority data added to newly available PCT documents. They could further simply tell Derwent to cover all priority countries once public information was available. Requests like these were routinely forwarded to national patent offices, WIPO, or commercial intermediaries which implemented them without much discussion. This is not to say that these changes were unimportant. As I have shown in chapter 2, searching and examining patents had been burdensome in the postwar decades precisely because seemingly minor, legal-technical barriers could not be overcome.

When legal-technical changes were more difficult to implement, the reason for this was typically that standards or even laws needed to be changed. This meant that patent office or WIPO officials had to be brought in, which would complicate the implementation process. Examples for legal-technical changes that were difficult to implement are the early publication of PCT country designations, and the publication of EPO search reports (Hahnemann and Kallas 1997: 122). Figure 6.3 shows that country designations in PCT applications were helpful to find out in which countries applicants intended to patent the underlying invention. EPO search reports, like the one shown in figure 6.4, were, by contrast, critical to identify documents which increased the risk that applications were rejected or invalidated.

PCT ВСЕМИРНАЯ ОРГАНИЗАЦИЯ ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ Международное бюро

МЕЖДУНАРОДНАЯ ЗАЯВКА, ОПУБЛИКОВАННАЯ В СООТВЕТСТВИИ С ДОГОВОРОМ О ПАТЕНТНОЙ КООПЕРАЦИИ (PCT)

(51) Международная классификация изобретения [4]: **A63B 69/40**	**A1**	**(11) Номер международной публикации:** **WO 86/02010** **(43) Дата международной публикации:** 10 апреля 1986 (10.04.86)

(21) Номер международной заявки: PCT/SU85/00018

(22) Дата международной подачи: 28 февраля 1985 (28.02.85)

(31) Номер приоритетной заявки: 3791133/28

(32) Дата приоритета: 28 сентября 1984 (28.09.84)

(33) Страна приоритета: SU

(71) Заявитель *(для всех указанных государств, кроме US)*: СУМСКИЙ ФИЛИАЛ ХАРЬКОВСКОГО ПОЛИТЕХНИЧЕСКОГО ИНСТИТУТА ИМЕНИ В.И.ЛЕНИНА [SU/SU]; Сумы 244007, ул. Римского-Корсакова, д. 2 (SU) [SUMSKY FILIAL KHARKOVSKOGO POLITEKHNICHESKOGO INSTITUTA IMENI V.I.LENINA, Sumy (SU)].

(72) Изобретатель, и

(75) Изобретатель/Заявитель *(только для US)*: ХОЛИН Борис Георгиевич [SU/SU]; Сумы 244030, ул. 1-ая набережная реки Стрелки, д. 38, кв. 9 (SU) [KHOLIN, Boris Georgievich, Sumy (SU)].

(74) Агент: ТОРГОВО–ПРОМЫШЛЕННАЯ ПАЛАТА СССР; Москва 103012, ул. Куйбышева, д. 5/2 (SU) [THE USSR CHAMBER OF COMMERCE AND INDUSTRY, Moscow (SU)].

(81) Указанные государства: AU, CH, DE, FI, GB, HU, JP, SE, US

Опубликована
С отчетом о международном поиске

Fig. 6.3 Random PCT application filing. 1986

European Patent Office

PARTIAL EUROPEAN SEARCH REPORT

which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number EP 03 01 6585

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,X, P	EP 0 318 216 A (CHIRON CORPORATION) 31 May 1989 (1989-05-31) * claims 1-40; figure 47 * -----	9-14, 17-19, 21-34	C07K14/18 C12N15/40 A61K39/29 G01N33/569 C12Q1/70 C12Q1/68

Fig. 6.4 Random EPO search report, 2004

By far the most difficult changes, according to Hahnemann and Kallas (1997: 122), were changes that also required lobbying at the wider political level. For instance, the coverage of Japanese patent documents in English patent abstracts or the public availability of EPO databases were heavily contested. The controversy about the availability of public patent databases, in particular, can be difficult to understand from today's perspective given that there are now numerous public patent databases available (see Adams 2020). In the early 1970s, however, corporate information specialists saw the availability of public patent databases as imminent threat to the survival of commercial intermediaries.

PDG information specialists vehemently opposed public patent databases when they seemed to threaten their companies' supply with high-quality patent information. What they feared was that supposedly low-quality patent information from patent offices, disseminated via full-text search systems, would render commercial intermediaries uncompetitive (Lambert 1999; Schoch-Grübler 1995; Simmons 2006). This seemed like an all too plausible scenario for information specialists who had experienced a severe decline in the demand for high-quality patent information in the postwar years (see Danilof 1956; Suhr 1967).

That the opposition of corporate information specialists against public low quality information was initially an important factor in the legal-technical development of patent offices is illustrated by failures of public projects that cannot be explained by purely technical challenges. I have mentioned earlier that the President of the German Patent Office admitted that public projects could not be implemented because "[t]he industry did not want an information system that is generally accessible" (Häußer 1998: 7). Similarly, INPADOC was arguably only successful because it took a form that was acceptable to PDG information specialists. Ursula Schoch-Grüber (1995: 86), a BASF and PDG information specialist, called "the cooperation [that began] in 1980 between INPADOC and 11 industrial companies to produce the Patent Register Service (...) a resounding success."

What happened rather gradually was that PDG information specialists shifted from a strategy of fundamental opposition against patent office projects towards what information specialists themselves called a "division of labor" between the public and private sector (Schoch-Grübler 1995: 86). It is not entirely clear why this shift happened when it happened, as many factors relevant for the buildup of legal-technical expertise changed roughly at the same time. For instance, it might be that growing concerns about productivity and competitiveness, as articulated by the President of the German Patent Office (Häusser 1979: 74-75), eventually advanced the construction of public patent information systems; but it might also be that the increasingly market-friendly political climate of the early 1980s made it easier for corporate information specialists to arrange favorable agreements between patent offices and commercial intermediaries (see next chapter).

Be that as it may, PDG information specialists increasingly supported the dissemination of public patent literature under the condition that more sophisticated processing was left to commercial intermediaries. Claus Suhr, also a BASF and PDG information specialist, observed during the 1987 PDG Anniversary Colloquium

> that the improvements introduced in the publication procedures of the patent offices [PCT and EPC] have been paralleled by a considerable rise in public awareness concerning the importance of patent literature as a source of technical information. (Bogsch et al. 1987: 250)

This growing awareness of the importance of patent literature was, according to Suhr, not an incidental side effect, but "has to a considerable degree been brought about by the activities of user organisations, and not least by the Patent Documentation Group" (Bogsch et al. 1987: 250). The PDG and other "user organizations" evidently abandoned their postwar resistance against public projects, and instead tried to establish a division of labor in which patent offices supplied commercial intermediaries with increasing amounts of digitized patent literature. Just how closely commercial intermediaries were tied to information specialists became apparent during the PDG's Anniversary Colloquium, where Paul Hunt, the new head of Derwent, said:

> [W]e hold ourselves accountable to the PDG, simply because as an organisation it represents most of our major customers, a fact always uppermost in our minds. (Bogsch et al. 1987: 247)

In a memoir-like article, written by Suhr nearly twenty years later, he conceded that patent offices had, once the PCT and EPC became effective, practically no other choice but to leave all information processing to commercial intermediaries. He wrote:

> The volume of patent literature increased further when in 1978 the Patent Co-operation Treaty (PCT) and the European Patent Convention (EPC) were put into operation, and international patent offices started to publish unexamined patent applications. Step by step, patent information processing had to be left to commercial services. (Suhr 2004: 42)

The observation that patent offices became increasingly dependent on commercial intermediaries is consistent with additional details from the speech that Paul Brändli, President of the European Patent Office (EPO), gave during the PDG Anniversary Colloquium. In his speech, Brändli told attendants that the EPO had just paid for 1500 hours of "structure searches" in the dabases of Derwent, the CAS, and other commercial intermediaries, and had intentions to double the search volume in coming years (Bogsch et al. 1987: 238-239).

To summarize, the late 1970s and early 1980s marked a historical turning-point at which information specialists successfully established a division of labor between large companies and commercial intermediaries on the one side, and patent offices and WIPO on the other. Putting it bluntly, the acquisition and enforcement of patents was no longer solely "governed" by states: both patent offices and WIPO became increasingly depended on commercial intermediaries which, in turn, held themselves accountable to information specialists representing large companies.

6.3 The Sudden Expansion of Legal-Technical Expertise

As I have argued earlier, commercial intermediaries likely found it easier to abstract and index patent information when countries joined the PCT, the EPC, and other procedural agreements. After all, patent activities in many countries could suddenly be covered with the help of newly introduced international patent documents. Figure 6.5 illustrates that the CAS, Derwent and INPADOC began to cover patent documents from a growing number of middle and low income countries at practically the same time. The late and nearly simultaneous start of coverage in middle and low income countries (upper half of figure 6.5) contrasts sharply with the earlier, haphazard start of coverage in high income countries (lower half).

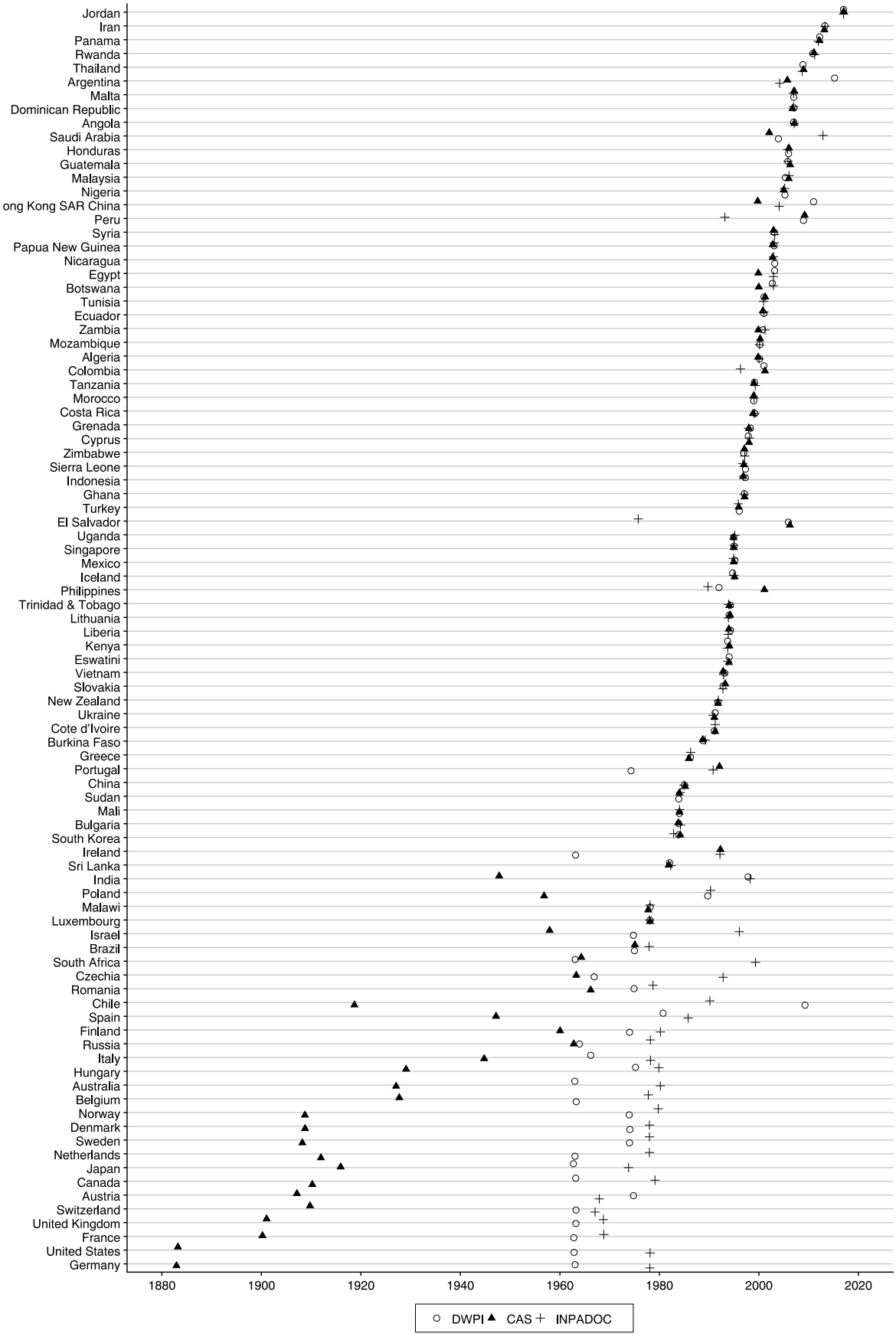

Fig. 6.5 First year of CAS, DWPI and INPADOC coverage, 1983-2017

Note: The United States and Germany were retrospectively covered by the CAS.
Source: The data are from Adams 2020, Table 11.5 & 16.2.

To understand why commercial intermediaries could begin to cover middle and low income countries almost simultaneously, after it had taken much longer to cover high income countries, it is helpful to think through coverage decisions using a stylized example. Figure 6.3 suggests that commercial intermediaries could either cover U.S. patent documents directly, indicated by uninterrupted links between the United States and the CAS, DWPI, INPADOC, or indirectly, indicated by links running through the PCT. The latter seemed possible because PCT documents became a new, increasingly standardized source of international patent information that could be abstracted, indexed or otherwise processed (see figure 6.3).

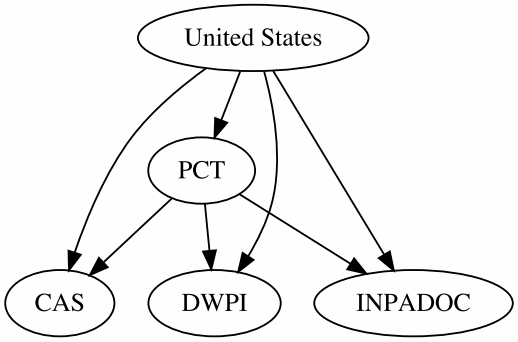

Fig. 6.6 Possibilities to cover the United States

If PCT documents were published early, like PDG information specialists had demanded, they opened up the possibility for commercial intermediaries to cover patent positions in middle and low income countries with far less effort. Figure 6.7 illustrates that the CAS, Derwent, and INPADOC could track international patent positions in low income countries, like Jordan, Rwanda, and Guatemala, by "only" covering PCT documents. Assuming, for instance, a PCT application resulted in equivalent patents in Jordan, Rwanda, and Guatemala, these equivalent patents could be identified by merely covering the PCT documents.

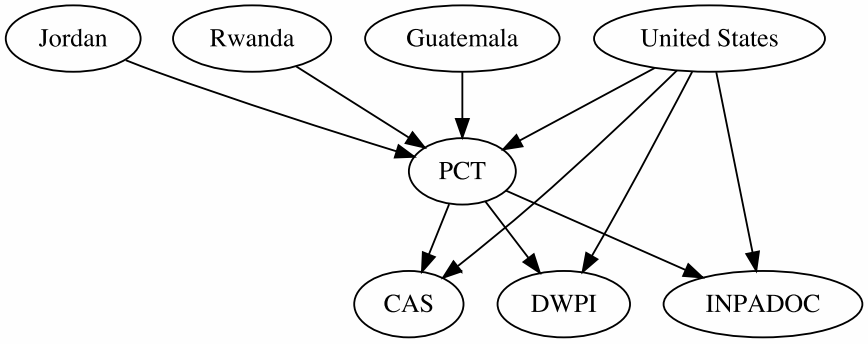

Fig. 6.7 Possibilities to cover the United States, Jordan, Rwanda and Guatemala

The remaining problem, from the perspective of PDG information specialists and commercial intermediaries, was that middle and low income countries needed to become PCT and EPC members before they could be covered with less effort. In other words, document availability depended on changes in patent laws. Or, to put it into the words of Suhr:

> Only quite recently has it been duly realized that legal protection and public disclosure of inventions are closely connected with each other, nay, are dependent on each other. (Bogsch 1988: 250)

This dependence might explain why the PCT, which was only the second patent treaty ever concluded, became closely linked to a series of patent treaties that are often only associated with legally-oriented lobbying efforts. According to WIPO PCT office directors Jay Erstling and Isabelle Boutillon (2006: 1585), eight subsequent multilateral treaties "include express reference to the PCT", and "even require PCT membership as prerequisite for joining the treaty." In case of the TRIPS agreement, for instance, such a linkage is established through the requirement that "World Trade Organization members must recognize the principles set forth in Articles 12 to 19 of the Paris Convention." (Erstling and Boutillon 2006: 585) One of the principles set forth in these articles is the communication of patent information, which many country practically accomplish via the PCT (Art. 12).

Without a series of international patent treaties, which scholars have plausibly related to lobbying efforts by multinational companies based in the United States, Europe and Japan, there would likely have been fewer PCT and EPC member countries, and thus fewer countries that commercial intermediaries could have covered with less effort. Moreover, the CAS would hardly have shifted the focus of its abstracting activities from U.S. and European patent documents towards PCT and East Asian patent documents, had the PCT and EPC not reduced the overall volume of relevant documents. Figure 6.8 shows that the CAS abstracted a sharply decreasing share of U.S., German and French patents after the 1970s, but abstracted a rapidly increasing share of PCT documents, as well as documents from Japan, China and South Korea.

In sum, the CAS statistics, as well as Suhr's comments, suggest that changes in coverage might not only have affected changes in patent laws, but that changes in patent laws might also have affected changes in coverage. To be able to nonetheless estimate potential effects of coverage on patent laws, I will use the remainder of this chapter to introduce and apply quasi-experminetal methods that "augment" the estimation of coverage effects.

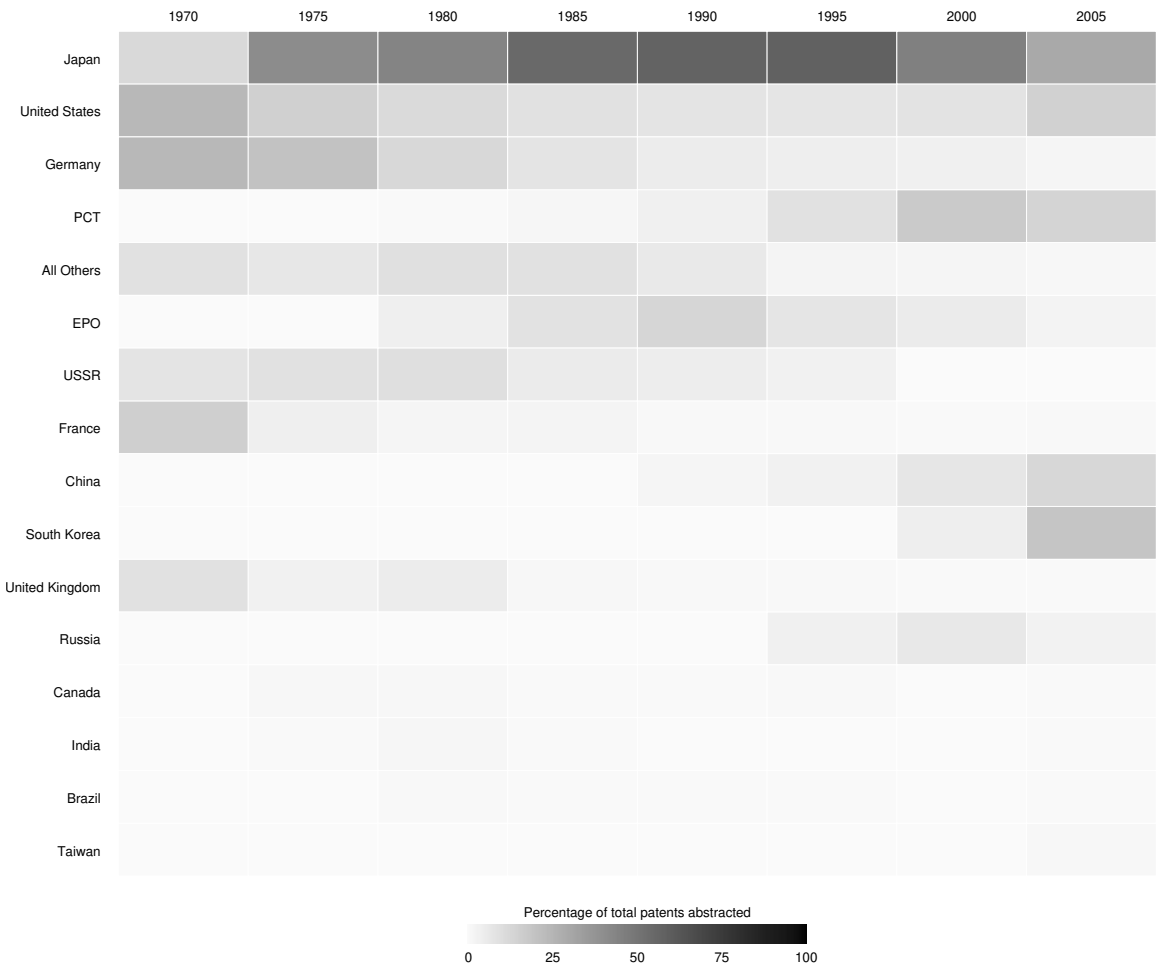

Fig. 6.8 Country of issue of patents abstracted in CAS

Source: The data are from CAS 2008: 6.

6.4 Data Sources and Estimation Strategy

The Basic Estimation Strategy

Thus far, there are, to my knowledge, no studies that attempt to estimate the effects of intermediary coverage on patent protection. My strategy to estimate such effects is by comparing country observations that were covered by intermediaries with country observations that were not covered yet share similar observed characteristics. The main challenge associated with such a quasi-experimental strategy is the selection of control observations that resemble each treated observation. It can, for instance, be difficult to identify country observations that are similar to observations from countries with high protection and high income, but are not covered by intermediaries.

In order to nonetheless enable a quasi-experimental comparison between covered (treated) and uncovered (control) country observations, I rely on matching methods. This type of machine learning methods can, as a burgeoning literature demonstrates, be used to select a set of control observations that closely resemble each treated observation. The data I use for this selection, as well as for later difference-in-difference (DiD) regressions, is closely oriented towards the data economists have used to study the determinants of patent protection. The reason why I use very similar data to most economic studies but a different methodological approach, is that intermediaries are likely to have covered countries with already high protection. In other words, it is likely that the treatment assignment or coverage process is not independent from the outcome: patent protection.

