

Fast-tracking Green Patent Applications

An Empirical Analysis

By Antoine Dechezleprêtre
London School of Economics and Political Science

ICTSD Global Platform on Climate Change, Trade and Sustainable Energy

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ICTSD welcomes feedback and comments to this document. These can be sent to Ahmed Abdel Latif (aabdellatif@ictsd.ch).

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LIST OF ABBREVIATIONS AND ACRONYMS

CCS	Carbon capture and storage
CIPO	Canadian Intellectual Property Office
CO2	Carbon dioxide
EPO	European Patent Office
INPI	Brazilian National Institute of Industrial Property
IP	Intellectual Property
IPO	Intellectual Property Office
JPO	Japanese Patent Office
KIPO	Korean Intellectual Property Office
LED	Light-emitting diode
PATSTAT	EPO Worldwide Patent Statistical Database
R&D	Research and Development
SIPO	China's State Intellectual Property Office
USPC	United States Patent Classification
USPTO	United States Patent and Trademark Office

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FOREWORD

Addressing climate change requires the large-scale development and diffusion of technologies to bring about the required changes to our patterns of production, consumption and energy use. In 2010, the United Nations Framework Convention on Climate Change (UNFCCC) established a Technology Mechanism to accelerate the development and transfer of technologies for climate change mitigation and adaptation. Efforts are now underway to make this Technology Mechanism fully operational.

However, the issue of intellectual property rights (IPRs) has remained one of the most contested in this arena. While it continues to be raised in the meetings of UNFCCC bodies, there has been no agreement on how to address it. Discussions too often tend to pit those who believe that IPRs are inherently a significant barrier to the transfer of climate change technologies against those who can only conceive them as incentives for climate technology innovation and as a *sine qua non* condition for any subsequent technology transfer and diffusion.

In September 2012, the Technology Executive Committee (TEC) – the policy arm of the Technology Mechanism – forwarded a report on its activities and deliberations to the 18th UNFCCC Conference of the Parties (COP), held in Doha, which identified IPRs "as an area for which clarity would be needed on its role in the development and transfer of climate technologies based upon evidence on a case by case basis."

A similar approach has, in fact, guided the work of the International Centre for Trade and Sustainable Development (ICTSD) in this area since the publication of the seminal paper by the late John Barton on *Intellectual Property and Access to Clean Technologies in Developing Countries* (2007) and the report on *Patents and Clean Energy* published with the European Patent Office (EPO) and the United Nations Environment Programme (UNEP), which became important milestones in the policy research on these issues. Since then, we have strived to address knowledge gaps, in particular at the level of empirical research and analysis, and clarify policy options that would help governments and other stakeholders better grasp the complexities and nuances of a multi-faceted issue that defies simplistic categorizations.

It is with this spirit in mind that we thought it would be timely to have a closer look at the measures taken by a number of countries, in recent years, to fast-track "green" patent applications. These measures allow applications to be examined and granted at a faster pace than regular patent applications.

In effect, starting 2009, a number of mainly industrialised countries – including the United Kingdom, the United States, Australia, Korea, Japan, Israel and Canada – have implemented fast-tracking measures and were more recently joined by emerging economies, such as Brazil and China. However, to date, no in-depth empirical analysis has examined these measures and their effects.

How many patents have been filed under the various fast-tracking schemes? Which technologies are mostly concerned? Do the programmes significantly reduce the time from filing the patent to it being granted, compared to regular examination procedures? What type of company is most likely to make use of the fast-tracking procedure? Do the programmes encourage the diffusion of green technological knowledge? These were some of the questions identified for the research project undertaken by Antoine Dechezleprêtre, a Research Fellow at the Grantham Institute on Climate Change and the Environment at the London School of Economics and Political Science (LSE), with previous experience in collecting and studying patent data in relation to renewable energies. For this paper, the analysis of patent data was complemented by interviews with a number of patent attorneys and intellectual property professionals carried out by the author.

This paper is thus the first study to empirically analyse green patent fast-tracking programmes and to examine whether these programmes may help the diffusion of green technologies. After pointing out the main differences among the approaches made by different countries, in particular the different definitions of what constitutes a "green" patent application, the paper presents several key findings.