By pre-processing the data using matching methods, however, it should become possible to conduct DiD regression analyses that plausibly adjust for outcome variables. The analyses that follow compare covered country observations to uncovered country observations which were refined using past outcomes and time-varying covariates. I hereby rely on diagnostics for assessing the quality of resulting matches; basically, I test if treated and matched observations are actually comparable with respect to observed confounders.

Relevant Data Sources

Before I describe this methodological framework in more detail, let me quickly discuss the data I use to analyse how changes in coverage affect changes in patent protection. The outcome or dependent variable, which operationalizes patent protection, is Park's patent rights index, introduced in chapter 1. While the index includes 120 countries over a period of 55 years, it is only available at 5-year intervals (1960, 1965, and so on). To address potential aggregation bias resulting from this, I impute missing values using linear interpolation. The fact that estimates based on Park's patent rights index and an alternative measure, the Pharmaceutical Intellectual Property Protection (PIPP) index (see Liu and Croix 2015), produce substantially similar results confirms this approach.

The treatment or independent variable is coded as 1 if a country in a given time period is covered by the CAS, Derwent and INPADOC, and 0 if it is not. I focus on all three intermediaries, instead of just the CAS or Derwent, as patent office and information specialists have repeatedly emphasized the complementarity of information from major intermediaries. In coding the actual treatment variable, I rely on coverage tables in Adams' (2020) reference work "Information Sources in Patents" (Table 11.5 & 16.2.). There is, in addition, a closely related, practical reason why I use coverage data from the CAS, Derwent and INPADOC, and not from other intermediaries. Between the years 1960 and 2015, only the beginnings of CAS, Derwent and INPADOC coverage can be precisely coded. For other intermediaries, it is

largely unclear from which year on specific national and international patent documents were covered; coverage tables include only the dates from which country-level patent information became retrospectively available.

Figure 6.9 displays the coverage distribution across countries over time. The y-axis refers to the 120 countries included in the patent rights index, and the y-axis to the years covered by intermediaries. Each tile is a country-year observation in the data. More specifically, the grey tiles are country-years not covered by intermediaries and the white tiles are country-years under coverage. In contrast to individual coverage starts, shown in figure 6.5 above, starts in joint CAS, Derwent and INPADOC coverage appear visually aligned with patent protection increases discussed in the introduction.

To what extent my analysis of the effect of coverage on patent protection succeeds depends on the refinement of matched observations. In order to adjust for past outcomes, I include lagged 'patent right index' variables in the refinement process. To further adjust for time-varying covariates, I include lagged variables from both the economic and the politically-oriented literature in the refinement process. The economic variables used to capture *income* are GDP per Capita and real GDP at chained Purchase Power Parities (PPPs) (Feenstra et al. 2015). *Innovation capacity*, the second key economic concept, is operationalized with the help of a Human Capital Index, based on years of schooling and returns to education (Feenstra et al. 2015). Because population and trade openness have shown to be correlated with protection strength, I also include a variable capturing population size, and a variable recording the ratio of a country's exports and imports to GDP (Feenstra et al. 2015).

Importantly, I rely not just on covariates identified in the economic literature to refine matched observations. Following politically-oriented explanations of patent protection, I include a variable recording country membership in IP-related preferential trade agreements (PTAs) (Morin and Surbeck 2019), and a variable recording membership in the World Trade Organization (WTO) (Fouquin and Hugot 2017; WTO 2021). While a country's IP-related PTA and WTO memberships should theoretically only influence the level of patent protection directly, and not via coverage decisions, it is at least conceivable that countries are covered by intermediaries only because trade agreements force them on a path of higher protection.

Finally, to take into account claims in the economic literature that some countries grant higher protection because their overall level of political and market freedom is higher, I include a "political rights" indicator from Freedom House (2018a) and a "state ownership" indicator from the VDEM project (Coppedge et al. 2021). While the political rights indicator grades countries on the availability of rights that allow individuals to participate freely in the political process (Freedom House 2018b), the state ownership indicator "gauges the degree

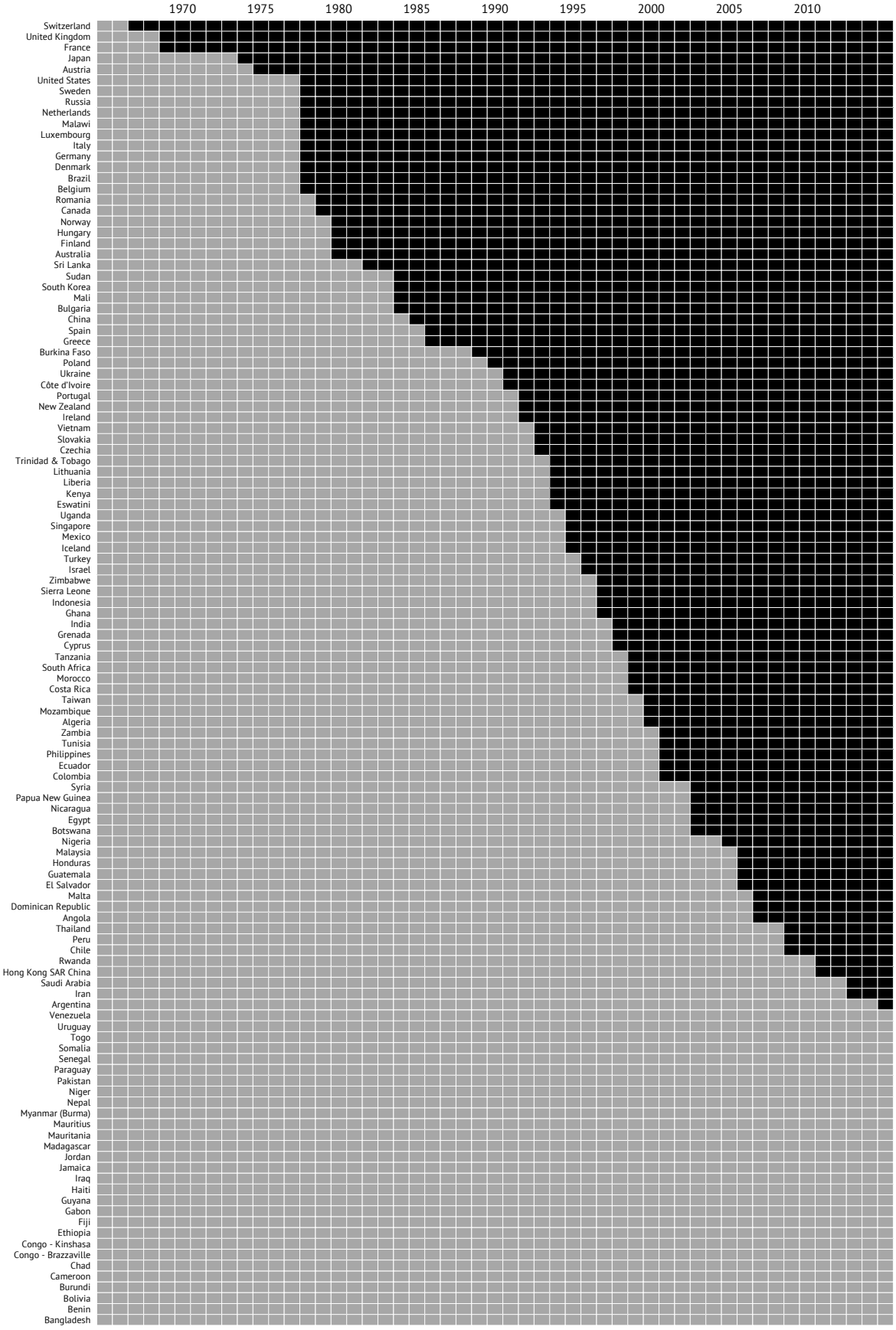

Fig. 6.9 Treatment Distribution Across Countries and Years, 1965-2015

Note: X (Y)-axis refers to years (countries) in the panel data. Each tile represents the treatment status in a country-year observation. Black (grey) tiles represent a county-year that is treated (not treated).

to which the state owns and controls capital (including land) in the industrial, agricultural, and service sectors."

The Estimation Strategy in Detail

Now that I have provided a basic overview of the estimation strategy and data sources, I will explain in more detail how the outlined approach facilitates a quasi-experimental comparison between covered (treated) and uncovered (control) countries using time-series cross-section data. According to Imai et al. (forthcoming), their approach creates so-called "matched sets" by matching each treated observation with a number of untreated observations sharing an identical treatment history up to a pre-specified number of lags.

If I match on L periods of treatment history, for example, I consider a country in a pair of consecutive time periods that switches from 0 at $t-1$ to 1 at t, as treated. I then look for countries that are untreated during both t and $t-1$, but have an identical treatment history during $t-2, t-3$ ... $t-L$. If I find countries with an identical history during the pre-specified number of lags L, I can use them to form a matched set for the treated observation. The point of the entire process is to create a set of matched control countries, M_{it}, for the corresponding L pre-treatment time periods for each treated observation i,t.

Once I have matched sets, I can adjust for past outcomes and time-varying covariates within each matched set M_{it}. This is done by calculating the average Mahalanobis distance between the treated country and each control country:

$$S_{it}(i^{'}) = \frac{1}{L}\sum_{t=1}^{L}\sqrt{(V_{i,t-l} - V_{i^{'},t-l})^{T}\sum_{i,t-l}^{-1}(V_{i,t-l} - V_{i^{'},t-l})}$$

In this equation, $i^{'} \in M_{it}$ stands for a control country in the matched set, V_{it} refers to L lagged dependent variables, such as $Y_{i,t-1}, Y_{i,t-2}$ and $Y_{i,t-L}$, as well as all time-varying control variables introduced above. l is a time period in the matched set, and $\sum_{it'}$ is a sample covariance matrix of $V_{it'}$. Basically, the equation means that given a control country in the matched set, the approach computes the standardized distance using the lagged dependent variables and control variables; it then averages everything across L time periods. To get the closest control countries in each matched set, the method further assignes a weight $\frac{1}{M}$ to each of the M "closest" control countries in the matched set and 0 to the other control countries. The penultimate step is, as hinted above, the estimation of weigthed DiD regressions for each matched set using the weights; in the very last step, the weighted estimates are averaged up across matched sets to estimate the causal effect.

What exactly this means will become clear when I present the intermediate and final results below. At this point it is important to repeat that I perform all the steps required

by this approach to ensure that serially-correlated time-varying confounders are not strong enough to severely influence treatment assignment for a number of pre-treatment periods. In other words, I try to make sure that the attractiveness of high-protection and/or high-income countries to intermediaries do not prevent me from estimating the effect of coverage on patent protection. Equally importantly, I seek to take into account influences of past patent rights changes discussed in the last chapter. How successful I am in achieving these goals depends on the robustness of my estimates, which I test using different numbers of lags and different numbers of closest control units.

6.5 Effects of Legal-Technical Expertise on Patent Rights

The estimation of coverage effects critically depends on information from matched control countries. Before I look at actual point estimates, I check whether there are enough matched sets and whether the size of these matched sets is sufficient. The x-axis in figure 6.10 refers to the sizes of matched sets, and the y-axis refers to the frequency with which matched sets of that size occur in the dataset.

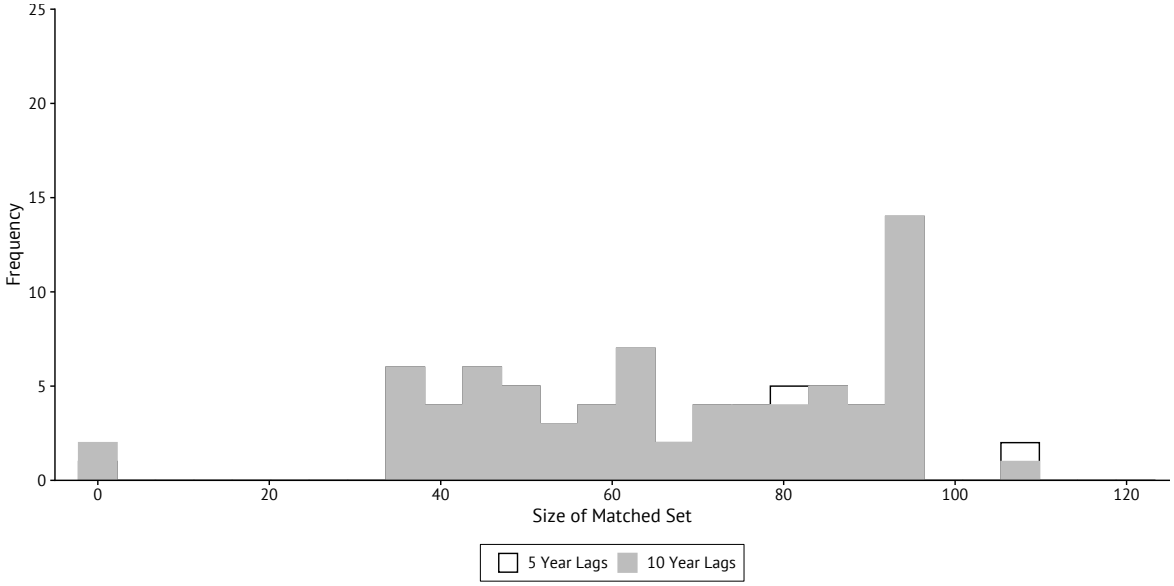

Fig. 6.10 Distribution of the number of control countries in a matched set

Note: The gray bars represent the number of matched control countries that share the same treatment history as a treated observation for 10 years prior to the treatment year. The white bars represent the number of matched control countries for 5 years prior to the treatment year; they are only visible when the size of the matched set differs. When it does not differ, 5-year (white) and 10-year (grey) bars are identical.

The grey bars represent the number of matched control countries that share the same treatment history with a treated observation for 5 years. This number becomes slightly

smaller if I look at 10 year lags, represented by the white bars. The reason for this is that fewer countries share such a long treatment history. The largely hidden white bars suggest an almost identical distribution under 5 year and 10 year lags except for matched sets with size 80 and 105 which become visibly smaller. What is most important, however, is that most matched sets have, despite different choices of lags, more than 60 matched control countries and nearly all matched sets have more than 30 matched control countries. This means there are enough matched control countries.

As indicated above, the matched sets are further refined by applying Mahalanobis distance matching. To assess the quality of the matches, I look at the improvement of covariance balance due to matching over the pre-treatment period. Figure 6.11 presents matching results that adjust for lagged outcomes and time-varying covariates during the five year period before the beginning of coverage. The x-axis refers to the five years before the beginning of coverage (-5 to -1). The y-axis refers to the standardized mean covariance balance for coverage, that is to the average difference between the dependent variable in the treated and control groups. The black line represents the balance of the lagged outcome variable while the grey lines plot the balance of all other covariates.

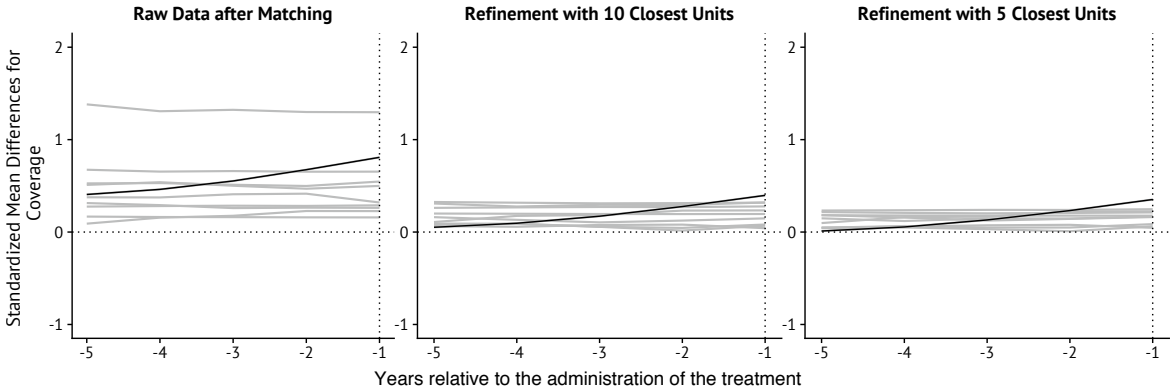

Fig. 6.11 Trajectories of patent protection before the beginning of coverage

Note: The x-axis refers to 5 pre-treatment periods, from $t-5$ to $t-1$. The grey lines represent the balance trajectories of time-varying covariates whereas the black line represents the balance trajectories of the lagged outcome variable. The left plot shows the trajectory for matched sets before Mahalanobis refinement. The center (right) plot shows the trajectory after refinement using the top 10 (5) closest control units.

The visible "squeezing" of black and grey lines in figure 6.11 suggests that the refinement process substantially improves the covariate balance. Matching alone, shown in the left plot, provides not much improvement on its own. Yet, refinement using the 10 closest units, shown in the center plot, and refinement using the 5 closest units, shown in the right plot, reduces most imbalance in confounding variables. The fact that the trend of the lagged outcome stays

constant suggests that the parallel trend assumption, necessary for difference-in-differences (DiD) regressions, is justified.

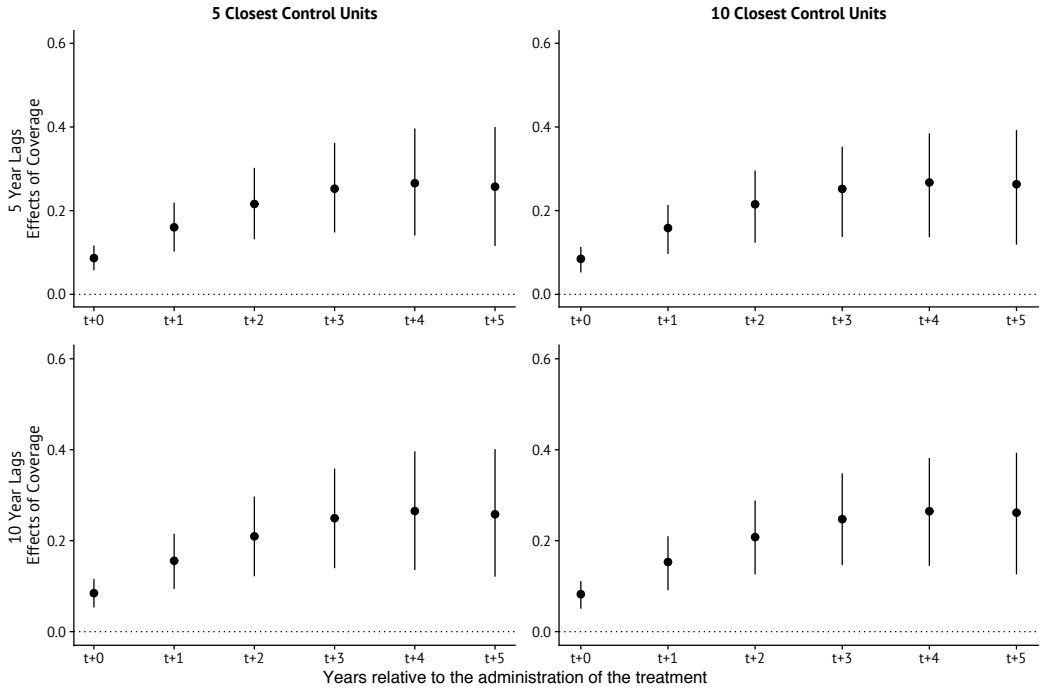

Fig. 6.12 Estimated effects of coverage on patent protection, 1965-2015

Note: The black dots represent effects of intermediary coverage on patent protection measured through Park's patent rights index. In the left (right) column, I have plotted the results from up to 5 (10) matches. In the top (bottom) row, I have plotted the results with 5 (10) year lags. The x-axis refers to the number of time periods relative to the beginning of coverage. 95% bias-corrected weighted block bootstrap confidence intervals are in black lines.

Given the quality of the matches, I am able to present point estimates obtained using the difference-in-differences estimators described in Imai et al. (forthcoming). Figure 6.12 shows the matching estimates of the effects of coverage on patent protection for the period of five years after the beginning of coverage, i.e. $t+0, t+1, \ldots, t+5$. I find statistically significant, positive effects of coverage on patent protection. The results do not visibly change if I modify the number of lags: there is a clear increase in the top row (5 lags) and the bottom row (10 lags). Similarly, the reliance on either the 5 closest control units (left column) or the 10 closest control units (right column) does not seem to change the results. The estimated effects are surprisingly large, indicating an approximately 9 to 26 percent increase of patent protection. Even though the confidence interval is wide, the effect size tends to generally increase in the longer term. In sum, the results indicate a large positive effect of being covered by intermediaries on a country's patent protection measured through Park's patent rights index.

6.6 Alternative Explanations

An alternative interpretation of the results could be that coverage does not increase overall patent protection, but mainly reflects a country's membership in the PCT and other international agreements. This explanation is, however, inconsistent with a closer inspection of patent protection data. Figure 6.13 contains point estimates of matching-augmented DiD analyses using the subindexes of Park's patent rights index as dependent variables.