First, despite a low participation in the programmes, which reflects the strong incentive for patent applicants to keep their patents in the examination process for as long as possible, there is a clear demand for fast-tracking procedures, in particular from small but fast-growing start-up companies in the green technology sector. Second, climate change-related technologies (in particular renewable energy technologies) represent the vast majority of patents in the fast-tracking programmes. Third, the time from application to grant has been effectively reduced by up to 75% for patents entering the accelerated procedure. Fourth, fast-track patents are of higher commercial value than other green patents that were filed at the same time but did not request accelerated examination. Finally, the analysis of patent citation data shows that fast-tracking programmes have accelerated the diffusion of knowledge in green technologies in the short run (during the first years following the publication of the patents), but whether this effect will be the same in the long run remains an open question.

In addition to these important findings, the author highlights a number of questions that could be addressed by future research. In particular, he underlines the need for more information about the licensing practices of companies using fast-tracking programmes, as this would enable a better understanding of the extent to which these programmes accelerate the diffusion of green-patented technologies through licensing, in particular to firms and institutions in developing countries.

Given the urgency of addressing environmental challenges, including climate change, the effects of fast- tracking programmes appear encouraging, particularly with regard to accelerating technology diffusion in the short run, though, as it has been mentioned, further research is needed to understand the longer-term effects and licensing practices.

More importantly, the fast-tracking programmes for "green" patent applications raise broader questions about the overall coherence and unity of the patent system. Are these programmes the start of a parallel patent system for green technologies? Should they be applied across the board and not be restricted to "green" technologies – as suggested by the author of the paper – as is the case for the EPO, which has an accelerated examination procedure that any applicant can request? Can the patent system remain technologically "neutral" or does it run the risk of greater fragmentation when faced with multiple demands for the differentiated treatment of specific sectors and technologies? Are these fast-tracking programmes ultimately a reflection of the capacity of the system to respond to new public policy challenges? Wouldn't such a capacity of adaptation also require further consideration of specific measures in the context of the system to promote the transfer and dissemination of technological knowledge? All these are open questions that an increasingly globalized patent system has to tackle.

I hope that the findings of this study on fast-tracking programmes for green patent applications will be useful for global and national efforts seeking to encourage green innovation as well as the transfer and diffusion of green technologies.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

EXECUTIVE SUMMARY

By the end of 2011, seven intellectual property offices around the world had implemented programmes to fast track "green" patent applications: Australia, Canada, Israel, Japan, Korea, the United Kingdom (UK), and the United States (US). This issue paper presents the first empirical analysis of these programmes. Its objective is to provide an up-to-date picture of the green patent fast-track programmes and to understand whether the schemes may help accelerate the diffusion of clean technologies.

Participation

Over the last three years, over 5,000 patent applications have requested accelerated examination under the various programmes. The United States Patent and Trademark Office (USPTO) has had the highest number of requests (3,533). We find that only a small share of the average annual number of green patents filed in each of the patent offices request accelerated examination. The participation rate is very low in Australia, Canada, Japan and Korea (between 1% and 2% of green patents) and significantly higher in the US (8%), Israel (13%) and in the UK (20%). This low participation rate was to be expected, since patent applicants have a strong incentive to keep their applications in the examination process (i.e. not granted) for as long as possible. However, the high participation rate in the UK shows that there is a demand for this type of mechanism, and that participation could be enhanced in many patent offices by increasing communication about the programmes.

Technology distribution

Climate change-related technologies (in particular renewable energy technologies) represent the vast majority of patents in the fast-tracking programmes. The main technologies requesting accelerated examination are wind power in the US and carbon capture and storage in Australia and Canada. Other environmental technologies – such as recycling or pollution control technologies – represent around 20% of patent applications, except in Israel where 30% of patent applications cover water-saving technologies.

Time-to-grant

Empirical evidence shows that fast-tracking programmes reduce the examination process by several years compared to patents going through the normal examination procedure. Depending on the patent office, the time from the first application to the grant of a patent is reduced by 42% to 75% for patents entering the accelerated procedure.

Value of patents

Using several commonly used measures of patent value, this study found that fast-track patents were of significantly higher value than other green patents that were filed at the same time but did not request accelerated examination. Fast-track patents are filed in more countries on average, are more likely to be filed in all major patent offices (EPO, JPO and USPTO), and include more claims. These results suggest that applicants request accelerated examination for patents of high value that may be the subject of early commercial interest from potential business partners.