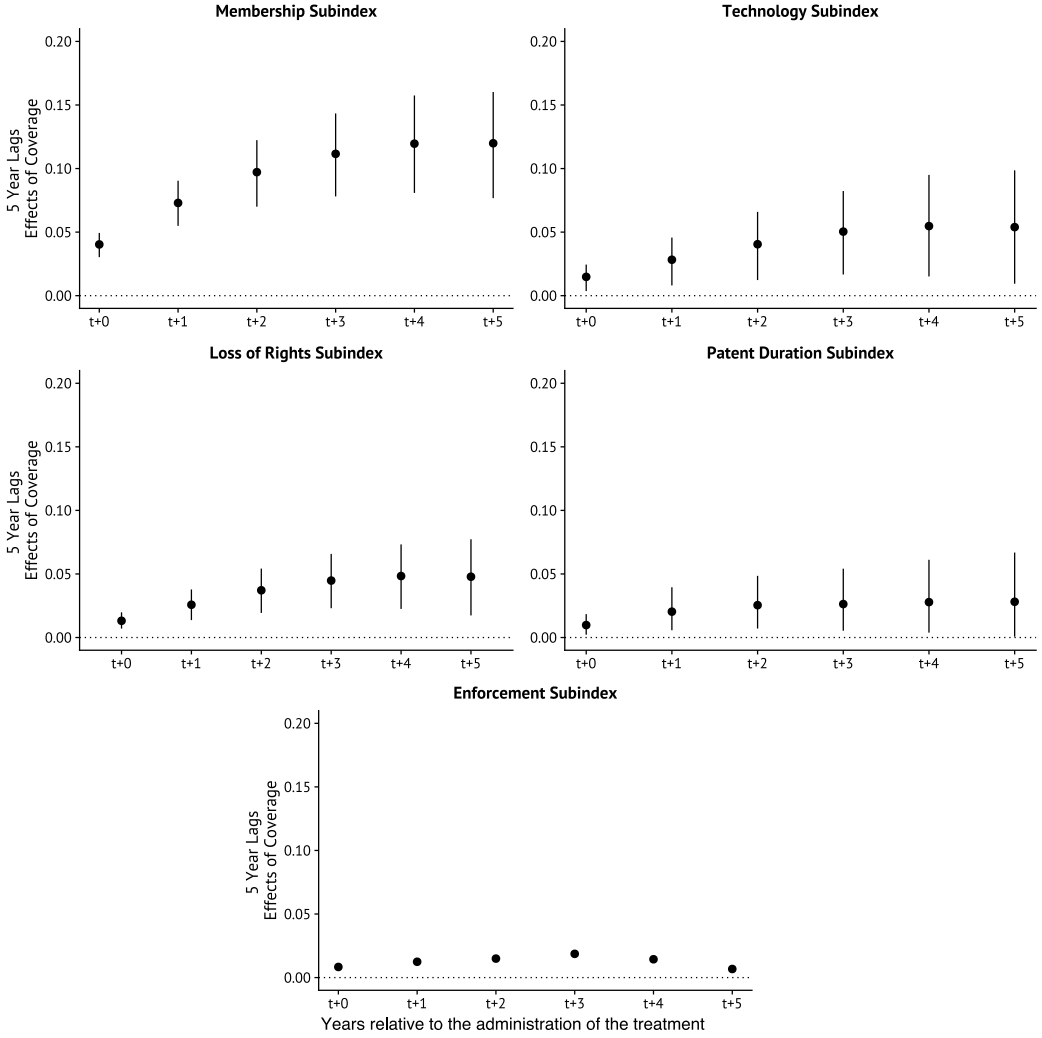

Fig. 6.13 Estimated effects of coverage on facets of patent protection, 1965-2015

Note: The black dots represent effects of intermediary coverage on membership in international agreements (membership subindex), patentability (technology subindex), loss of patent rights, patent duration, and patent enforcement. All plots are based on estimates with 5 matches and 5 year lags. The x-axis of each plot refers to the number of time periods relative to the beginning of coverage. 95% bias-corrected weighted block bootstrap confidence intervals are in black lines.

While the effect of coverage on patent protection is indeed largest on the membership subindex (from t to 11 percent), it also affects the technology subindex. If a country is covered by intermediaries, its protection of technologies like pharmaceuticals, chemicals, or surgical products still increases by 1 to 5 percent. The concern that coverage matters only for membership is therefore overblown. Effects of coverage on the loss of rights subindex, the patent duration subindex, and the enforcement subindex are, however, quite small. This is not unexpected as changes in compulsory licensing, patent duration, and enforcement mechanisms should be less related to intermediary coverage. Legal-technical expertise is from a theoretical point of view mainly relevant for the acquisition of international patents in new technology areas. More purely legal aspects of patent protection, such as compulsory licensing, patent duration, or enforcement mechanisms should not have been substantially affected by coverage.

Another explanation is that the coverage variable still captures mainly PCT-related legal effects despite adjusting for lagged patent protection. To some extent, distinguishing between legal and legal-technical effects of the PCT remains indeed challenging given that coverage could, as I have shown qualitatively, not have increased dramatically without the PCT becoming effective. Yet, there are empirical indications that coverage also increased patent protection independently from PCT membership. Taiwan, for instance, which was for political reasons never able to join the PCT, still severely increased its patent protection after it was covered by Derwent in 1993 and INPADOC in 1994 (Adams 2020: 407, 524).

6.7 Conclusion

This chapter showed that patent protection in many countries increased if patent documents were covered by commercial intermediaries. Access to growing volumes of national patent documents was often only granted to commercial intermediaries after corporate information specialists had lobbied on their behalf. These lobbying activities reinforced already existing, close ties between commercial intermediaries and corporate information specialists. A network of information specialists, so-called country reporters, continually monitored a variety of legal-technical developments in different countries on behalf of corporate information specialists and commercial intermediaries; potential issues and requests were discussed in joint working group meetings that information specialist used to bring together information commercial intermediaries, patent offices, and WIPO.

The implementation of international patent agreements, such as the PCT, was naturally also addressed in a long series of joint working group meetings. Ultimately, these meetings led to changes in the implementation of international patent agreements that allowed commercial

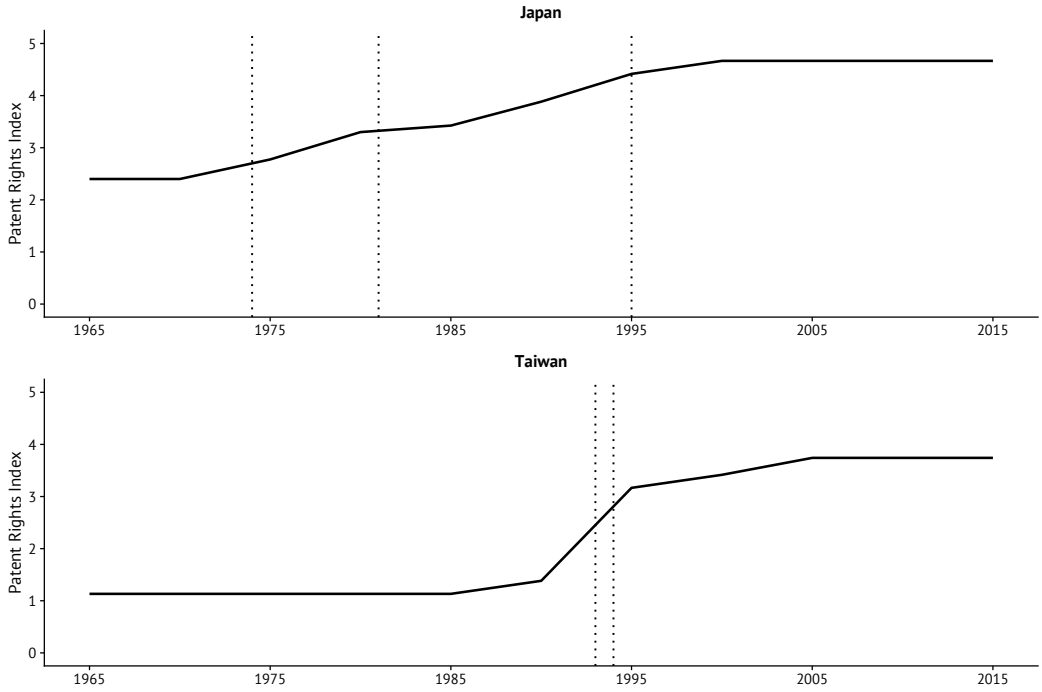

Fig. 6.14 Patent protection and intermediary coverage in Japan and Taiwan, 1965-2015

Note: The horizontal black line represents the development of patent protection in Japan as measured by Park et al.'s patent rights index. Missing values were imputed through linear interpolation. The vertical dotted lines represent years during which major changes in intermediary coverage occurred.

intermediaries to cover growing volumes of national and international patent documents. Patent offices and WIPO were, by contrast, increasingly overwhelmed by the sheer volume of patent information. More sophisticated information processing and legal-technical coverage largely had to be left to commercial intermediaries which remained closely tied to corporate information specialists. It is not an overstatement to say that patent offices and WIPO became largely dependent on commercial intermediaries and corporate information specialists.

Precisely because corporate information specialists played an important role in the legal fine-tuning of public patent documents and in commercial intermediaries' coverage decisions, it is challenging to assess the causal effect of information coverage on patent protection. It is not easy to distinguish whether an effect of coverage on patent protection really reflects increases due to membership in international agreements or a better understanding of technologies, or whether such an effect just reflects decisions by commercial intermediaries for higher protection and higher income countries.

To nonetheless estimate causal effects of coverage on patent protection, I have relied on a quasi-experimental approach, i.e. matching-augmented DiD, suggested by Imai et al. (forthcoming). This approach enables me to not only adjust for past patent protection

levels of countries, but also for time-varying covariates identified in the economic and political science literature. The point estimates of the effect of intermediary coverage on patent protection are surprisingly large (around 9 to 26 percent), and seem to be mainly related to the strengthening of international protection for new, hitherto unpatentable technologies. There is thus plausible evidence for an effect of legal-technical expertise on patent protection.

Chapter 7

A Market in the Making: The Patent Information Market

My examination of patent data has established that patent protection increased when countries were covered by commercial intermediaries. It still remains unclear, however, why commercial intermediaries remained important after patent offices began to implement extensive legal-technical projects. Chapter 5 has shown that patent offices had long been determined to implement large legal-technical projects against the wishes of corporate information specialists. The goal of this chapter is to demonstrate that corporate information specialists were, despite their initial resistance against government projects, soon able to use these projects in their companies' advantage. More specifically, I intend to show that patent offices could be pushed into the role of raw information suppliers.

In essence, lobbying initiatives by corporate information specialists succeeded in maintaining a division of labor between patent offices on the one side and commercial intermediaries on the other. Even though patent offices were able to introduce a number of new devices, such as full-text databases, they became mostly suppliers of commercial intermediaries. This is most evident in the fact that patent offices continued to rely on private abstracts and indexes for examination tasks. In more recent years, patent offices even gave up on challenging commercial intermediaries altogether. Instead, there is now a clear division of labor in which commercial intermediaries depend on patent office raw information, and patent offices depend on commercial abstracts and indexes. This is the kind of "two-way street" between government agencies and private companies that Michael Mann (1993; 2008) has characterized as "infrastructural power".

In what follows, I will first explore how corporate information specialists shaped the postwar information policies of the four largest patent offices: the USPTO, the GPO, the EPO, and the JPO. I will then discuss to what extent corporate information specialists were

able to define the role of patent offices in the emerging "patent information market". Finally, relying on the example of patent information from East Asia, I will argue that the division of labor between information specialists, commercial intermediaries, patent offices, and WIPO became a stable feature of patent and innovation systems despite new technical, cultural and political challenges.

7.1 Legal-Technical Projects of Large Patent Offices

United States Patent and Trademark Office

Most clearly on display were attempts to define a division of labour between patent offices and commercial intermediaries in the United States. Even though corporate information specialists had not been as active in the United States as in Europe, the USPTO had become especially reliant on externally processed patent information. It had, as Weissmann (1973) emphasized, early on neglected its own legal-technical projects, and made heavy use of abstracts and indexes from commercial intermediaries.

Whenever USPTO officials took steps to increase the legibility of patent documents, they made sure to avoid confrontations with information specialists and commercial intermediaries. For instance, when the USPTO required the submission of an official abstract with each patent application in 1967, these abstracts were not designed to replace commercial abstracts. They were rather, as the "Domestic Policy Review" - convened by the U.S. Secretary of Commerce (1979) - made clear, "designed to enable scientists, researchers or general practitioners unfamiliar with patent legal terms to understand the nature of the subject matter."

The U.S. Department of Commerce, which reviewed patent policy in response to President Carter's concerns about declining patent numbers (see chapter 2), had no intention of changing this. On the contrary: it followed the Domestic Policy Review's recommendation to

> clarify the nature of the abstract and [...] give additional weight to the concept that the abstract is not to be used in interpreting the scope of the patent." (U.S. Department of Commerce 1979)

Given this recommendation, it should not come as a surprise that members of the Domestic Policy Review's "Advisory Subcommittee on Patents and Information" were exclusively directors of patent, research, and information departments in large U.S. companies, e.g. Merck, FMC Corporation, Honeywell, Eastman Kodak or McGraw-Hill. These directors were apparently as interested - or even more interested - in patent information as in the

patentability of university R&D or the establishment of a new specialized patent court (i.e. in legal changes that have since then attracted an enormous amount of scholarly attention).

But why exactly did directors of large U.S. companies participate personally in a seemingly technical committee, and devote many report pages to patent information? The answer that their own report gives is that they agreed that patent documents were critical for investments in patented technology. The report explains:

> In addition to whatever use inventors make of the patent system, the patent document can stimulate financing of innovation by giving the entrepreneur a sense of security about the invention he is funding and hence, a sense of confidence about his potential profit. This suggests that the patent document as an information resource is potentially most useful in affecting the willingness to innovate rather than the ability to innovate. But while it would appear that the patent document is suitable to lawyers and technical and scientific personnel for their purposes, it is not geared to provide information to the innovator (or his financial executive) to enhance their willingness to innovate. (U.S. Department of Commerce 1979)

It was, at the end of the 1970s, indeed difficult to get any form of pre-processed patent information from the USPTO. The office released patent information in almost exactly the same way as in the late 19th century. In order to search patent documents, inventors and patent practitioners typically had to work inside the USPTO's public search room in Arlington, Virginia. Only there, they had access to recurrently classified patent documents. While there were a number of libraries spread across the country that disseminated patent documents, these libraries - with one exception - only disseminated unclassified patent documents that were of limited use in patent and research practice (U.S. Department of Commerce 1979). To put it bluntly: whereas information specialists in large US chemical companies had access to abstracts and indexes that covered patents from many countries, small and mid-sized US companies did not even have access to the USPTO's own classification system.

What bothered corporate directors even more, however, were information gaps in the USPTO's internal search file. The U.S. Department of Commerce (1979) report mentioned that "various portions of the search file have from 2 to 28% of the U.S. patent documents missing", whereby "higher percentages occur in those portions of the file relating to the more active technologies". And as if this were not enough, the USPTO also had "literally thousands of unclassified foreign patent documents in storage, unavailable to the U.S. patent examiner" (U.S. Department of Commerce 1979). This unavailability of foreign patent documents implied that many U.S. companies had generally more difficulties t han technically necessary to acquire patents domestically and abroad.

I have already mentioned in chapter 5 that the files of commercial intermediaries were, by contrast, considered complete and timely in the technology fields covered. The fact that the USPTO nonetheless continued to underinvest in "file integrity" (GAO 1986), can only be attributed to an existing division of labour. For Domestic Policy review participants, the USPTO was only supposed to develop legal-technical representations and devices if it simultaneously avoided to "distort" private abstracting and indexing activities in fields like chemistry and pharmaceuticals. Commercial intermediaries already active in these fields should simply be supplied with as much raw patent information as they needed. The U.S. Commerce Department (1979) report explicitly demanded that

> [t]he Patent Office itself should develop its information resources to fulfill its mission in partnership with the private sector.* For example, other firms and scientific societies are already developing and disseminating information about patents. Generally speaking, persons within a given industry or at the information companies that service those industries would know best what the needs are. Indeed the more obvious of these needs have already been filled. However, the Patent Office can help identify unfilled needs in patent information and encourage other private organizations to develop information in areas that are not being served by existing services.

This is arguably precisely what the U.S. Commerce Department and the USPTO did in subsequent years. First, the Commerce Department's National Technical Information Service (NTIS) made available 10 years of US patent publication text data (1970-1980) to commercial intermediaries; tapes with raw patent information were not just sold to the CAS and Derwent, as I have shown above, but also to U.S. bibliographic and full text providers, such as IF/Plenum, Mead Data Central, and InfoLine/Pergamon (McMaster 2005: 154). What this meant was that companies that could afford commercial intermediaries' products were soon able to access full text patent information alongside commercial abstracts and indexes on computerized search systems.

Second, the Commerce Department and the USPTO embarked on an 18-year, 808 million U.S. dollar "patent automation" project to develop an on-line full text search system (GAO 1986: 2). This public information project was, unlike other public projects before, not simply left to commercial intermediaries. The main reason for this was, according to USPTO officials, that "no commercial system had the image storage and retrieval capabilities needed" (Ebersole 2003: 5). Moreover, USPTO officials apparently really wanted to make patent drawings - key representations of patent rights in the electrical and mechanical industries - available to more companies. Even this USPTO signature project, however, indirectly became a windfall for the

CAS, which acted as principal subcontractor in the project. The CAS provided the USPTO "with proprietary software and [was] developing significant portions of the automated patent system's software." (GAO 1986: 52) It was "[a]ccording to Commerce officials [...] critical to the patent automation effort." (GAO 1986: 52)

Joseph Ebersole, who later became Counsel for the Coalition for Patent and Trademark Information, a lobbying group financed by commercial intermediaries, had no complaints about the division of labor between commercial intermediaries and the USPTO in the 1970s and 1980s. He wrote that "[d]uring these first decades of electronic patent search systems, the respective roles of patent offices vis-à-vis the private sector were more easily defined." (Ebersole 2003: 5-6) Adopting similar language as PDG information specialists in Europe, he claimed that there was "a relatively well-defined demarcation line between what patent offices provided and what private sector services provided" (Ebersole 2003: 6). By this he meant that commercial intermediaries supplied companies with "value-added" abstracts, indexes, and full text, whereas patent offices focused on the provision of raw information.

From the perspective of PDG information specialists, the USPTO was together with the German Patent Office (GPO) seen as the most "user-friendly" patent office. The reason for this was the fact that both patent offices avoided to charge commercial intermediaries substantially higher fees for raw patent information than regular companies (i.e. companies that did not re-sell patent information). According to Schoch-Grübler (1995: 88) of BASF, the USPTO and the GPO were "far-sighted enough to understanding that bloating the cost of value-added databases is certainly neither in the public's nor the patent office's interest."

German Patent Office

The GPO became, after its president had successfully fought for an independent information system, more accommodating towards commercial intermediaries. Although the GPO did charge commercial intermediaries for raw patent information, it made no attempts to "bloat the cost" of Derwent, CAS, or full text providers. Erich Häusser, the then President of the GPO, emphasized that the PATOS database, created by WILA and offered by Bertelsmann, two German commercial intermediaries, "presents an almost ideal complement to the database PATDPA" (Bogsch et al. 1987: 242). The latter was a public patent database developed jointly by the GPO, the Technical Information Center Karlsruhe (collaborating with the CAS in the U.S.), the Association for Information and Documentation (German information specialists), and a number of smaller intermediaries (Bogsch et al. 1987: 242-243).

Much like U.S. patent documents, German patent documents soon also became more legible through official patent abstracts. Yet, again like in the U.S., patent practitioners and scholars insisted practically from the get-go that these abstracts should merely have signalling

value. Karl-Friedrich Beier and Joseph Straus (1977: 405), two eminent German patent law scholars, argued that the purpose of official abstracts and other devices was explicitly not to improve the "inadequacy of content in the patent disclosure". Rather, the real purpose of official patent information was to "refer those interested to purchase the required additional information by concluding license and know-how contracts." (Beier and Straus 1977: 404) What makes this argument quite remarkable in retrospect is that it partly contradicts current WIPO policy. While the WIPO (2015) today claims that patent documents are a "rich source of technical, legal and business information", Beier and Straus depicted them only as signals that secret or tacit information was available through licensing.

It is thus no exaggeration to say that the introduction of new legal-technical representations and devices was mainly pursued with the goal to create a "market for patents" (see Lamoreaux and Sokoloff 2001; Lamoreaux et al. 2013). The goalevidently was not to improve the immediate diffusion of technical insights but to make patent documents more visible to researchers, executives, or investors. In other words, the goals articulated by Beier and Straus were very similar to the goals articulated by participants in the U.S. Department of Commerce's Domestic Policy Review.

Interestingly, Beier and Straus arrived at their view through a nearly identical analysis of postwar patent systems to the one I have presented in chapters 2 and 3. They explained to an audience of German patent law scholars that

> [t]he operations of the examining patent offices became so critical that a near breakdown of the patent system almost ensued in the middle sixties. As a consequence, the patent offices, under pressure of mounting numbers, were forced increasingly to neglect their task of documentation and information and finally regarded their task to be only that of handling patent applications, i.e., the refusal or granting of industrial property rights. (Beier and Straus 1977: 399)

In contrast to some U.S. patent practitioners and legal scholars, however, Beier and Straus (1977: 397) openly criticized that the provision of patent information was subsequently "left to expert private services which cover, of course, only special fields of technology and are not inexpensive." They proposed instead to fill information gaps left by commercial intermediaries with the help of public information projects at the national and international level. The fact that this was principally possible had, according to Beier and Straus, been demonstrated by the Soviet Union, as well as other communist and socialist countries. The Soviet Union had indeed, as early as 1967, established a "Central Patent Information and Engineering-Economic Research Institute" in Moscow. Eastern Germany had soon after followed suit, in 1971 to be precise, by founding its own "Center of Information

and Research" (IRZ) in Berlin. These national efforts by socialist countries were, finally, complemented through the setup of an international patent information system between COMECON member countries (Beier and Straus 1977: 402).

To back up their proposal for public patent information projects, Beier and Strauss nonetheless publicly avoided references to socialist countries[1]. Instead, they relied on the support of mainstream, neoclassical economists. The director of the ifo Institute in Munich, Karl Friedrich Oppenländer (2011: 53), wrote later that legal scholars and patent practitioners seemed "quite happy to have found the support by economists." Oppenländer and his fellow economists at the ifo Institute conducted a series of studies that tried to provide evidence for "patent information deficits" of Germany's small and mid-sized companies (see Greif 1982; Greipl et al. 1984). The policy recommendations given based on these studies largely resembled the earlier recommendations by Beier and Straus, as well as recommendations by the Domestic Policy Review. Oppenländer (1984: 73) even specifically emphasized that

> one should think less about extending the content of patent documents, given that small and mid-sized companies were anyway no longer able to handle the paper flood, and more about making patent documents computer readable with the goal to fully mechanize the patent documentation.

Perhaps unsurprisingly, the legal efforts that came out of this collaboration did never really challenge commercial intermediaries. In essence, the proposals only provided support for legal adjustments and public information projects in Germany and Western Europe. I have earlier already discussed INPADOC's rather selective information dissemination strategies: from the perspective of Germany and other Western Europeans countries, INPADOC was seen as public information service; from the perspective of the rest of the world, INPADOC was, until it was taken over by the EPO in 1990, effectively just another commercial intermediary (see McMaster 2005: 156).

[1] A closer inspection shows that the state information institutes in communist and socialist countries mentioned by Beier and Straus relied heavily on commercial intermediaries. This is what, Brian Gore (2005: 2), responsible for Derwent services in the Eastern Bloc, wrote about these institutes:

> I got involved with the Eastern Bloc in about 1980. It was big business: patents were legal intelligence in the Eastern Bloc countries. They had state information institutes that would spend fortunes, particularly the East Europeans who were doing most of the manufacturing. They didn't have the technology to do the kind of searching we were doing in the West, and had to take information on magnetic tape. But they would take all the Derwent data and process it. For ten to fifteen years, I was the Derwent expert in those countries. I would regularly have to disappear to this completely different world. My friends and neighbours thought I might as well be going to the moon! But it was just scientists and technologists like us trying to using patents as intelligence information.

European Patent Office

In contrast to the USPTO and the GPO, the European Patent Office (EPO) and the Japan Patent Office (JPO) pursued a number of patent information projects which corporate information specialists considered openly "user-hostile". The EPO had, as I have previously mentioned, concrete plans to charge commercial intermediaries considerably higher fees for the use of raw information than companies using information inhouse. This policy, linked to an Administrative Council directive in 1988, was strictly opposed by corporate information specialists in general, and by PDG information specialists in particular.

Schoch-Grübler (1995: 88), not known for mincing words, argued that the "EPO [was] bleeding the commercial operators to death". She also warned that the very same 1988 Council directive had demanded "not to distort or impair competition in the commercial sector." (Schoch-Grübler 1995: 88) From the perspective of Schoch-Grübler, and other PDG information specialists, EPO officials were unwilling to accept a division of labor between commercial intermediaries and the EPO as readily as their USPTO and GPO colleagues.

The biggest bone of contention was a plan for a EPO royalty system in which commercial intermediaries would have had to pay royalty rates of up to 40% of product revenue for online services (Gardner 1995: 95). These plans were apparently quite difficult to bury. Schoch-Grübler (1995: 89) complained to fellow PDG information specialists:

> The work of the offices is governed by law and they are responsible only to their national governments, or in the case of the EPO, the Administrative Council. Whilst they maintain close contact with patent lawyers, they are fairly isolated from the mainstream of the information user community. There is only limited scope for transmitting the opinions of industry and the public to the offices.

Despite such harsh complaints about the limited influence of the "information user community", however, the EPO essentially caved in about a decade later. In a 1997 hearing, the EPO conceded that commercial intermediaries would only have to pay marginal costs for its raw information (Schoch-Grübler 2004: 273). The EPO (1997: 43) even highlighted in its annual report that "[t]hanks to this policy, most commercial data providers cut their prices up to 50% in 1997 alone." This was precisely what PDG information specialists had long seen as preferable to patent offices' own attempts to develop more sophisticated information systems. In place of public projects, PDG information specialists strongly favored initiatives to enlarge the "market for patent information".

A still open question is, of course, why PDG information specialists ultimately triumphed over the EPO, as their own writings have emphasized (see Philipp and Appleton 2007: 149). The most likely answer seems to lie in the funding arrangements supporting the

EPO. Contrary to what one might expect, the EPO was not funded through contributions by its member states, but through fees that it charged for the filing, issuing, maintenance and extension of patents. This meant nothing other than that the EPO's funding came to a large extent from precisely those high-patenting companies that were represented by PDG information specialists.

And, indeed, Schoch-Grübler (1995: 88) repeatedly reminded EPO officials who really paid for the EPO's public information projects, and should therefore be calling the shots:

> [T]he actual data supplied by the EPO has in fact already been paid for by the patentee's fees. Thus when we, as patent holders, use commercial databases and the royalty charges are passed on to us, we end up being charged twice. I do not know of any plans by the EPO to reimburse the patentee's share of the royalties!

It seems likely that the EPO dependency on both private fees, and private databases in the examination process, swayed the decision to lower royalties in the late 1990s. Schoch-Grübler (1995: 88) had explicitly warned the EPO that it could no longer pretend to supply small and mid-sized companies with high-quality patent information when EPO examiners themselves relied on Derwent abstracts and indexes to reject applications. In other words, she pointed towards infrastructural entanglements that undermined the EPO's attempts to pursue an independent information policy.

These infrastructural entanglements were likely particularly important for the EPO's decision to lower royalties. Following the EPO, the USPTO and the GPO had early on also introduced a fee-based model, but had not attempted to openly "compete" with commercial intermediaries. They had accepted a growing dependency on commercial intermediaries, as the overall amount of patent documents grew, and ultimately the EPO did so as well. It focused on the provision of raw information through an Internet-platform called Esp@cent, and restricted the buildup of more sophisticated legal-technical expertise to search systems for its own examiners (see McMaster 2005: 156).

In sum, therefore, the information policy of the EPO could later no longer be described as "user-hostile", if it ever could. The same kind of division of labor that had early on characterized relationships between corporate information specialists and patent office officials in the USPTO and the GPO, later on also characterized relationships between corporate information specialists and patent office officials in the EPO.

Japan Patent Office

The Japan Patent Office (JPO) had, finally, always been a difficult source for U.S. and European information specialists. While Japanese patent documents in some technology fields

were covered by commercial intermediaries early on, documents in other fields remained uncovered for a long time. Derwent, for instance, only added Japanese electrical patents in 1981, and coverage for all other patents as late as 1995 (see Clarivate 2021b: 2).

Even if language differences had not been an issue, abstracting and indexing patent documents from Japan would still have been challenging given the sheer number of patent documents published by the JPO. Because of institutional differences, Japanese patent applications contained no more than one claim per application, which resulted in a much higher overall volume of patent documents. According to Adams (2020: 83), it was "estimated that during the late 1990s and early 2000s, up to one-third of the entire annual growth in the Chemical Abstracts Service (CAS) bibliographic file was due to new Japanese patent applications." When Derwent finally began to abstract Japanese patent documents in all technology fields in 1995, it employed "about 350 abstractors in the UK [its headquarter] and over 100 in Japan." (Gardner 1995: 93)

These difficulties, however, only made it considerably more difficult for U.S. and European commercial intermediaries to process patent information from Japan. It did not prevent the emergence of a division of labour between the public and private sector within Japan. While large-scale abstracting and indexing in Japan began with JAPATIC, a quasi-governmental organization similar to INPADOC, companies also relied on Derwent and the CAS early on. As a matter of fact, Information specialists in the employment of 14 Japanese companies founded an organization similar to the PDG in 1966 (Yoshida et al. 2009: 238).

The so-called Japan Farmdoc Association (JFA) assessed the quality of Derwent's abstracts and indexes, and made suggestions for legal-technical changes. It even jointly negotiated about prices for commercial patent information, which were apparently twice as high in Japan as in the U.S. and Europe (Yoshida et al. 2009: 240). In addition, homegrown Japanese commercial intermediaries gradually become more important as well, but likely remained less visible to foreign information specialists as they often "operate solely in Japanese" (Adams 2020: 93).

The actual differences thus lay not so much in the general division of labor as in the way patent information was published and used. The Japanese Ministry of Trade and International Industry (MITI), responsible for both the JPO and JAPATIC, was seemingly never as worried as U.S. and German government officials to make high quality patent information publicly available. Not only had JAPATIC the support of large Japanese companies, like Matsushita Electric, and the Keidanren (the Federation of Economic Organizations) (Kawashima 2008), it also played an important role in MITI's industrial policy-making.

Unlike the U.S. and Germany, Japan granted considerably weaker patent rights in the postwar decades, particularly to foreign companies. This "weakness" entailed that

> no patent rights were ever bought without MITI's pressuring the seller to lower the royalties or to make other changes advantageous to Japanese industry as a whole; and no program for the importation of foreign technology was ever approved until MITI and its various committees had agreed that the time was right and that the industry involved was scheduled for "nurturing" (*ikusei*). (Johnson 1982: 17)

MITI could hardly have maintained tight control over foreign patent rights without a substantial volume of abstracted and indexed patent documents. In sharp contrast to INPADOC, JAPATIC was explicitly setup as an abstract service and assembled information to enable judgement determinations on licensing issues. Nagamura (1981: 189), who introduced JAPATIC during a WIPO conference, emphasized that

> in every case of technology transfer in Japan - from Japan to abroad or from abroad to Japan - patent information plays an indispensable role and JAPATIC has, as a matter of fact, fixed its foundation as an organization to process and disseminate patent information efficiently in accordance with needs.

If there were problems with this system, they came - like in the U.S. and Europe - mostly from a growing amount of patent documents published under deferred examination, as well as from unknown foreign documents. Among the JPO's responses to these problems was the development of an internal patent family and cited document inquiry system. But it also relied on external services, such as JAPATIC's later privatized Patent On-Line Information Service (PATOLIS) and the CAS-online system (Okazaki 1984: 178,180).

The division of labor between the patent office and commercial intermediaries therefore also mattered in Japan, even though clearly to a lesser degree. The JPO not only developed system after system, but in contrast to the USPTO and GPO also provided its examiners, and thus indirectly Japanese companies, with unrestrained access to commercial databases. A prominent German patent lawyer tied the JPO's high examination quality directly to the accessibility of commercial patent information to JPO examiners:

> the examiner showed to me how she was now entering all these cost-bearing databases. This is different for the GPTO examiner: She/he needs, so to say, the signature of a director if she/he wishes to spend the money for the search on an outside data bank. (Goddar and Appelt 2007: 111)

Taken together, it can be said that Japan had long remained difficult to cover for U.S. and European commercial intermediaries. This was the case even though MITI and Japanese

companies seemed to have extensively used quasi-governmental and commercial patent information services to monitor developments overseas. Ultimately, however, even the JPO began to open up more and more of its raw information to U.S. and European commercial intermediaries. Why exactly this happened is not clear, yet both the U.S. Secretary of Commerce's (1979) report and Hyams's (1978; 1985) writings contain frequent warnings about the limited accessibility of European and Japanese patent information when compared to U.S. patent information. It is likely that concerns about European and Japanese information accessibility were behind the 1983 initiative for "trilateral cooperation" between the USPTO, the EPO, and the JPO (see McMaster 2005: 155).

7.2 Trilateral Cooperation and the Market for Patent Information

For commercial intermediaries, the new framework of a "trilateral cooperation" between the USPTO, the EPO, and the JPO was associated with both risks and opportunities. Yet if one looks at statistics on the early patent information market, then it seems that commercial intermediaries were mostly able to exploit opportunities that came with the generation of voluminous public databases. Risks of serious government competition did, by contrast, not seem to have materialized.

Jacques Michel (1991), a former Vice-President of the EPO, has assembled the only statistics on the early patent information market I could find. Figure 7.1 plots his numbers for major databases in chemistry and patents. Apparently, the total size of the market for databases in chemistry and patents increased from $30 million in 1986 to $80 million in 1989. Derwent earned $8.5 million in 1986, and $20 million in 1989. The CAS, by contrast, generated $17 million in 1986, and $50 million in 1989.

These numbers are incomplete in so far as earnings in the separate market for patent information cannot be broken down by company, only by region. Given that Derwent was located in Europe, and the CAS in the U.S., it is likely that Derwent generated substantially larger earnings than the CAS in the market for "pure" patent information. As figure 7.2 shows, the market for pure patent information in Europe grew from $11 million in 1986 to $25.5 million in 1989, but only from $4.3 million in 1986 to $7.1 million in 1989 in the U.S.

What is more important, however, is that Derwent and the CAS together accounted for almost 85% of the total market for chemistry and patent information whereas every other database producer represented less than 3.5% of the total market. In other words, patent

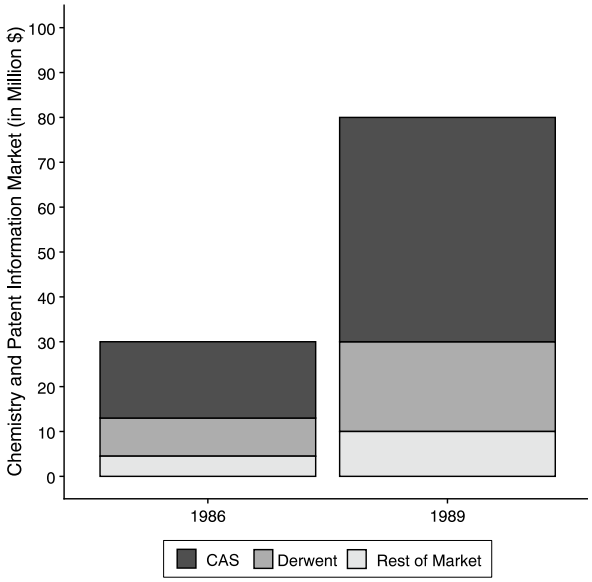

Fig. 7.1 Development of the chemistry and patent online information market, 1986-1989
Source: The data are from Michel 1991: 61.

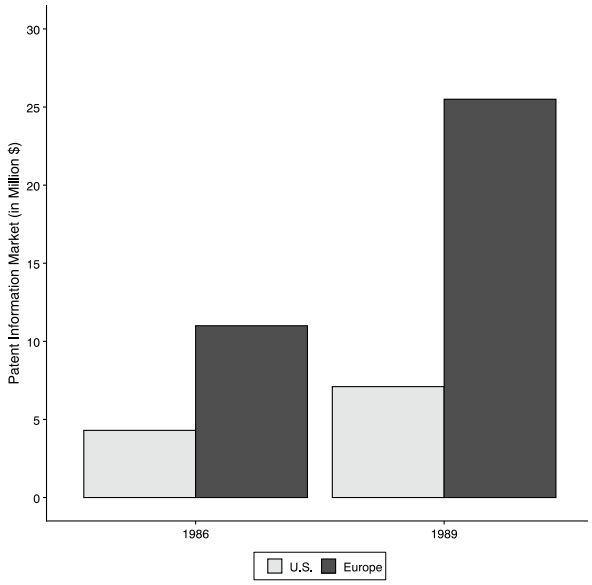

Fig. 7.2 Development of the patent online information market, 1986-1989
Source: The data are from Michel 1991: 62.

offices made very little money with patent information in the 1980s: the USPTO, GPO, EPO, and JPO combined generated less than $5 million with patent information.

Whether things would stay this way was fought out between information specialists, commercial intermediaries, and patent offices. Michel (1991: 62), as representative of the EPO, took the position that the overall market for patent information had remained much smaller than it could have been because "[s]mall and medium size companies are not really using online services". The problem with online services was, in his view, that "their access requires a relatively high level of expertise." (Michel 1991: 62)

Michel suspected, however, that the impending availability of technical drawings and images in online databases would soon drastically simplify patent searching for small and medium size companies. The reason why he expected technical drawings and images to become available soon was that

> [i]n the framework of the cooperation between the USPTO, JPO and EPO, it has been decided that each office will capture, through scanning in facsimile mode, all the pages of the patents belonging to the minimum PCT documentation, filed and published in its respective area since 1920. (Michel 1991: 62)

Figure 7.3 illustrates how many patent documents had already been digitized, or were scheduled to be digitized, in public patent information projects. A total of 105 million pages from Europe were on the list, of which 65 million came from applications and patents from France, Germany, Switzerland, the United Kingdom, and WIPO PCT. But the electronic capture of documents was also expanded to European countries even if they were not part of the PCT minimum documentation. This meant that the list contained another 50 million more pages from Austria, Belgium, Denmark, Greece, Italy, Luxembourg, the Netherlands, Spain and Sweden. The number of U.S. and Japanese documents was similarly large: 45 million pages and 40 million pages respectively.

To implement this massive digitization project, the participating patent offices spent around $40 to $50 million (Michel 1991: 63). This was almost half of what what the entire market for chemistry and patents generated in earnings in 1989. In light of such enormous costs, it should not come as a surprise that the pricing of 200 million digitized documents became a critical point of contention between patent offices, commercial intermediaries, and information specialists. Schoch-Grübler (1995: 89), and fellow PDG information specialists, wanted the digitized, raw information as cheaply as possible, and successfully demanded that

> [t]he patent offices should concentrate on their primary task of examining and granting the patents and providing access to patent information, whereby the

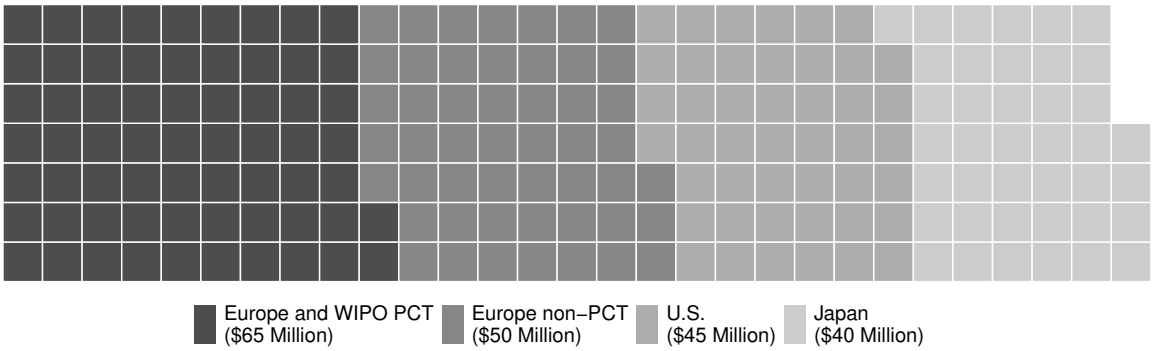

Fig. 7.3 Number of pages digitized in public patent information projects
Source: The data are from Michel (1991: 62).

> provision of patent information should be stressed and not necessarily its dissemination in the form of new databases. Interference in the rest of the information market should be minimal and be the consequence of market mechanism failure, e.g. if a commercial organisation began to abuse its own position.

In sum, it can be said that the division of labor between patent offices and commercial intermediaries looked increasingly like information specialists wanted it to look like: patent offices focused on making raw patent information available to commercial intermediaries. The latter, in turn, supplied both patent offices and multinational companies with abstracts and indexes. There was, in the words of Derwent's managing director Paul Gardner, "a virtuos innovation cycle". Of course, this cycle could just as well be described be as a "vicious innovation cycle" if one worries about the growing dependence of government agencies on commercial intermediaries.

7.3 The East Asian Challenge

A renewed challenge to the division of labor between patent offices and commercial intermediaries arose with the explosive growth of patent documents in East Asia. While Derwent and the CAS eventually succeeded in increasing their coverage of Japanese documents, they soon also had to contend with growing document masses from, what is today called, the Korean Intellectual Property Office (KIPO) and the Chinese National Intellectual Property Administration (CNIPA). Much like the JPO before, the KIPO and the CNIPA saw dramatic growth in the number of domestic patent applications. This growth in domestic patent applications became worrisome to commercial intermediaries and information specialists because JPO, KIPO or CNIPA documents could not simply be linked to already known equivalents.

It had to be assumed that the patent documents contained potentially novel and non-obvious inventions that were not yet known in the rest of the world.

Figure 7.4 demonstrates that the number of domestic patent applications in Japan, South Korea and China (straight lines) grew at a much higher pace than the number of foreign patent applications (dotted lines). This was partly due to the rapid domestic economic growth, as well as an unprecedented rise in R&D spending in these three countries. Yet there were doubtlessly also institutional changes and government initiatives that raised the number of domestic patent applications far above the number that one would have seen without these changes and initiatives. In particular, the rise of domestic applications in China appears much too steep to be solely explained by changes in economic growth and R&D spending.

I have earlier described how the introduction of deferred examination, and the corresponding publication of applications, led to an explosion of domestic applications in Japan. What happened was that the "traditional" Japanese practice of scattering very narrow patent claims over multiple documents produced an enormous amount of potentially relevant prior art, far more than the U.S. and European practice of bundling multiple claims in single documents. The rapid growth of Japanese unexamined publications posed a severe problem for U.S. and Europe-based commercial intermediaries and information specialists. This was the case even though the JPO begun to release English abstracts of Japanese patents: the so-called "Patent Abstracts of Japan". Stuart Kaback (2002: 140), a prominent information specialist in the employment of ExxonMobile, wrote that

> Japan has been a major challenge, China and Korea are becoming ever more important, and the pool of competent document analysts who can provide meaningful document analysis in idiomatic and technically correct English does not seem to be inexhaustible.

The main reason why South Korea and China became more important, and needed to be better covered from the perspective of information specialists, was very likely the massive economic growth and R&D spending in both countries (OECD 2021). But both countries also supported domestic patent filings through a series of government-sponsored initiatives. The Korean government, for instance, soon defined the role of the KIPO similarly broad as the JPO, and sought to explicitly develop the "patent capacity" of small and mid-sized companies in South Korea. To this end, it provided - in cooperation with the private sector - services such as patent information consultation, as well as numerous patent-related education and training services (Erstling and Strom 2010: 463-464).