Green technological knowledge diffusion

Using citations to patents as a measure of knowledge spillovers, we found that fast-track patents received more than twice as many citations in the same time period, when compared with patents filed in the same month, of similar value but not fast-tracked. Thus, we found strong evidence that green patent fast-tracking programmes have accelerated the diffusion of technological knowledge in green technologies in the short run (during the first years following the publication of the patents). Given the urgency of addressing environmental challenges, including climate

change, this result is encouraging, but whether this effect will be the same in the long run remains an open question.

Programme users

72% of applicants have requested accelerated examination for a single patent and only 7% requested accelerated examination for five patents or more. Compared to companies that do not request accelerated examination, fast-track users tend to have smaller revenues and faster-growing assets. This shows that fast-tracking programmes seem to be particularly appealing to start-up companies in the green technology sector that are currently raising capital but still generating small revenue. In addition, domestic applicants are overrepresented among programme users, suggesting that foreign applicants may be unaware of the programmes and that applicants may only want to expedite the first application, which is usually filed in their home country.

1. INTRODUCTION

In the past few years, promoting environmentally friendly innovation has become a key priority for national and international environmental policy. Green innovation is seen by governments not only as an essential means to tackle environmental issues and promote sustainable development, but also as a potential driver of economic growth, especially in a time of economic downturn. Indeed, environment-related industries such as renewable energy generation are some of the few sectors of the economy that still experience significant growth.

Against this background, a number of national intellectual property offices around the world have recently put in place measures to fast track "green" patent applications. These include Australia, Canada, Israel, Japan, Korea, the UK, and the US.[1] More recently, the Brazilian National Institute of Industrial Property (INPI) and China's State Intellectual Property Office (SIPO) have launched similar programmes.[2] The common objective of these schemes is to allow patents covering green technologies to be examined as a matter of priority. Consequently, the time needed to obtain a granted patent could be significantly reduced,[3] from several years to just a few months.

There are several advantages to a reduced examination process. It allows patent applicants to start licensing their technologies sooner, thereby reducing the time to reach the market. Possessing a granted patent may also help start-up companies to raise private capital (Lane, 2012). For these reasons, green patent fast-track schemes have been expected to accelerate the diffusion of clean technologies.[4] However, an early grant may not always be in the interest of patent applicants, who may prefer to wait until the market for the technology develops before requesting a grant and incurring the associated costs. Therefore, whether fast-tracking programmes are successful in practice needs to be examined in light of empirical evidence.

With the earliest green patent fast-track programme now in place for three years, it is possible to provide a first empirical analysis of the fast-tracking procedures. The purpose of this study is to provide such an analysis, based on data from Australia, Canada, Israel, Japan, Korea, the UK and the US.[5] In order to analyse the characteristics of fast-track patents and companies that resort to these programmes, data sets were assembled from the various patent offices and combined with the PATSTAT worldwide patent database and the ORBIS financial database. The data analysis was complemented by interviews with patent attorneys and IP professionals.

The objective of this paper is to provide an up-to-date picture of the green patent fast-track programme landscape and to examine whether these programmes may help the diffusion of clean technologies. The study provides answers to the following questions: How many patents have been filed under the various fast-tracking schemes? What technologies are mostly concerned? Do the programmes significantly reduce the time from filing the patent to it being granted, compared to regular examination procedures? What type of company is most likely to make use of the fast-tracking procedure? Do the programmes encourage the diffusion of clean technological knowledge?

This paper is the first study to empirically analyse green patent fast-tracking procedures. To the best of our knowledge, no empirical analysis has been conducted so far, although some aggregate statistics have been made available by several patent offices. Lane (2012) and Patton (2012) offer an analysis of green patent fast-tracking programmes from a legal point of view.

Three results stand out from our analysis. First, despite a low participation in the programmes, which reflects the strong incentive for patent applicants to keep their patents in the examination process (i.e. not granted) for as

long as possible, there is a clear demand for fast-tracking procedures, in particular from small but fast-growing start-up companies in the green technology sector. Second, fast-tracking programmes seem to keep their promises. The time from application to grant is reduced by up to 75% for patents entering the accelerated procedure. Finally, the analysis of patent citation data shows that fast-tracking programmes have accelerated the diffusion of knowledge in green technologies during the first years following the publication of the patents.