If one believes Korean economists, then the buildup of "local technological capability", of which patent information consultation was a part, helped to raise the number of domestic

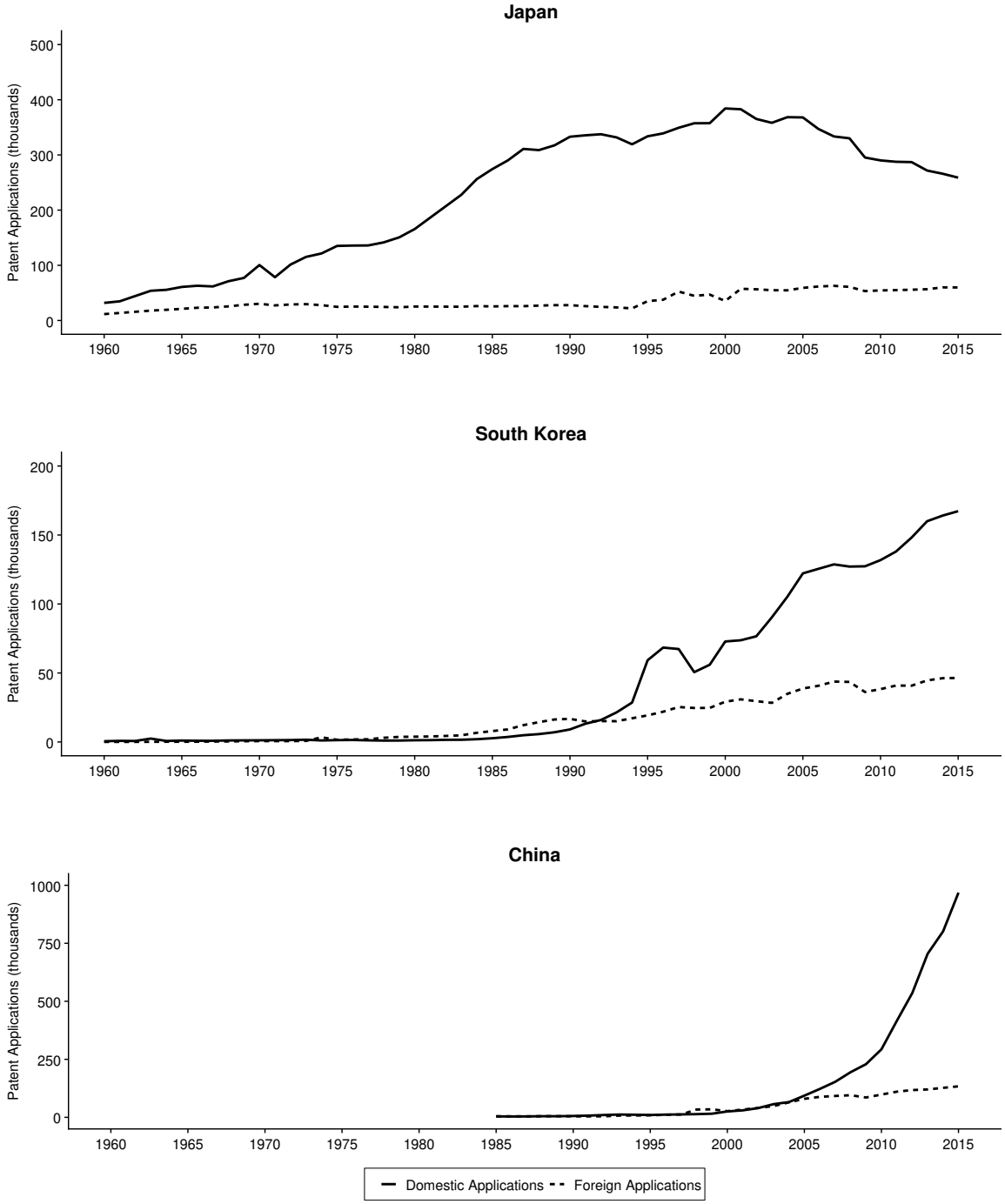

Fig. 7.4 Domestic and foreign patent applications in Japan, Korea and China, 1960-2015

Source: The data are from WIPO 2021d; 2021f.

patent applications. The latter had apparently not simply increased automatically after the country had seen substantial economic growth and increases in R&D spending:

> As the technological capability of domestic firms rose and the market for technology was formed in the 1980s, the proportion of foreign applicants became dominant. But since the mid 1980s, with the increase in local technological capability, the proportion of Korean IP rights started to catch up with foreign-owned IP rights. (Lee 2003: 4)

It is also worth pointing out that, much like the JPO before, the KIPO became a member of the trilateral cooperation, as both the relevance of patent documents from South Korea and the examination capacity of the KIPO increased further. In 2007, the trilateral cooperation between the USPTO, the EPO and the JPO was transformed into a cooperation between five patent offices (the so-called "IP5"). The IP5 now included the USPTO, the EPO, the JPO, the KIPO, and the CNIPA (fiveIPoffices 2021).

The fact that the USPTO and the CNIPA began to cooperate in the same working-sharing and patent information initiative might be surprising in view of a "trade war" between the U.S. and China that is at least partly justified by weak patent rights in China (Colback 2020; Wei 2018). Yet what government officials and business representatives typically mean when they complain about weak patent rights in China are "forced technology transfers" between, for example, European and Chinese automotive and rolling stock manufacturers. They generally do not mean that statutory patent rights in China have not increased, or that the patent capacity of Chinese companies has remained unchanged (see Branstetter 2018; Prud'homme and von Zedtwitz 2019; Prud'homme et al. 2018).

Just like Japan and South Korea before, China has embarked on an ambitious plan to support the buildup of legal-technical expertise, which includes, among other things, "Technology and Innovation Support Centers (TISCs)" in 17 host institutions, "extended local access systems for patent search and analysis" in 26 provinces, and a "patent data service test system" with 15.000 users (see CNIPA 2019, chap. 5). These investments have, again like in Japan, in all likelihood the intention to increase the international enforceability, and thus the cross-licensing value, of future Chinese patents.

It is likely precisely because this legal-technical expertise had not yet been buildup that the Chinese government relied on subsidies to directly increase the number of domestic patent filings. Interestingly, studies have not just shown that government subsidies were key drivers of domestic applications in China (Eberhardt et al. 2017), but also that government subsidies seem to spread out a roughly constant number of claims over more documents (Lei et al. 2013). In other words, China seems to have - intentionally or not - pursued a similar strategy as Japan in building up patent capacity.

The more recent challenge posed by Chinese applications must thus have appeared quite similar to U.S. and European information specialists as the earlier Japanese challenge. And indeed, during the 2007 PDG Impact meeting one of the participants said: "When I look at all the new languages, application figures and new content sources, I almost despair" (Kallas 2019: 2). This feeling was apparently common among many PDG information specialists in the late 2000s who were confronted with 1) more sources than they had anticipated, 2) far from perfect machine translation, and 3) a lack of databases with full-text, images, legal status, as well as "hidden" utility model information. In particular the last issue, hidden utility model information, was an important driver of the large number of domestic filings (Kallas 2019: 5).

To address these concerns, PDG information specialists began to monitor patent information from East Asia more closely and explored opportunities for cooperating with Asian industry groups, such as the Japan Intellectual Property Association (JIPA). Unlike in the decades before, the EPO also seemed to have performed an important "bridging function" and organized joint "East meets West" workshops with Asian Patent Offices (see EPO 2020). Once such working relationships were established, Asian Patent Offices and their publishing organizations participated in PDG IMPACT meetings in Vienna, and PDG representatives began to regularly attend Asian Patent Conferences (Kallas 2019: 3).

The overall strategy of PDG information specialists for coping with the high volume of East Asian patent documents through cooperation and technical development seemed to have borne some fruits. PDG President Peter Kallas (2019: 5) wrote that between 2009 and 2019 the "availability of full-text, images, A2E searching, legal status and access to "hidden" information (like UM in CN) would improve drastically." He also mentions that machine translation made considerably more progress than he had anticipated. Most importantly, he felt reassured that commercial intermediaries had added more "value added" abstracts (Kallas 2019: 11).

It were thus, once again, information specialists that began to span the boundaries that international organizations, patent offices, and commercial intermediaries had left open. Their efforts can likely be explained by information specialists' ongoing attempts to increase and maintain status within multinational companies. Unlike previous generations of information specialists who had primarily attempted to secure status via certification, the new generation of information specialists began to see themselves more and more like information supply-chain managers. Schoch-Grübler (2004: 274) head earlier written about the future of the information specialists that

> [a] bookworm who wants to stay holed up in an ivory tower, lamenting budget cuts and poor services from the suppliers, has no future - he is not an information professional and no amount of certification will save him.
>
> Only if our garden, the patent information market, is going to develop and flourish, the information resources that our companies need will be secure for the future. This requires long-term strategic thinking, as not everything in our garden is rosy, we have to stand up and make our opinions known.

More generally, recent activism by information specialists to organize patent information from East Asian countries demonstrates three things. First, national databases are until the present day seen as insufficient by multinational companies. Second, commercial intermediaries did not automatically process patent information from countries with high protection and economic output when language differences rendered processing unprofitable. Third, when national databases became interconnected, and commercial intermediaries added more abstracts, information specialists "had stood up and made their opinions known", as Schoch-Grübler put it. These interventions established and reinforced a division of labor between information specialists and patent offices.

7.4 Conclusion

The influence of information specialists and commercial intermediaries on patent practice and related legal developments did not end when patent offices and WIPO embarked on large-scale public projects. Just as information specialists and commercial intermediaries had intended, patent offices and WIPO continued to rely on commercial abstracts and indexes. Despite heavy investments in full-text databases with image search capabilities, as well as numerous other devices, patent offices and WIPO avoided to "hire a technical staff which can make intelligent summaries", as Arpad Bogsch had predicted in New York in 1966 (see Bogsch et al. 1966).

The main reasons why public actors accepted the division of labor favored by information specialists and commercial intermediaries were, as I have argued, the administrative distress associated with unprocessed patent documents, as well as lobbying campaigns by commercial intermediaries and information specialists. The latter claimed, to some extent correctly, that their companies were already paying for public digitization projects and should therefore receive raw information at production costs. The fact that such demands were ultimately met suggests that patent offices themselves no longer saw an alternative to a cyclical, market-like exchange. In this exchange, patent offices sold raw information at production costs

to commercial intermediaries and bought back expensive legal-technical expertise from commercial intermediaries.

Yet information specialists did indeed not only intervene to protect commercial intermediaries from "competition" with patent offices; they also tried to fix "market failures" with the help of patent offices. Especially the challenges associated with the processing of patent information from East Asian countries demonstrates that commercial intermediaries had - before information specialists' influence on national patent offices - few incentives to process patent documents from East Asian countries. The overall situation only improved after information specialists secured commercial intermediaries' access to international patent documents (see chapter 6), and thereby freed up resources to process growing amounts of domestic applications from Japan, South Korea and China.

As even these interventions proved insufficient to get patent information from East Asian countries processed, information specialists began to steadily intensify cooperation with peers and patent office officials from East Asian countries. To put it bluntly: if there is a market for patent information, it is a market that depends critically on state action under the influence of corporate information specialists.

Chapter 8

Long-Term Changes in Corporate Patent Practice

To many company patent lawyers, it was clear at the end of the 1970s that patent information was critical for the availability of foreign patent protection. Pauline Newman, a company patent lawyer, who went on to become a prominent judge on the U.S. Federal Circuit - the highest patent appeals court in the U.S. -, argued in 1978:

> Long-term international commitments may be made, capital expanded, and markets developed based on patent positions. The legal advice as to these patent positions is no better than the facts on which the advice is based - again, the patent information, the prior art. (Newman and Hoegberg 1978: 85)

Yet if patent information was really as important for companies as Newman claimed, the question remains why information specialists and their work are rarely mentioned by contemporary legal scholars and economists. They write almost exclusively about inventors, examiners, and lawyers who are sometimes lauded as "transaction cost engineers" and sometimes scolded as "ticket clippers" (see Drahos 2010: 308-310).

Could it be that Newman's view of patent protection, as well as my findings in chapter 6, are somehow off the mark? Maybe patent information mattered only for the early implementation of regional and international application procedures, but everyday practice was dominated by license deals that could be arranged whenever there were strong, information-efficient patent rights available (see Long 2004; Smith 2007).

My argument in this chapter is that the acceptance of such a simple view of patent protection is understandable but ultimately misleading. I will show that the acquisition and enforcement of patent rights was in practice often the result of a "team effort": while information specialists focused on information availability and complex search procedures,

patent lawyers focused on application drafting, oppositions and licensing, in other words, on tasks for which patent information provided the input.

This is not to say that patent lawyers did not search patent information and that information specialists lacked knowledge of patent law, only that there typically was a complex division of labor. Most clearly recognizable was this complex division of labor, according to Newman (1978: 83), in the area of foreign patent protection:

> The area of foreign patent activity is one where direction is needed from the company's long-range planning, sales, and marketing department, so that the patent attorney and the patent information staff can conduct the requisite searches, evaluate the possibilities for foreign patent protection, file the foreign patent applications, and lay any necessary groundwork for licensing and cross-licensing arrangements.

If the argument that corporate information specialists and patent lawyers closely worked together in practice, is correct, then legal and economic approaches that associate patent protection solely with legal expertise are insufficient. They conveniently overlook that devices, representations and standards that have simplified international patent acquisition had their origins outside "innerjuristic discourses" (Weber 2010). Even more importantly, they overlook that it was not legal expertise but the buildup of legal-technical expertise that made it possible to assemble large boundary-spanning patent portfolios, and thus turned patents into "immediately usable monetary assets".

This chapter is structured as follows: I will first describe the buildup of legal-technical expertise in multinational companies. Next, I will shine a light on how practices of information specialists in different technical fields and multinational companies evolved. Finally, I will put the efforts of information specialists in the context of overall profit seeking attempts by multinational companies.

8.1 From Small Teams to Information Departments

Because of a series of articles in *World Patent Information*, there is no company whose patent information activities are better documented than the activities of the German chemical company BASF. Over the years, BASF information specialists have written extensively about the necessity of cooperative patent processing (Danilof 1956), information projects of commercial intermediaries (Suhr 1967, 2004), and information policies of large patent offices (Schoch-Grübler 1995, 1998, 2004). The fact that the contributions by BASF information specialists grew over the years is not sruprising given that the team of BASF information

specialists grew as well. In the early 1950s, even BASF - the largest chemical company in the world -, employed only around five chemists who were primarily concerned with patent information. These five chemists were at the time still part of the patent department. Eventually, however, the number of information specialists grew substantially enough to form an independent department that began to supply all branches of the company with patent and scientific information. According to Claus Suhr (2004: 41), the world of patent information "changed tremendously, it had become to be realised as an indispensable commodity."

It is, of course, not reasonable to assume that every company formed a separate information department following the BASF example. Yet we know that at least the PDG member companies had to employ sizeable numbers of information specialists, as otherwise they could not have made equivalent contributions during the early years of the group (Suhr 1967). Given that later PDG activities still required substantial resources and expertise, we can safely assume that participating companies continued to employ information specialists. PDG information specialists Minoo Philip and Bob Appelton (2007: 150) insisted that

> [a] new member company is expected to have an active patent and/or information department or to have professional staff engaged in patent and information activities.

When electrical and mechanical engineering companies became PDG members in the 1980s and 1990s, they should, by extension, also have employed a number of information specialists[1]. And there are indeed several articles by information specialists working for electrical and mechanical engineering companies in World Patent Information (see Boehme and Werner 1983; Chasen 1981; Naetebusch et al. 1994; Schoeppel and Naetebusch 1995; van der Ligt 2008). In one of those articles, information specialists from the German electrical company Siemens revealed that patent information became critical for the around one hundred "patent engineers" who worked in the company's patent department. Patent engineers were essentially patent lawyers in training who were taught to search patent information before they began to draft patent applications (Naetebusch et al. 1994: 199).

The drafting of patent applications was hardly the only task of patent engineers, and it was also not the only task for which patent information was important. In addition to patent applications, they had to prepare patent oppositions, i.e. procedures that could be used to invalidate already granted patents. For those procedures, patent engineers needed to find patent

[1]The PDG is, by no means, the only organization in which patent information specialists participate. Other organizations include the Confederacy of European Patent Information User Groups (CEPIUG), and its members, as well as the Patent Information Users Group (PIUG). These organizations seem to be growing in recent years. In contrast to the PDG, also individual information specialists and not just corporate information specialists can become members

and non-patent information that patent examiners might have missed during the examination of patent applications (Schoeppel and Naetebusch 1995: 166). If patent engineers could dig out such information, patent lawyers could present it during the opposition proceedings and get rid of competing patent positions.

Patent engineers were, furthermore, assigned the task to get Siemens out of trouble if it was rightfully accused of having infringed the patents of competitors. This was, once again, only possible by checking the patent information on whose basis patents - that were now being enforced against Siemens - had originally been granted. Assuming the patent engineers found patent information that called the novelty and non-obviousness of patents that were being enforced against Siemens into question, this information could be used to invalidate the patents of attacking companies (Schoeppel and Naetebusch 1995: 167).

Another important role that information specialists played was to teach patent engineers how to search patent information as part of patent engineers' on-the-job training. Ideally, patent engineers should get to know the devices, concepts and standards information specialists had developed, while information specialists should pick up knowledge of patent law by working with patent engineers. This is what Siemens information specialists wrote about their company's in-house training:

> The patent engineer benefits from the fact that training in the field of intellectual property includes on-the-job training in the subdepartments responsible for the provision of current patent information and for patent searching. The trainee patent engineer thus becomes familiar with methods, facilities and costs of these subdepartments. On the other hand, the information engineers and search engineers working in the patent information and patent search departments learn by training, daily contact with the patent engineers whilst carrying out their tasks, as also through continued in-house training, the basics of intellectual property and its national and international developments, inasmuch as this is necessary for their professional activities. (Naetebusch et al. 1994: 200)

Siemens information specialists stressed repeatedly that patent engineers should become familiar with the costs that burdened information departments (Naetebusch et al. 1994: 200). These costs were generally a major cause of concern for corporate information specialists (see Danilof 1956; Daniszewski 1983; Schoch-Grübler 1995, 2004; Simmons 2006), and Siemens's information specialists were no exception: they argued that the value of patent information could not reliably be quantified in economic categories. In particular, the "[d]amage caused by non-acquisition or non-use of information" (Naetebusch et al. 1994: 198) seemed impossible to determine; they, like most information specialists, pointed out

that patent lawyers and company executives associated too few risks with underinvestments in patent information.

To underpin this claim, information specialists sought to demonstrate that they could not only keep the costs of patent information in multinational companies at bay, but also that investments in patent information could actually increase company profits. An argument like this would likely have sounded absurd in the immediate postwar decades, yet became increasingly plausible as more and more legal-technical expertise was assembled with the help of commercial intermediaries. Joseph Daniszewski (1983: 121), an information specialist in the employment of the U.S. multinational company DuPont, noted that the "[r]eliance on [...] commercial data bases totally replaced the costly, labor-intensive in-house indexing about ten years ago".

This replacement led, according to Daniszewski, however, not to status losses of corporate information specialists. Rather, corporate information specialists were able to use new representations and devices to claim jurisdiction for more technically and legally relevant, as well as more profitable tasks. In other words, the interconnected buildup of legal-technical expertise allowed information specialists to gradually climb the corporate "mobility ladder". Daniszewski (1983: 123) argued:

> [C]omputer files have made it possible for certain inquiries - e.g., patent equivalents, inventor or assignee searches - to be handled almost exclusively by trained clerical personnel. This has made available more time for the technical staff to pursue the more complex subject searches for general information or for legal consideration.

In essence, the processing of patent information became less an everyday task of information specialists, and more an abstract, indeterminate task (see Abbott 1988). In their everyday work, information specialists used the freed up time, as well as features of new representations and devices, to lay the groundwork for licensing and cross-licensing arrangements. Complex subject searches and searches for legal consideration allowed information specialists not just to prepare better license deal for companies, but also to prevent unprofitable "duplicate" R&D. The only thing that was missing, from their perspective, was that prior art searching became legally mandatory.

8.2 A New Perspective on Patent Information

Substantial investments in patent information had long been difficult to justify, even within large chemical companies. Both information specialists and patent lawyers believed that their

interests were best served by stressing the "stimulating effect" of patent information. As late as the 1950s, Arthur Bakalar (1952: 104), Associate Director of Shell's patent department, wrote about the use of patent information in his department:

> [B]efore the initiation of long term research on a given subject, the patent department should prepare a "field" report thereon [...] Such a report, more often than not, will lift the deadening hand of prior art from the work of the research man, give him a better understanding of the background work and stimulate him into devising new or better lines of attack on the problem.

The fact that this stimulating effect could be rather limited in practice is underlined by Hildegard Danilof's (1956) early complaints about the declining demand for patent information. While the exploration of patent information seemed to have the potential to lift the "deadening hand of prior art", the volume and complexity of public patent documents grew - especially in postwar Europe - so much that the stimulating effect of patent information could no longer be the only argument for investments in patent information.

To address the language and classification differences that were considered responsible for a rapidly declining demand for patent information, Danilof and her colleagues advocated interfirm and cross-country cooperation, as well as the development of new representations and devices. I have already described these efforts in chapter 3. In addition to these practical efforts, however, information specialists also developed new justifications for investments in patent information: instead of emphasizing the discovery of better methods, information specialists began to emphasize the negative consequences that could arise from the non-use of patent information in an increasingly competitive economic environment. Pauline Newman, who headed the Patent & Standards department of FMC Corp., before she was appointed as a judge on the U.S. Federal Circuit, wrote:

> There is no justification, in general, for spending research money in industry unless one expects to be able to make commercial use of the fruits of a successful project. Of course, a researcher does not always know where the investigation will lead. But there is no excuse for being surprised, if it turns out you have merely duplicated the patented results of a competitor. (Newman and Hoegberg 1978: 83)

Putting it differently: the goal of using patent information was, according to Newman, not so much to be surprised or stimulated, but to avoid surprises that threatened the company's bottom line. In addition, Newman felt the need to emphasize legal precautions that ensured that patent rights would not actively hamper the R&D process. She explicitly stated that

> [t]here must always be freedom to use the research results. The results need not always be patentable to you, but they should be free of domination by adverse patents. (Newman and Hoegberg 1978: 83)

I suspect that Newman also took this view as a member of the subcommittee on patent information. This subcommittee, as part of the 1978 Domestic Policy Review, recommended to the Carter Administration the implementation of patent automation and information projects if, and only if, these automation and information projects did not affect the financial interests of commercial intermediaries (see U.S. Department of Commerce 1979). Then, in later years, as judge on the U.S. Federal Circuit, Newman emphasized in concurring and dissenting opinions that the availability and use of patent information needed to be predictable. In the case *Integra v. Merck*, for instance, Newman wrote that

> [t]he purpose of a patent system is not only to provide a financial incentive to create new knowledge and bring it to public benefit through new products; it also serves to add to the body of published scientific/technologic knowledge. The requirement of disclosure of the details of patented inventions facilitates further knowledge and understanding of what was done by the patentee, and may lead to further technologic advance. The right to conduct research to achieve such knowledge need not, and should not, await expiration of the patent. That is not the law, and it would be in practice impossible to administer. (331 F.3d 860 (Fed. Cir. 2003))

Arguably, Newman often took on the role of pointing out problematic legal-technical consequences of decisions by her more legally oriented colleagues. Unlike many of them, Newman knew by experience that patent information allowed companies to abandon research efforts early on, and thus save money, if they found out that they had simply duplicated the patented results of competitors. This particular perspective was strengthened by decisions of the U.S. Federal Circuit that forced multinational companies to search more, but not by decisions that effectively removed the common law research exception, as in *Integra v. Merck*.

Newman's court, the U.S. Federal Circuit, had been established in 1982 with the aim to establish a uniform revision instance for patent cases within the U.S. judicial system (see Meador 1992). It was supposed to make it more difficult for companies to invalidate competitor's patents via "forum-shopping" between U.S. district courts (see Jaffe and Lerner 2007; Scherer 2009). Once established, however, the Federal Circuit did much more than that: it also influenced how multinational companies had to search patent information. Because of the sheer size of the U.S. market, multinational companies that wanted to avoid patent

Table 8.1 Patent damage awards (in Million $)

Case	Damages
Polaroid Corporation v. Eastman Kodak Company	873.16
Smith International, Inc. v. Hughes Tool Co.	204.81
3M v. Johnson & Johnson Orthopaedics	106.80
Pfizer Inc. v. International Rectifier Corp.	55.81
Shiley, Inc. v. Bentley Laboratories, Inc.	44.77
B&H Manufacturing Inc. v. Owens-Illinois Glass	36.49
Syntex Inc. v. Paragon Optical Inc. (& Wilsa Inc)	36.11
Trans-World Manufacturing Co., Inc. v. Dura Corp.	31.29
Deere & Co. v. International Harvester Co.	28.46
Micro Motion Inc. v. Exac Corp.	26.23

Source: The data are from Naetebusch et al. 1994: 199.

infringements lawsuits in the U.S. had to search patent information as meticulously as the U.S. Federal Circuit determined in its judgements. If multinational companies, in particular, abstained from searching, they could be confronted with unprecedented damage payments that the court began to grant immediately after its establishment (Scherer 2009: 193).

These unusually high damage payments in the U.S. market were arguably just what information specialists in multinational companies had been waiting for. It allowed them to strengthen the case for higher overall investments in patent information. Siemens information specialists, for instance, included a list with record damages the U.S. Federal Circuit had awarded (see table 8.1) in one of their *World Patent Information* articles. From the perspective of these information specialists, record damage awards in the U.S. reinforced what they had been saying along, namely that there was an "essential difference between patent information and scientific and technical information", a difference which threatened to "jeopardize the very existence of the company." (Naetebusch et al. 1994: 199)

And indeed, Arno Körber, who was at the same time head of Siemens's patent department, largely seemed to share this perspective and supported additional investments in patent information. He began a book chapter, published in 1999, with a detailed description of the patent environment in the early 1990s that echoed the perspective of his company's information specialists. He wrote that

> [t]he times of relative patent peace in our industry are largely over. At first, legal measures in the U.S., such as the extension of process patents to the immediate product of the process, as well as the establishment of the Court of Appeal for the Federal Circuit have led to the strengthening of patent protection. This has induced some companies to enforce their intellectual property rights much more aggressively than before. The high damage payments U.S. courts have partially granted to patent owners have raised awareness in company managements of other countries for intellectual property rights as immediately usable monetary assets. (Körber 1999: 26)

This new perspective on patents as "immediately usable monetary assets" seemed, according to Körber, almost inevitable in markets characterized by increasing competition and declining prices. He appeared particularly worried about the market entry of new competitors following globalization and deregulation, as well as about the successful exploitation of foreign markets through existing competitors. What became important in this situation, from Körber's perspective, was the pricing of externally vs. internally developed technologies. He claimed

> [i]f patent licenses are acquired and granted in this situation, "price" plays a much more important role than before. Today, before patent licensing agreements are concluded, companies typically assess each others patent portfolios by relying on extensive procedures. In the case of promising future technologies, it can even become difficult for companies - that cannot offer licenses to their own technologies - to receive patent licenses in exchange for fees which can still be considered reasonable. (Körber 1999: 27)

Figure 8.1 illustrates that the development described by Körber was unlikely to have only concerned Siemens and the electronics industry. In contrast to the postwar decades, companies indeed began to pay substantially higher licensing fees to foreign entities. For instance, the amount of U.S. dollars that companies in Germany paid for foreign licenses, including patent licenses, went from roughly 4 billion $ in 1975 to around 16 billion $ in 2015. Even payments by U.S. companies to foreign license holders increased from 2.4 billion $ in 1971 to almost 43 billion $ in 2015. This suggests that payment increases were not, as sometimes claimed, only driven by payments between U.S. affiliated companies.

The most appropriate response to these developments was, according to Körber, the formulation of patent strategies that involved the built up of massive patent portfolios, stretching multiple countries and technology fields (see also Cohen et al. 2000; Hall and

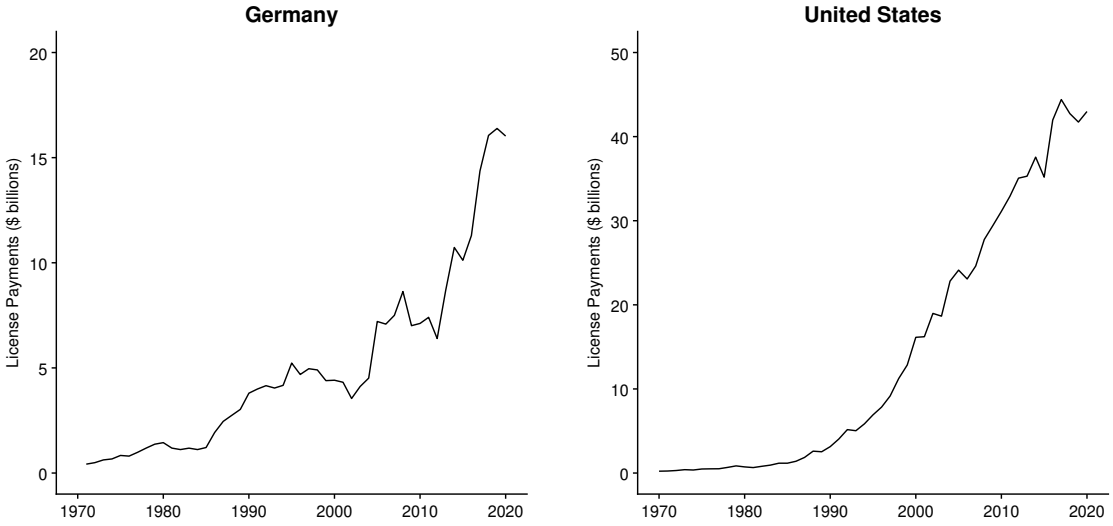

Fig. 8.1 Payments for the use of (foreign) intellectual property, 1970-2020
Source: The data are from IMF 2021.

Ziedonis 2001). To make this possible, Körber saw it as critical to concentrate the assembly and use of patent information in certain branches of the company. He argued that

> [t]he information available within the company about technological developments, business goals, prospective behavior of competitors, and the status of intellectual property rights need to be combined in individual business branches (...) In order to formulate detailed protection strategies and decision guidelines, we have founded strategic patent committees below the divisional level; they include, in addition to the technology, sales and patent department, also the marketing department. (Körber 1999: 28)

External information, in particular, was essential for the work of these newly created strategic and operative patent committees, and had to be organized, processed, and simplified by corporate information specialists. It is interesting to note that Körber especially stressed the relevance of - what I have earlier called - qualitative patent information:

> The relative benchmark for assessing one's own intellectual property positions are the respective positions of the most important competitors. Such comparisons have therefore a very high importance in our patent work. Purely quantitative comparisons provide, according to our experience, too little insight into the strengths or weaknesses of competitors' patent portfolios. Extensive qualitative analyses of individual intellectual property rights cannot be avoided. We have

> developed specific methods for structuring and visualizing such comparisons that cannot be discussed here. (Körber 1999: 28)

While Körber did not want to discuss specific methods, we can guess what he must have meant based on reports of Siemens information specialists in World Patent Information. In these reports, extended abstracts and manual indexes are introduced as devices to monitor competitors, as well as devices to induce Siemens's own R&D engineers to spend more time studying patent information. Siemens information specialists, in essence, argued that the problems outlined by Körber - generally low engagement in patent information and too infrequent invention reports by R&D engineers - could be addressed by copying what information specialists in chemical and pharmaceutical companies had accomplished earlier:

> The salient point is not that creativity should be unnecessarily restrained, but should come to bear where a development is really new. One of the reasons for this unsatisfactory relationship to information is the training of engineers, in which the aspect of information use in the context of development processes has not yet been commensurately dealt with. This is not the case among chemists and in the chemical industry, where greater awareness of the value of information may be observed. The basis of this awareness is recognition of the great value of knowledge already available, made accessible by sophisticated databases and retrieval systems which even allow structure searches. (Naetebusch et al. 1994: 198)

The databases and systems to which the Siemens information specialists referred were mainly databases and systems by commercial intermediaries. They basically seem to have hoped that the availability of better representations and devices for mechanical and electronical patent documents would increase the number of invention reports and simplify comparisons with international competitors. Both their expectations and rhetoric followed paths that information specialists from chemical and pharmaceutical companies had outlined in groups like the PDG.

8.3 The Formation of Temporary Teams

Reports by Siemens information specialists in World Patent Information show that the company's patent engineers were introduced to Derwent's World Patent Index database, to INPADOC, as well as to databases by various patent offices during their on-the-job training. This introduction was apparently a key step in the training of all patent engineers:

> We regard is as essential that a modern patent engineer is familiar with documents from the Derwent World Patent Index database, the Inpadoc/Epidos databases, and also the national patent databases, of which only EPAT, PATDPA and the various US patent databases will be mentioned by way of example. (Schoeppel and Naetebusch 1995: 169)

Important and complicated searches remained, by contrast, clearly under the jurisdiction of information specialists. Collision searches, for instance, i.e. searches to detect Siemens's potential patent infringements, were not independently performed by patent engineers. Unlike them, information specialists seemed to be able to assess patent positions in different countries in much greater detail and thereby prepared the development of production sites and foreign markets (Schoeppel and Naetebusch 1995: 167).

The same was true for statistical patent analyses that were only possible early on with Derwent's World Patent Index database and represented, according to Siemens information specialists, a form of competitive intelligence. They argued that statistical patent analyses were generally only reliable if a confusingly large number of company names could be melted into one, and if patent documents from different countries could be associated with these unique, clearly recognizable names. Once it was clear who had applied for what inventions in which countries, the Derwent database could further be used to make sense of the content of patents, assess their value, and predict future activities of competitors. Derwent's representations and devices were evidently essential in all of these tasks:

> Statistical patent analysis has only become feasible since high quality databases have become available and the hosts on which these databases can be accessed have provided retrieval systems with commands suitable for statistical evaluation. A particularly suitable patent database for such tasks is, in our experience, Derwent's World Patent Index (WPI), as it combines wide country coverage with high quality titles and abstracts and facilitates asignee searching. (Schoeppel and Naetebusch 1995: 167)

A typical statistical patent analysis would either begin with "technical fields" or with a "set of competitors". Assuming an information specialist decided to begin with a technical field, she would aim to identify all documents in this technical field and sort them according to competitors, number of documents, and respective countries. Conversely, if an information specialist would instead begin with a set of competitors, she would assess the number of applied inventions, the technical fields in which applicants were active, and the overall spectrum of countries. The ultimate goal of of both approaches was "to draw conclusions on

possible future activities of a competitor on the basis of past filings patterns". (Schoeppel and Naetebusch 1995: 167)

Over time, Siemens saw the emergence of a division of labor in which end users, mostly R&D engineers and patent engineers, formed "temporary teams" together with information specialists. Within these teams, searching was primarily the task of information specialists, but in the search process they were supported by R&D engineers and patent engineers as the latter possessed more technology-specific knowledge. Siemens information specialists characterized this division of labor as follows:

> [I]t is the general practice at Siemens to employ professional patent searchers to perform patent searches. This is because performance of high quality searches requires special professional competence. This competence is the result of thorough training, continuing education, daily practice and sharing of experience with other search engineers in the patent searching department unit. It is not possible and, for economic reasons, not advisable to train the end user to such a level of search proficiency, as the end user is engaged in other professional activities and can only seldom make use of such search capabilities. (Schoeppel and Naetebusch 1995: 168)

In order to support the formation of temporary teams, Siemens information specialists and patent engineers were not only located in the same building, but on the same floor. The spatial proximity was supposed to enable an optimal harmonisation of activities within short periods of time. It seems that heads of information and patent department had a precise idea of how temporary teams of information specialists and patent engineers should work together:

> Specialized technical information relevant for the search can be passed on in the course of discussion between the patent engineer and search engineer, focal points for the search can be defined and the significance of the search for the company entity can be discussed so as to assess the resources to be made available for the task in question. During the search, which generally lasts several days, intermediate results can be presented and discussed; the final result will be discussed with the patent engineer in all cases. (Schoeppel and Naetebusch 1995: 168)

The formation of temporary teams was never limited to Siemens or to multinational companies located in Europe. Yutaka Wada, President of the PATOLIS corporation, which was early spun off from JAPATIC, described very similar team formation processes in

Japanese companies as "a sort of 'chemicalization'" (Wada 2005: 32). According to him, Japanese companies needed to know precisely what their competitors were working on, and there was no better way to achieve that than by "having your R&D staff and IP experts work together in the same office and sharing their knowledge (...) but this time utilizing IP information that concerns other companies" (Wada 2005: 32).

In summary, patent engineers and information specialists increasingly began to train and work together, often in arrangements that were supposed to favor the development of both legal and legal-technical expertise. After the end of their training, patent engineers typically went on to head patent departments or became partners in patent law firms. Information specialists either became expert searchers, heads of information departments, or also pursued legal careers. From the perspective of information specialists, the legal-technical training of patent lawyers was essentially an investment in their own professional future. It also partially explains why commercial intermediaries held themselves accountable to the PDG and information specialists more generally: the latter brought entire generations of patent engineers in contact with their devices, concepts, and arrangements.

8.4 Stylized Facts about Information Specialists

To find out how many patent engineers and information specialists have been employed by multinationals, it is useful to take a look at the EPO's list of individuals who have successfully passed the European Qualifying Examination (EQE) since 1979. While not every patent engineer passed the EQE, and became a "European Patent Attorney", the list is singularly helpful to get rough estimates of the number of people who at one point have searched patent information to prepare applications and oppositions. By browsing through the list of successful EQE candidates located in Germany, we find a total of 89 patent engineers who have worked for Siemens between 1987 and 2012[2]. The cumulative number of successful EQE candidates is shown in the upper panel of figure 8.2. If we also look at the yearly number in the lower panel, we can see that the individuals who have passed the EQE each year increased rapidly. In the 1990s, only one to five Siemens candidates passed the EQE each year, but in the 2010s already five to ten Siemens patent engineers passed the yearly EQE.

Among all German companies in the EPO list, Siemens trained particularly many European Patent Attorneys. Fellow PDG companies, such as BASF, Bayer, Robert Bosch, and Boeringer Ingelheim followed, however, closely behind. Figure 8.3 shows that eight out

[2]Before 1987, there were no Siemens addresses included in the EPO register. In more recent years, the EPO has stopped to publish company addresses.

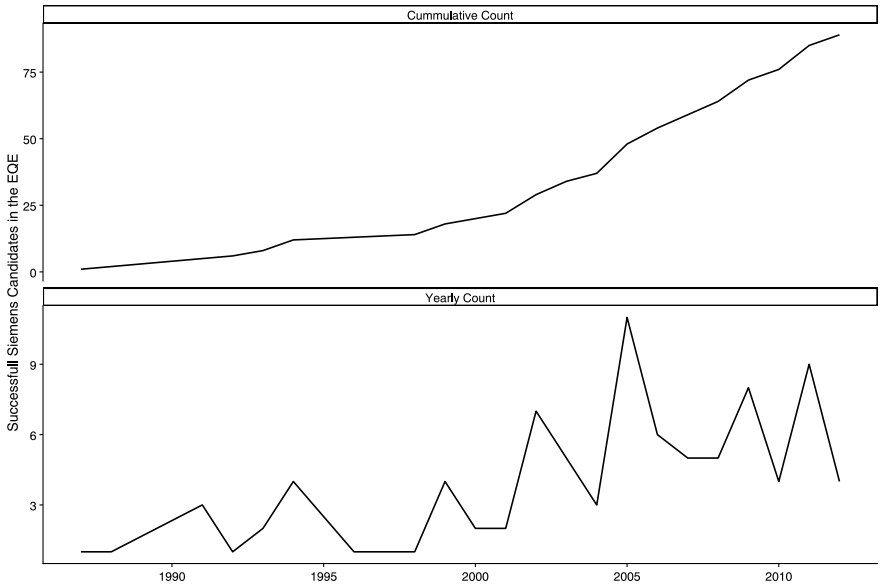

Fig. 8.2 Number of Successful Siemens Candidates in the European Qualifying Examination (EQE), 1987-2012

Source: The data are from EPO 2021.

of the ten companies that trained particularly many European Patent Attorneys in Germany were PDG member companies. Between 1987 and 2012, PDG member companies trained 548 European Patent Attorneys, whereas all other companies trained 618 European Patent Attorneys. This suggests that around 47% of European Patent Attorneys, trained by companies in Germany, had access to "high quality" patent information at least at one point[3]. Of course, this could also be true for patent attorneys from non-PDG firms, large patent law firms, or small patent boutiques, but cannot be confirmed or disproven here.

It is, however, interesting to note that other European countries have not produced quite as many European Patent Attorneys as Germany. Figure 8.4 illustrates that only the United Kingdom and France have trained comparably many European Patent Attorneys. The high number of European Patent Attorneys trained in Germany can probably be explained by its relatively large manufacturing industry. Yet it is likely also related to the clustering of patenting filing activity around Munich - the location of the EPO -, and the GPO. Figure 8.4 below demonstrates that the number of European Patent Attorneys per one million people is exceptionally high in Germany, which is consistent with this explanation.

Even though these numbers tell us quite a bit about the patent attorney profession, a possible next career step for both patent engineers and information specialists, it remains

[3]The actual number of successful EQE candidates is much higher (see below). I have only relied on successful candidates with company addresses for this comparison.

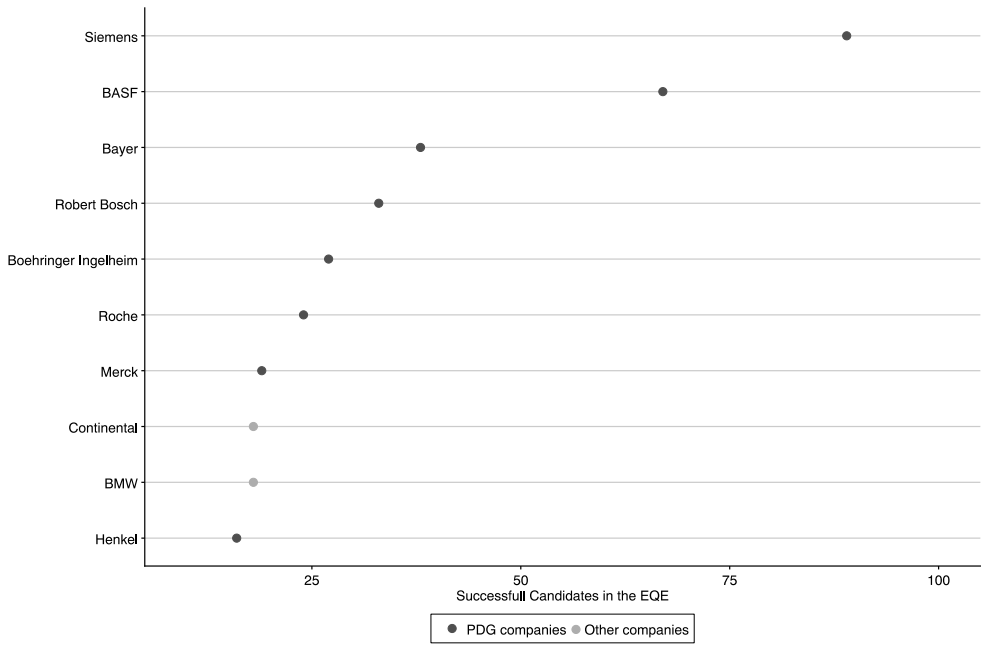

Fig. 8.3 Companies with the highest number of successful EQE candidates in Germany, 2012
Source: The data are from EPO 2021.

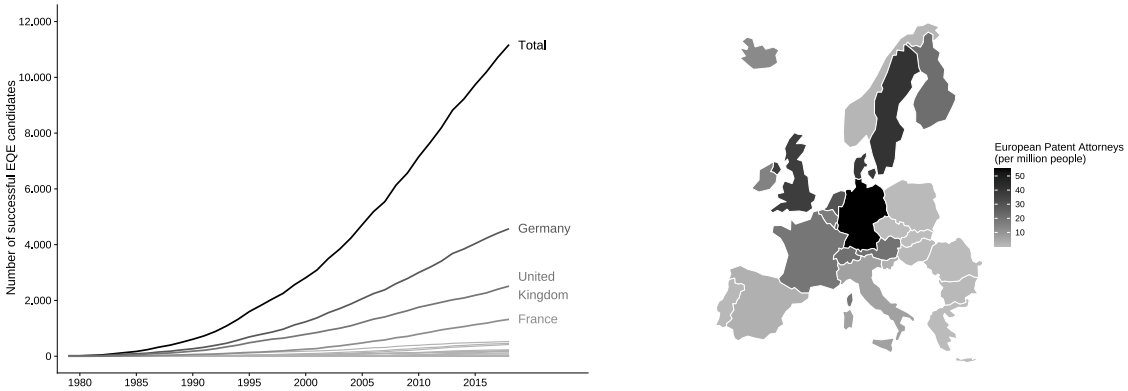

Fig. 8.4 Number of successful EQE candidates, 1978-2018
Source: The data are from EPO 2021.

difficult to say something similarly concrete about information specialists. Most articles remain silent on the size of information departments. There are, however, some exceptions to the rule. Gerald Ligt (2008: 132), head of the "Business Intelligence Unit" of the Dutch electronics multinational Philips, for instance, mentions that 25 information specialists worked for Philips in 2001, and 35 information specialists in 2007. His "Business Intelligence Unit" has been part of the larger Intellectual Property & Standards department in which Philips employed around 400 individuals in 2013 (van der Ligt 2008: 132). This is about

as large as Siemens's intellectual property department which - according to the company's 2011 Annual Report - has also employed around 400 individuals (Siemens 2011: 62). It is therefore not unreasonable to assume that at least around 30 to 40 patent information specialists must have worked for Siemens in the 2000s.

Once again the fact that even large multinational companies did not employ more information specialists should, however, not tempt us to underestimate the importance of legal-technical expertise. As I have shown in previous chapters, patent processing work typically did not take place inside large multinational companies anymore. It was essentially outsourced to commercial intermediaries which held themselves accountable to expert organizations like the PDG. Especially Derwent and the CAS became larger and larger nodes in a network in which expert organizations increasingly acted as gatekeepers and coordinators for multinational companies (see Fernandez and Gould 1994).

Apart from coverage statistics (see chapter 6), we can infer the size of commercial intermediaries, like Derwent, with the help of self-reports in World Patent Information. Paul Gardner (1995: 93), Managing Director of Derwent, claimed that Derwent paid wages to around 800 full-time employees and 450 part-time employees in 1996. These employees processed roughly 22 thousand patent documents from around 36 patent offices and international organizations each week. This amounted to no less than 1.1 million patent documents per year.

Figure 8.5 illustrates just how many more patent documents were thus processed by Derwent in 1996 than had been processed by the PDG thirty years earlier. While many of the patent documents processed in 1996 were, of course, duplicates and subsequent filings, at least around 600 thousand documents also required detailed abstracting and indexing work (Gardner 1995: 92). If one compares these numbers to the 684 thousand worldwide filings, mentioned in the 1997 Trilateral Report (EPO et al. 1997), then it seems that Derwent covered the majority of all new patent documents published worldwide (88%).

To outsource all this work to Derwent, as well as to other commercial intermediaries, was apparently very attractive to many multinational companies. If we believe Gardner (1995: 93), then Derwent had acquired around 10,000 paying customers in 66 countries, including "virtually all of the major pharmaceutical, chemical and engineering companies from around the globe". While it is difficult to doublecheck Gardner's claims, they are essentially consistent with numbers from Thomson Reuters, which later fully incorporated Derwent in its Intellectual Property & Science Unit. This unit generated, according to Thomson Reuters, around 982 million $ in 2013. Not all of these revenues can directly be attributed to Derwent, but it appears reasonable to attribute a substantial share of the 501 million $ generated by "IP Solutions" to Derwent's representations and devices (Thomson Reuters

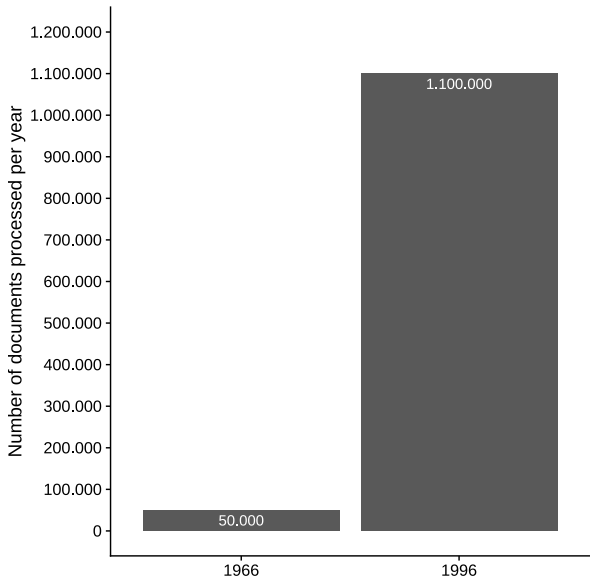

Fig. 8.5 Number of patent documents processed by Derwent per year, 1966 vs. 1996
Source: The data are from EPO 2021.

2014: 40). More recently, Derwent's products switched owners again, and are now part of Clarivate Analytics (2021a), along with numerous scientific index products, life science-related intelligence services, and commercial trademark databases.

This suggests that sophisticated patent information, as well as other forms of legal-technical expertise, was increasingly assembled outside multinational companies. If multinational companies nonetheless employed information specialists, then the reason was likely, as Ursula Schoch-Grübler emphasized, that information specialists actively brokered emerging information gaps between patent offices, commercial intermediaries, and multinational companies with the help of expert organizations like the PDG. She argued that

> our clients expect that we not only run searches, but also examine new databases, media and tools, run patent analyses, deliver business intelligence for strategic decisions and negotiate contracts with suppliers. In addition, we have become enablers and coordinators: we also provide end-user tools with training and community solutions (...) (Schoch-Grübler 2004: 274)

Basically, information specialists seem to have brokered relationships between patent offices, commercial intermediaries, and their own companies in a way that maintained a sophisticated division of labor outside and inside their own companies. Without their brokerage activities it would arguably have been exceptionally difficult for corporate lawyers to cope with steadily growing amounts of complex patent and non-patent literature. Similarly,

motivating corporate researchers to search patents during their everyday work would probably have remained much more limited in the absence of easily understandable abstracts and indexes.

The fact that the relevance of information specialists' brokering activities was nonetheless overlooked can, somewhat paradoxically, be explained by the relatively small number of information specialists who made sense of patent documents. I have previously mentioned that legal scholars like Henry Smith and Clarissa Long have argued that patent rights had to be information-efficient based on the small number of information specialists that appeared necessary to organize and search patent information. They, like most social scientists, overlooked commercial intermediaries and subsequently misrepresented the role of information specialists.

8.5 Patents as Immediately Usable Monetary Assets

The ability to make sense of patent documents with the help of just a few information specialists and commercial intermediaries ultimately changed not only how multinational companies viewed patents, but also whether and how small and mid-sized companies, as well as universities, acquired patents as "immediately usable monetary assets". In contrast to the postwar years, it was soon no longer necessary to invest in "costly, labor-intensive in-house indexing" to be able to acquire potentially valuable patents. Instead, small and mid-sized companies and universities began to rely on external search services which suddenly sprung up in high and middle income countries alike; alternatively, they could now even employ internal patent lawyers or information specialists with access to libraries or online databases. Heinz Goddar (2006: 1682), a prominent German patent lawyer, for instance, recommended "that my clients do internal searches - in a library or on the Internet", and file applications "at a very early stage of development of an invention". Once his clients - small and mid-sized German companies, as well as universities - had secured priority applications in this way, he advised them to 1) use the PCT to buy time, 2) get rid of no longer viable applications, and 3) search for licensees in different countries. Only if they found licensees after in-depth searching, his clients would extent applications to countries in which potential licensees were active, turning applications into immediately usable monetary assets.

Obviously, the goal of patent searches and applications was typically not to setup entirely new Global Value Chains (GVCs). It was rather to identify licensees that were already lead companies in existing GVCs (Durand and Milberg 2020). The latter could profit from in-licensing inventions of small and mid-sized companies and universities, as this allowed them to avoid "duplicate" R&D results. Small and mid-sized companies and universities,

by contrast, could avoid investments in production capacity in foreign markets, but still profit from out-licensing inventions. A recent example for how pharmaceutical companies profitably combine out-licensing and in-licensing strategies is the Pfizer/BioNTech Covid-19 vaccine partnership. In this partnership, the U.S. company Pfizer was able to avoid investments in "duplicate" R&D results by licensing-in BioNTech vaccine technology. BioNTech, a mid-sized German pharmaceutical company, by comparison, effectively licensed-out to Pfizer, and was thereby able to avoid investments in independent production capacity (see Bown and Bollyky 2021).

Arguably, it is arguably not a coincidence that examples for patents as immediately usable assets often feature pharmaceutical companies. More than companies in other industries, pharmaceutical companies have achieved exceptionally high profits while keeping overall capital expenditures at a minimum. Figure 8.6 plots capital expenditures as a percentage of pre-tax profit for the top 500 Orbis-20114 companies. These numbers, compiled by Mark Herman Schwartz (2021: 21), indicate that companies in industries reliant on patents and other intellectual property rights were generally far more profitable than companies in other industries, but invested very little in actual production capacity.

Fig. 8.6 Capital expenditures as a percentage of pre-tax profit, for the top 500 Orbis-20114 firms, 2010-2018

Source: The data are from Schwartz 2021: 21.

The high profitability of intellectual property-intensive industries in general, and of the pharmaceutical industry in particular, is hardly a surprise for political scientists and LPE

scholars who have shown in study after study how pharmaceutical companies based in the U.S., Europe and Japan lobbied for stronger international IP rights. Beginning in Italy in the 1970s, which was forced to introduce pharmaceutical patents and subsequently lost its generics industry to India, and further continuing in middle and lower-middle income countries, like India, pharmaceutical companies pushed hard for higher protection standards (Scherer 2009: 202). The spearhead of early lobby efforts was Edmund Pratt, CEO of Pfizer and chairman of the U.S. President's Advisory Committee on Trade and Negotiations (ACPTN) between 1981 and 1987. He, together with John Opel, CEO of IBM and chairman of the subcommittee on intellectual property, advised the U.S. Trade Representative (USTR) and Congress to put patent and copyright standards front and center in bilateral trade negotiations. One early result of their lobbying efforts was the introduction of "Section 301" and "Special 301", on which, for instance, U.S. measures against Brazil in 1989 were based, after the country's pharmaceutical patent protection had been found deficient. It also formed the basis for threats against Mexico, South Korea, China, Thailand, and a number of other countries (Scherer 2009: 203-204).

Even more important, however, were efforts to shift the forum of international IP lawmaking from WIPO to trade policy negotiations during the Uruguay Round of the General Agreement on Tariffs and Trade (GATT). At WIPO, efforts to strengthen protection had failed because delegates from the U.S., Europe, and Japan could not agree on a common strategy. Middle and low income countries, moreover, were able to successfully oppose uniformly strong protection given their majority in the UN organization. Mainly for this reason, U.S.-based multinational companies, like Pfizer, Merck, du Pont, and FMC Corp., joined forces in the so-called Intellectual Property Committee, and worked with similar organizations from Europe and Japan, to include IP provisions in whatever treaty resulted from the Uruguay Round. These efforts culminated in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which prescribed much stronger IP standards in middle and lower-middle income countries in exchange for greater market access. From the perspective of middle and lower-middle income countries, TRIPS was a bitter pill to swallow, but also, at least, removed possibilities for unilateral U.S. Section 301 investigations (Scherer 2009: 204-207).

I have emphasized before that the lobbying efforts that led to TRIPS, TRIPS+, and numerous bilateral and multilateral trade agreements, were doubtlessly essential in strengthening national and international patent laws. Yet these lobbying efforts only had the potential to turn patents into immediately usable assets because information specialists from multinational companies like BASF, Bayer or Shell had begun to knit together disparate legal-technical networks. They thereby helped to address a chief concern of both patent office and corporate

executives in the postwar years: "gigantic and uneconomic duplication of [patent-related] work". With the help of ever more closely linked commercial intermediaries and patent offices, it became sensible for multinational companies and governments to first promote PCT implementation in high income countries, and later, after the success of legally-oriented lobbying campaigns, also in middle and lower-middle income countries. Practically at the same time, small and mid-sized companies as well as universities began to use the PCT, and acquired international patents as immediately useful monetary assets. This meant that it became possible to extend patent protection to more countries, technology areas, and industries without a really global patent system.

It is unlikely that information specialists and government officials were able to foresee these developments early on given that even former high-ranking WIPO officials, like Jay Erstling (2006: 1585), admitted "that the PCT is a success is a surprise even to the most ambitious of the founders of the PCT". Even they did not anticipate that the PCT would "become synonymous with the international patent system." Yet the success of the PCT and commercial intermediaries explains why patent practitioners today still celebrate PCT founder Arpad Bogsch and Derwent founder Monty Hyams as "founding fathers of intellectual property" - to the incomprehension of even well-read and experienced economists. Essentially, my dissertation explains why Bogsch and Hyams are still celebrated: they have helped to build the everyday legal-technical expertise that sustains modern patent protection.

Chapter 9

Conclusions

Several decades of research have dramatically reshaped our view of government decisions to expand patent rights. Research on patent rights, moreover, became increasingly interdisciplinary relying on diverse conceptual perspectives. First, economists discarded the view of patent rights as "exogenous policy choices" in favor of a political economy perspective: they began to argue that governments decided independently to adopt stronger patent rights whenever countries crossed a threshold of economic growth and innovation capacity. Governments that adopted stronger patent rights thus did so because they expected to maximize national welfare. This "independent decision-making" perspective has only recently been modified by economists who now concede that governments of middle and lower income countries can be politically restrained in the choice of their desired patent regime.

Second, political scientists and LPE scholars saw efforts to strengthen patent rights in middle and lower income countries from the get-go as a consequence of external coercion. In research on forum shopping strategies by rich countries that preceded the negotiation of TRIPS and TRIPS+, they have shown that middle and lower-middle income countries did not independently decide to join international patent agreements. Rather, the main reason why middle and lower-middle income countries became members of international patent agreements was that richer countries turned membership in these agreements into a sine qua non condition for entering bilateral and multilateral trade agreements. More recent analyses find a strong impact of WTO membership on the development of patent protection.

Despite this now widely accepted external coercion account, however, it is not clear why multinational companies and rich countries supported universally stronger patent rights in the absence of a global patent system. After all, this meant that both multinational companies and patent offices still had to deal with vasts amounts of patent documents in different languages. Especially the disappearance of language-based mistrust that used to undermine legal initiatives among high income countries during the postwar decades is a genuine puzzle.

I have argued that the buildup of legal-technical expertise, starting with small groups of corporate information specialists, allowed first multinational companies, and later patent offices, to make sense of masses of patent documents in multiple languages and classifications. This enabled patent offices in high income countries not only to examine patent documents from other high income countries more easily but also to examine patent documents on behalf of middle and low income countries. Quite suddenly, it seemed plausible to replace language based mistrust by "technocratic trust by one organization of another organization's system".

It is critical to understand that this would not have been possible by simply relying on existing public infrastructures. Instead, the evidence I have presented in chapter 5 pointed to the conclusion that the patent information market, which had been expanded and protected by corporate information specialists, provided patent offices like the EPO, USPTO, and JPO with the infrastructures and devices required to examine millions of patent documents in middle and lower-middle income countries. Even though patent offices eventually developed their own search infrastructures, these infrastructures only complemented rather than replaced the arrangements information specialists had secured earlier. Until the present day, there is a surprisingly strict division of labor between private and public actors.

As chapter 6 showed, it was this division of labor that allowed information specialists and commercial intermediaries to continually benefit from large information projects in the public sector. Especially Derwent and CAS were able to cover substantially more countries after governments agreed to introduce international and regional patent documents. It did not take, as some economists have suggested, several decades until public-sector information projects had any impact on patent practice; the impact came quite suddenly - just not from patent offices and WIPO, but from commercial intermediaries. The latter were able to purchase and process vast amounts of digitized patent information from patent offices at a point at which public search systems existed only on paper. Information specialists made sure that commercial intermediaries were able to purchase digitized public information at production costs and processed it in line with their specifications.

This conclusion does not just imply that private-sector actors became critical in organizing the supply of patent information. The more important insight is that the legal-technical expertise necessary to get inventions patented and enforced was increasingly assembled in networks including information specialists, commercial intermediaries, patent offices and WIPO. To be sure, patent offices and WIPO gradually also intensified independent efforts to supply small and medium companies with patent information. But it is essential to keep in mind that the devices, concepts, and arrangements of information specialists became the lens through which patent offices viewed the world.

It is this dependence of patent offices on private legal-technical expertise that justifies a reconsideration not only of economic and political science explanations of changes in patent laws, but also of legal accounts of "global knowledge governance". Peter Drahos (2010: 3), for instance, has stressed that different patent offices integrate

> if they adopt the same technical systems for searching the patent and non-patent literature, if they adopt the same system for classifying patent applications, or if they establish a procedure for sharing or recognizing the work results of other offices.

This account of knowledge governance is only partially correct, however. First, as I have shown in chapter 2, patent offices have not adopted the same technical systems early on because interoffice initiatives to create search systems in the postwar decades failed. While most patent offices did indeed adopt the International Patent Classification (IPC) after its introduction in 1971, it remained too coarse to have much impact. In practice, national and regional patent classifications were used more routinely as recent attempts to create a cooperative patent classification based on the United States Patent Classification (USPC) System and the European Classification System (ECLA) illustrate. These failures make it difficult to associate the actual adoption decisions of patent offices with projects by patent office officials. Second, reports by information specialists suggested that patent offices of middle and lower-income countries had long not the same access to private legal-technical expertise as patent offices in higher income countries. The reason why middle and lower-income country patent offices had long only limited access was not a lack of trust but of resources. This interpretation is supported by the fact that there is still a WIPO program that subsidizes access to commercial databases in lower income countries.

Instead of an explanation that associates changes in patent protection with interoffice cooperation, the evidence suggests more complex infrastructural entanglements between private and public-sector actors. The major patent law changes that this dissertation seeks to explain were based on networks co-constructed by corporate information specialists, commercial intermediaries, patent offices, and WIPO. The abstracts and indexes that corporate information specialists initially used to link national patent documents already provided uniform representations of patent rights. This simplified application processes that harmonization efforts by legal associations, patent offices. and commercial intermediaries had not been able to simplify. Moreover, close ties between corporate information specialists and commercial intermediaries led to the scale-up of networked information systems which established a practical foundation for the implementation of the PCT, the EPC, and similar legal initiatives. In a series of trade agreements, from the 1980s until well after the 2000s,

high income countries made sure that middle and lower-middle countries would not just accept the patentability of pharmaceutical or microorganisms, but also of PCT application processes as such. The international patent documents published under the PCT made it easier for commercial intermediaries to cover more countries and easier for patent offices to grant more cross-national patent rights.

What I have thus shown is that expert trust between patent offices was insufficient to bring about changes in the governance of knowledge. At the same time, I have not put into question that expert trust between patent officials may have later become important in enabling the sharing of search results in administrative practice. High-level cooperation in working groups meetings between private and public-sector actors likely ensured that everyday administrative practice remained relatively undisturbed by the uneven access to legal-technical expertise. Furthermore, it is out of question that WIPO invested more and more resources in the patent-related training of inventors, business managers, legal practitioners, policy makers and government officials in its member states.

This argument should generally not be understood as an attempt to make redundant theoretical frameworks that economists, political scientists and legal scholars have used to understand changes in patent protection. My point is, rather, that these frameworks should be complemented by a sociological framework that highlights the co-construction of expertise in interstitial spaces between nations, industries and occupations. The key implication of my research is not that economists have somehow misunderstood the relevance of economic growth and innovation capacity, political scientists the relevance of state power, and legal scholars the relevance of administrative law, but that there can be mediating actors and systems whose relevance is more easily analyzed in a sociological framework. More specifically, I contend that a sociological framework is helpful to explain the fading relevance of cultural and structural barriers which constrained patent law-making before the 1970s.

The Usefulness of a Legal-Technical Perspective

What kind of sociological perspective would be helpful to make sense of the expansion of patent protection described in the previous chapters? In chapter 1, I have offered a sketch of what I believe is the right way to think about how legal-technical expertise shapes legal developments. That sketch focused on networks of devices, concepts, and arrangements that information specialists construct in response to status-quo requirements that informationally overwhelm their organizations and endanger their work. Such networks are only constructed if crises associated with legal information render initiatives by information specialists more relevant to organizational audiences than innerorganizational, governmental or market initia-

tives. In the 1960s, an excessive amount of patent information rendered salient cooperation and tool building efforts by information specialists from major multinational companies. By illustrating to organizational audiences that cultural and structural barriers could be jointly overcome, early cooperation and tool building efforts paved the way for the accumulation of infrastructural power in the private sector. In later stages of legal and legal-technical development, information specialists were then able to rely on previously established ties to broker between patent offices and commercial intermediaries.

The administrative crisis in the postwar decades highlighted the importance of expert cooperation across corporate and national boundaries. But it was never entirely clear to information specialists whether innerorganizational, governmental, or market solutions were optimal from their collective point of view. This is why information specialists avoided to disband the PDG and other groups once abstracting and indexing activities had been outsourced to commercial intermediaries. These groups were used to help commercial intermediaries through crises instead and, more importantly, to exercise influence on patent offices and WIPO during political turning points. Neither large patent offices nor WIPO intensified investments in patent information in direct response to the postwar administrative crises, which they had been able to wait out, but in response to a broader political turning point beginning in the late 1970s.

Yet if moments of crisis were critical for assembling and reassembling networks of information specialists, representations and devices, levels of preexisting expertise determined whether information specialists from specific companies could participate in the PDG and other groups. Information specialists who wanted to join the PDG had to demonstrate that their company had a active patent and/or information department or professional staff engaged in patent and information activities. As I observed in chapter 39, PDG information specialists did not just exclude information specialists from small and mid-sized companies to avoid technology-sharing with the "glue heaters", but also to ensure that normative social pressure in the group could be kept up. In groups of information specialists from roughly equal-sized multinational companies, information specialists could more easily demand equal contributions to the club good than in groups of information specialists from companies with different levels of preexisting expertise.

It was the ability to deal with crises, turning points, and normative concerns about cooperation that allowed information specialists organized in groups like the PDG to overcome language and institutional barriers. The continuous translation, summarization, and linking of patent documents via abstracts and indexes became the foundation of international patent agreements and generally stronger protection; but these activities could hardly have continued into the present without the networks of legal-technical expertise that information specialists

first established among themselves, and later amongst themselves, commercial intermediaries, patent offices, and WIPO.

The role of information specialists as "meta-intermediaries" is today openly embraced by information specialists in the employment of multinational companies. They are more likely to see themselves as value-chain managers for lawyers, scientists, and executives than as corporate librarians or searchers. This is why changes in transnational law-making that concern legal-technical aspects of protection can no longer solely be associated with the initiatives of sophisticated lawyers. Rather, they need to be routinely traced back to information specialists who assemble networks of devices, concepts, and arrangements. In information-intensive fields of law, the "sophistication" of lawyers and the "malleability" of the law is at least as much a function of legal-technical expertise as it is of legal expertise.

Applicability to Other Fields

Until now, I have focused almost exclusively on the transnational expansion of patent protection. Yet, the explanation of changes in patent protection provides insights that enable me to provide an abstract theoretical framework which I outline in chapter 1. The reason for setting up an abstract framework is that the insights gained in one information-intensive field of transnational law-making may be transferable to other fields. Accordingly, in the final pages of this dissertation, I will discuss how the theoretical argument I have outlined makes sense of other empirical settings.

The findings I have presented in the previous chapters are consistent with four general propositions implied by the theoretical framework introduced in chapter one: First, legal changes in specific countries become more plausible if private-sector actors acquire legal-technical expertise to evaluate boundary-crossing legal positions. Second, the growth of legal-technical expertise depends on markets that are co-constructed by private and public sector actors. Third, private sector actors are likely to defend infrastructural power conferred by markets against public sector initiatives. Fourth, public sector actors become gradually dependent on market-based legal-technical expertise whereas private sector actors become dependent on public sector initiatives.

The literature on transnational law-making offers empirical observations that are broadly consistent with my generalizations. I will limit my discussion to two prominent fields of law. To begin with, the field of financial law-making demonstrates that public sector actors avoid the curtailing of markets that serve as infrastructure for the implementation of regulatory policies. Given that central bankers have helped to establish, expand and protect transnational repo and securitization markets, it is not surprising that they continue to

co-construct legal-technical expertise in these markets jointly with information specialists and private bankers. Examples include the mutual support for market-based sovereign debt management practices, the introduction of information systems for non-performing loans, and more recently, initiatives to establish global legal entity identifiers (see Braun 2020; Braun and Gabor 2019). In particular, the Global LEI System (GLEIS) appears to play a similar role in the co-construction of legal-technical expertise as the networks analyzed in this dissertation. The GLEIS brings together 1) the Regulatory Oversight Committee (ROC), which describes itself as "a group of more than 65 financial market regulators and 19 observers from more than 50 countries"; 2) the Global LEI Foundation (GLEIF), a non-profit that sees itself as "uniquely positioned in the entity identification market"; and finally 3) LEI issuers, that is commercial intermediaries such as Bloomberg or Moodys. The co-construction of legal-technical expertise in the financial system points to its relevance in the containment of systemic crises, as well as in the defense of the status-quo in financial law-making (see GLEIF 2021).

A second instructive case is global climate governance, which has a mixed, if not dismal, record with respect to the establishment of enforceable laws. Despite numerous intergovernmental and transnational institutions and initiatives, in which both public-sector and private-sector actors sought to address climate change, there is still a lack of legal-technical expertise. To be sure, the secretariats of institutions, such as the UN Framework Convention on Climate Change (UNFCCC), collect data and receive reports from various countries. Yet, the overarching question remains "how the private sector, potentially both a user and a source of relevant knowledge, can be better integrated into knowledge systems for sustainability." (Cash et al. 2003: 8090)

As in the case of patent information systems, public-sector actors have mainly invested in the construction of national or regional information systems which produce masses of raw information. They have, by contrast, made limited attempts to summarize, translate and link the available information up to a point where it can readily be used by regulators, lawyers, compliance officers, and others. Louis Kotzé (Kotzé 2021), a legal scholar associated with the Potsdam Institute for Potsdam Institute for Climate Impact Research, argues convincingly that "[e]nvironmental law does not see the earth. Instead it focuses on discreet, localised environmental problems and does not recognise the planetary context it needs to operate in". The recognition of the planetary context would arguably require initiatives that integrate public information collections in a way that makes them useful for everyday monitoring in supply chains. Even the most ambitious public-sector information projects, however, tend to remain restricted to particular nations and regions. The Shared Environmental Information System (SEIS), for instance, set up by the European Community (EC), collects

and exchanges environmental data and information, but retains its focus on Europe (see European Environment Agency 2021). Among the reasons why global climate governance has not successfully established enforceable laws, I submit, is that environmental information systems are not yet co-constructed by public-sector and private-sector actors. Though the co-construction of legal-technical expertise has typically increased the infrastructural power of private-sector actors, there is no reason why public-sector actors should not play a more active role in the build up of private systems linking qualitative information.

Finally, an even broader implication of my argument is that far-reaching legal reforms should not be anticipated in the absence of initiatives to rebuild legal-technical expertise. Despite the emphasis that some reform-minded legal scholars have put on sophisticated lawyers and the malleability of law, legal reforms continue to rely on legal-technical expertise that typically cannot be forced. A lack of engagement in legal-technical systems makes it generally difficult for reform-minded legal scholars to develop proposals that appear as practically viable as proposals of company lawyers. If the latter can invoke legal-technical expertise to avoid universal national systems, they tend to win policy contests within multiple countries without extensive lobbying. Much real world lobbying activity is, in fact, related to seemingly technical issues and remains under the radar of reform-minded legal scholars and activists. This means that private sector actors find it easy to employ infrastructural power for law-making purposes. In contrast, when reform-minded legal scholars seek to employ infrastructural power, they typically face the difficult, if not impossible, task to transform a co-constructed system into an actually, effective monitoring system.

Two predictions follow from this set of observations: First, as long as networks of legal-technical expertise are put together and controlled by corporate information specialists, legal proposals by reform-minded lawyers will continue to face charges of implementability that are difficult to dismiss legitimately. Second, in sectoral contexts in which reform-minded lawyers are able to co-opt information specialists, they are more likely to experience unexpected regulatory successes. Arguably, because reform-minded lawyers associated with the Creative Commons copyright licensing project insisted on representations of license terms that could easily be understood by both non-lawyers and machines, their licenses could be independently adopted in many different countries. Linguistic and institutional barriers did not matter as much as one would think because individuals learned to coordinate based on representations, devices and standards.

If it is true that lawyers can be creative and the law malleable, then this creativity and malleability frequently depends on teamwork. What this dissertation shows is that the creativity of lawyers and the malleability of law are co-constructed in larger expertise. In this dissertation I have intentionally avoided to engage in analayzing a myriad of legal details

that are being studied by other disciplines in order to bring into focus actors, representations, devices and standards that are otherwise easily overlooked.

Appendix A

Supplement to Chapter 2

My main main data source for studying the influence of legal-technical expertise on patent law-making is Park's patent rights index. Yet since this index is only available between 1960 and 2015, it cannot be used to explore the development of patent law-making in the immediate postwar years. Even if it were available, however, it would not be useful to determine whether the United States Patent Office (USPTO) or the German Patent Office (GPO) were really, as I claim in chapter 2, overwhelmed by foreign patent applications. The patent rights index is "only" a *de jure* not a *de facto* measure of patent protection.

To show that patent offices were, in fact, overwhelmed by foreign applications I focus instead on the impact of foreign patent applications on patent offices' examination capacity. The only way to do is by proxying for examination capacity with the amount of patents that patent offices grant to domestic applicants. The assumption here is that patent offices, as national government agencies, care ultimately more about granting patents to domestic applicants than to foreign applicants. If they do, then an inability to grant domestic patents in response to increasing foreign applications would indeed amount to an administrative crisis, as I argue in chapter 2.

The most obvious choice for assembling both patent application and grant data in the post-war decade are WIPO's historical patent datasets which I use extensively in this dissertation. An important problem with WIPO's historical datasets is, however, that application and grant data are missing for practically all major patent offices in the postwar decade. Fortunately, howerver, Pasquale Joseph Federico, a former USPTO Examiner-in-Chief and co-drafter of the 1952 U.S. Patent Act, has in a number of articles in the *Journal of the Patent Office Society* released postwar patent application and grant data of a large number of countries. For the analyses in chapter 2, I rely on a collection of Federico's published datasets, that covers the years from 1951 to 1960, by GESIS - a German infrastructure institute for the social sciences.

Using this collection, I employ a two-way fixed-effects model to model domestic grants. The model looks like this:

$$Y_{it} = \alpha_t + \gamma_t + \beta X_{it} + \varepsilon_{it}$$

The outcome Y_{it} is the number of domestic grants a given country i receives in year t. X_{it} represents a vector of time-varying observed covariates. This vector includes the foreign application ratio, GDP, and a Human Capital Index. I calculated the foreign application ratio by simply dividing the number of foreign applications a patent office receives in a given year by the total number of applications it receives in that year. In addition, I control for country and year fixed effects through α_t and γ_t. Essentially, by adding country and year dummies I hope to avoid that country and year specific trends drive the overall results. This model is the basis for the results reported in figure 2.2. In this section, I provide the full regression table.

Table A.1 Estimates from model predicting domestic patent grants in 11 countries, 1951-1960

	Dependent variable:	
	Domestic patent grants per capita (log)	
	(1)	(2)
Foreign application ratio (log)	-0.403^{***}	-0.416^{***}
	(0.117)	(0.125)
GDP (log)		0.746
		(1.612)
Human capital (log)		0.194
		(0.195)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	No	Yes
Observations	100	100
R^2	0.082	0.127
Note:		*p<0.1; **p<0.05; ***p<0.01

Appendix B

Supplement to Chapter 4

The high missingness rate in WIPO's historical patent data makes it not only difficult to show that major patent offices were in crisis in the postwar years: it can also not be used to study the conditions under which legal harmonization initiatives failed. In particular, quantitative evidence for the existence of "language-based mistrust" remains difficult to provide. Theoretically, if WIPO would supply more complete historical data on both the origin of patent applicants and the target countries of patent applications, it would be possible to study whether, for instance, patent applicants located in English-speaking countries have a higher tendency to file patent applications in other English-speaking countries.

But while this is not possible with WIPO historical data, it becomes, once again, possible because articles by Joseph Pascale Federico in the *Journal of the Patent Office Society* included a substantial number of country-by-country patent applications matrices. What I mean by country-by-country applications applications matrices are basically tables that show, for example, how many foreign patent applications in the U.S. were filed by applicants located in Canada, the United Kingdom, France, Germany, and so on. All these individual tables can easily be combined into a single, dyadic dataset in which each row represents a bilateral application flow from country A to country B in year t.

Proceeding in two steps, I have first constructed such a dataset based on Federico's matrices. Second, I have matched this baseline dataset with the CEPI Tradehist dataset that contains information on whether two countries A and B speak mainly the same language in year t. The new, combined dataset allows me to model bilateral patent applications from the baseline dataset with the help of a recoded "common language" indicator included in the matched CEPI Tradehist dataset. I can further control whether a potential effect of language differences on bilateral patent applications can still be observed if other dyadic relationships, included in the Tradehist dataset, such as population-weighted distance between two countries, are taken into account.

It might be that U.S. applicants file more patent applications in Canada, as shown in figure 4.3., because English is the main language spoken in both the U.S. and Canada. But it might also be that U.S. applicants file more applications in Canada because it is geographically close: patent applications in Canada might be more attractive for U.S. applicants than patent applications in Germany or Japan independently from language differences. I thus control for population-weighted distance and common border (contiguity) between two countries.

To study the relevance of language for cross-border patent applications I estimate the following gravity equation for each year in which bilateral patent application flows are available:

$$X_{ij} = \alpha O_i D_j d_{ij}^{\theta} e^{\lambda' z_{ij}}$$

$X_i j$ stands for a bilateral patent application flow. O_i is an index that describes an origin country's overall patent filling capacity. D_j is an index that describes a destination country's overall patent filling capacity. The distance effect θ measures the elasticity of patenting with respect to distance. To measure distance d_{ij}, I use population-weighted distance in kilometers from the CEPII tradehist database. This has the advantage that cross-border and internal distances are measured consistently. z_{ij} includes the "filling cost" variables, i.e. language difference and common border (contiguity), both also from CEPII.

Because the consistent estimation of the distance effect requires the inclusion of fixed effects for both both origin and destination countries, I include dummies in each yearly equation. Finally, to avoid dropping country pairs without cross-national fillings, as well as to avoid bias in the presence of heteroscedasticity, I use the Poisson pseudo-maximum likelihood (PPML) procedures to estimate the individual equations.

Table B.1 Gravity estimates from model predicting bilateral patent applications, 1951-1955

	Dependent variable:				
	Bilateral patent applications (log)				
	1951	1952	1953	1954	1955
Different language	-0.448^{***}	-0.455^{***}	-0.441^{***}	-0.445^{**}	-0.402^{***}
	(0.089)	(0.083)	(0.080)	(0.078)	(0.073)
Distance	-0.369^{***}	-0.285^{***}	-0.324^{***}	-0.264^{***}	-0.286^{***}
	(0.057)	(0.053)	(0.052)	(0.049)	(0.046)
Common Border	0.875^{***}	0.969^{***}	0.860^{***}	0.959^{***}	0.926^{***}
	(0.147)	(0.136)	(0.133)	(0.126)	(0.120)
Observations	295	311	306	320	315
R^2	0.961	0.965	0.967	0.967	0.973

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

[Gravity estimates from model predicting bilateral patent applications, 1956-1961]Gravity estimates from model predicting bilateral patent applications, 1956-1961

		Dependent variable:			
		Bilateral patent applications (log)			
1956	1957	1958	1959	1960	1961
-0.407^{***}	-0.294^{***}	-0.217^{**}	-0.178^{*}	-0.192^{*}	-0.264^{***}
(0.074)	(0.070)	(0.066)	(0.070)	(0.043)	(0.070)
-0.289^{***}	-0.307^{***}	-0.289^{***}	-0.254^{***}	-0.292^{***}	-0.245^{***}
(0.047)	(0.045)	(0.043)	(0.044)	(0.043)	(0.041)
0.892^{***}	0.707^{***}	0.754^{***}	0.740^{***}	0.676^{***}	0.808^{***}
(0.122)	(0.112)	(0.105)	(0.110)	(0.109)	(0.113)
314	353	349	334	332	291
0.974	0.970	0.972	0.970	0.972	0.977

Note: *p<0.1; **p<0.05; ***p<0.01

Appendix C

Supplement to Chapter 6

While Park's patent rights index is not available before 1960, it can be used to study the impact of legal-technical expertise between 1960 and 2015. Because there are likely effects of legal-technical expertise on patent rights protection simply because intermediaries tend to cover high protection countries first, I have relied on matching-augmented DiD analyses in chapter 6 to disentangle the relationship between legal-technical expertise and patent protection. I will not again discuss matching-augmented DiD analyses in this section as I have done so extensively in chapter 6. Instead, I will specify and estimate more conventional two-way fixed models to dissipate concerns that the results presented in chapter 6 might be technique- and/or model specific.

The specifications of the two-way fixed models take the following form:

$$Y_{it+1} = \beta X_{i,t} + \sum_{l=1}^{l=L} \delta_l Y_{it-l} + \zeta^T Z_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{it}$$

where i and t refer to country and year, respectively. The outcome Y_{it+1} is Park's patent rights index one year after the treatment. $X_{i,t}$ represents the treatment, that is, whether a country is covered by Derwent, the CAS and INPADOC. The estimation controls for country and year fixed effects via α_i and γ_t. $Z_{i,t-1}$ denotes the same set of control variables that I have used to create matched sets in the analysis in chapter 6. All control variables are lagged by one year. In some specifications I also include the lagged dependent variable, Y_{i-1}, i.e. Park's patent rights index, in order to mitigate the influence of country-specific and year-specific time-varying confounders that can themselves be correlated across time.

The first set of estimations in table C.1 suggests that coverage has not just a significant, positive effect on patent protection in matching-augmented DiD regressions but also in more conventional fixed-effects regressions. Essentially, the effect of coverage on patent protection visible in model 1 remains robust to the inclusion of control variables in model 2.

Table C.1 Effects of intermediary coverage on patent rights index next year, 1965-2015

	Dependent variable:	
	Patent rights index next year	
	(1)	(2)
Coverage	0.490***	0.458***
	(0.077)	(0.068)
GDP per capita (log), last year		0.359***
		(0.082)
GDP per capita^2 (log), last year		0.007
		(0.042)
Trade (log), last year		0.141**
		(0.058)
Human capital (log), last year		0.104
		(0.168)
Population (log), last year		-0.497**
		(0.221)
WTO membership (1 = member), last year		0.330***
		(0.093)
Preferential Trade Agreements, last year		-0.005
		(0.007)
State ownership, last year		0.033
		(0.046)
Political rights, last year		0.001
		(0.037)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	No	Yes
Observations	4,478	4,342
R^2	0.900	0.917
Within R^2	0.131	0.272
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table C.2 further suggests that the effect of coverage on patent protection also remains robust to the inclusion of patent protection as lagged depended variable. The overall effect remains positive and significant, yet decreases to the lower limit of the confidence interval calculated in the matching-augmented DiD regression.

Table C.2 Effects of intermediary coverage with lagged dependent variable

	Dependent variable:	
	Patent rights index next year	
	(1)	(2)
Coverage	0.462***	0.046**
	(0.068)	(0.019)
Patent rights index, last year		0.921***
		(0.015)
GDP per capita (log), last year	0.359***	0.051**
	(0.082)	(0.025)
GDP per capita^2 (log), last year	0.007	-0.011
	(0.042)	(0.011)
Trade (log), last year	0.141**	0.007
	(0.058)	(0.013)
Human capital (log), last year	0.104	0.044
	(0.168)	(0.035)
Population (log), last year	-0.497**	0.003
	(0.221)	(0.059)
WTO membership (1 = member), last year	0.330***	0.056***
	(0.093)	(0.021)
Preferential Trade Agreements, last year	-0.005	-0.003***
	(0.007)	(0.001)
State ownership, last year	0.033	0.001
	(0.046)	(0.011)
Political rights, last year	0.001	0.019**
	(0.037)	(0.009)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	Yes	Yes
Lagged dependent variable included?	No	Yes
Observations	4,342	4,342
R^2	0.917	0.988
Within R^2	0.272	0.891
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table C.3 shows that the overall results do not seem to be substantially influenced by the use of imputation methods. If anything, the effect size of coverage seems to decrease slightly due to the use of yearly data.

Table C.3 Effects of intermediary coverage at 1-year and 5-year intervals

	Dependent variable:	
	Patent rights index	
	1-year	5-year
Coverage	0.4579***	0.4889***
	(0.0676)	(0.0708)
GDP per capita (log), last year	0.3588***	0.3498***
	(0.0824)	(0.0927)
GDP per capita^2 (log), last year	0.0072	-0.0218
	(0.0420)	(0.0476)
Trade (log), last year	0.1414**	0.1298*
	(0.0578)	(0.0664)
Human capital (log), last year	0.1040	0.1047
	(0.1675)	(0.1718)
Population (log), last year	-0.4968**	-0.5977***
	(0.2211)	(0.2225)
WTO membership (1 = member), last year	0.3305***	0.3565***
	(0.0934)	(0.1002)
Preferential Trade Agreements, last year	-0.0049	-0.0075
	(0.0071)	(0.0074)
State ownership, last year	0.0327	0.0214
	(0.0461)	(0.0483)
Political rights, last year	0.0015	0.0259
	(0.0372)	(0.0404)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	Yes	Yes
Observations	4,342	882
R^2	0.91681	0.90592
Within R^2	0.27166	0.26069
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table C.4 demonstrates that the use of an alternative dependent variable, the Pharmaceutical Intellectual Property Protection (PIPP) index, does not substantially change the overall result. The effect remains significant and positive, also if the lagged PIPP index is introduced as independent variable. Yet the effect of coverage again decreases substantially.

Table C.4 Effects of intermediary coverage on PIIP index (alternative dependent variable)

	Dependent variable:	
	PIPP index index next year	
	(1)	(2)
Coverage	0.3904***	0.0938***
	(0.0668)	(0.0255)
PIPP index, last year		0.9118***
		(0.0146)
GDP per capita (log), last year	0.4132***	0.0436
	(0.0925)	(0.0302)
GDP per capita^2 (log), last year	0.1341**	-0.0091
	(0.0641)	(0.0155)
Trade (log), last year	0.0031	-0.0057
	(0.0377)	(0.0139)
Human capital (log), last year	-0.3515**	0.0090
	(0.1455)	(0.0407)
Population (log), last year	-0.8717***	-0.2074***
	(0.2180)	(0.0668)
WTO membership (1 = member), last year	0.0791	0.0286
	(0.0818)	(0.0275)
Preferential Trade Agreements, last year	0.0031	-0.0088**
	(0.0135)	(0.0038)
State ownership, last year	0.0700**	0.0226**
	(0.0285)	(0.0097)
Political rights, last year	-0.0680**	0.0030
	(0.0271)	(0.0080)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	Yes	Yes
Lagged dependent variable included?	No	Yes
Observations	3,295	3,295
R^2	0.88754	0.97577
Within R^2	0.40391	0.87158
Note:	*p<0.1; **p<0.05; ***p<0.01	

Finally, table **??** suggests that the overall results are unlikely to be driven by the way the treatment is measured. If coverage by Derwent is chosen as treatment variable, the results remain similar to the results obtained if coverage by Derwent, the CAS, and INPADOC is chosen.

Table C.5 Effects of DWPI coverage on patent rights index (alternative treatment variable)

	Dependent variable:	
	Patent rights index next year	
	(1)	(2)
DWPI (1 = coverage)	0.4116***	0.3956***
	(0.0766)	(0.0718)
GDP per capita (log), last year		0.3644***
		(0.0841)
GDP per capita^2 (log), last year		0.0127
		(0.0437)
Trade (log), last year		0.1395**
		(0.0570)
Political rights, last year		-0.0055
		(0.0371)
Human capital (log), last year		0.0684
		(0.1731)
Population (log), last year		-0.5919***
		(0.2251)
WTO membership (1 = member), last year		0.3051***
		(0.0945)
Preferential Trade Agreements, last year		-0.0058
		(0.0074)
State ownership, last year		0.0302
		(0.0462)
Country FE?	Yes	Yes
Year FE?	Yes	Yes
Controls?	No	Yes
Observations	4,478	4,342
R^2	0.89543	0.91328
Within R^2	0.09150	0.24080
Note:	*p<0.1; **p<0.05; ***p<0.01	

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