The paper is organized as follows: Section 2 provides a brief overview of the fast-tracking programmes currently in place. Section 3 presents some basic statistics about the number of patents that have requested accelerated examination so far and provides some explanation for the limited participation in the programmes. Section 4 analyses the characteristics of the fast-track patents, including their technological distribution, time-to-grant and value. In Section 5, we examine the characteristics of fast-track patent applicants. Section 6 offers some concluding remarks.

2. OVERVIEW OF THE FAST–TRACK SYSTEMS

Green patent fast-track schemes have been implemented in nine countries so far. This section briefly describes each of these schemes.[6]

2.1 UK IPO

The first green patent fast-track scheme was put in place by the UK in May 2009, in the context of the run-up to the United Nations Framework Convention on Climate Change (UNFCCC) conference in Copenhagen, which was expected to give birth to the successor of the Kyoto protocol. In order to have their patent considered for expedited examination, the applicant must submit a letter explaining why the invention is environmentally friendly. The IPO does not require evidence for this "environmental friendliness" but states it will reject clearly inappropriate inventions.[7] There is no formal process requirement for the patent and no additional fee is required. According to the UK IPO, patents can be expected to be granted in nine months, compared to two to three years for the normal examination procedure.[8]

2.2 Australia's IPO

Australia's green patent fast-tracking programme started in September 2009. As in the UK, there is no formal definition of what constitutes a green patent. Applicants must simply provide a statement that the technology has some environmental benefits. Examination of applications under the programme is expected to begin within four to eight weeks after filing the request for expedited examination and no additional fee is required.

2.3 Korean IPO

In October 2009, the Korean Intellectual Property Office (KIPO) launched a "super-accelerated examination system for green technology." KIPO states that a first office action will be issued within one month of the request. Contrary to the UK and Australia, only technologies funded or accredited by the Korean government – or mentioned in relevant government environmental laws – are eligible for expedited treatment under the super-accelerated examination system. Technologies for which all applicants can request accelerated examination include noise prevention, water quality, air pollution prevention, waste disposal, livestock waste management, recycling and sewage. Other green technologies, including renewable energy, carbon emissions reduction, energy-efficient transportation, and LEDs are eligible only if the invention has "received financial support or certification from the government."[9] In addition to this requirement, applicants must submit results of a prior art search along with a request for fast-track examination. These features limit participation in the Korean scheme.

2.4 Japan Patent Office

The Japan Patent Office (JPO) launched its programme to accelerate the examination of "Green-technology related applications" in November 2009. The technologies must be of a kind "that has an energy-saving effect and contributes to CO_2 reduction." Applicants must provide the patent office with "a short description that explains that the claimed invention has an advantage in reducing consumption, reducing CO2 and the like in a reasonable manner" and must conduct a prior art search and a comparison of the claimed invention to the closest prior art. This transfers part of the patent office's work onto the patent applicant. Under the programme, applicants should receive a first office action in about two months.

2.5 USPTO

The United States Patent and Trademark Office launched a Green Technology Pilot Program in November 2009. The programme was initially limited to applications falling under one of the US Patent Classification (USPC) codes considered to cover "green

technologies." These USPC technology classes included alternative energy production, energy conservation, environmentally friendly farming, and environmental purification, protection and remediation. However, after a few months the USPTO realized that the classification requirement was too restrictive and decided to replace it with a simple statement as to why the invention covers a "green technology." This may include applications pertaining to environmental quality, energy conservation, renewable energy or greenhouse gas emissions reduction. In addition to these subject matter requirements, the USPTO also imposes some restrictions on the number of claims made in the patent.[10] The examination of applications accepted into the Green Technology Pilot begins immediately, instead of having to wait for two to three years.

The USPTO Green Technology Pilot Program closed in early 2012, after the 3,500th application was received under the scheme. However, other accelerated examination options applicable to all technologies are still available for green patents, including the Prioritized Examination Program (Track I), the Patent Prosecution Highway, the Accelerated Examination Program and a petition based on the applicant's age or health.

2.6 Israel Patent Office

Israel's fast-tracking programme was launched in December 2009. Israel's Patent Office allowed green patents to receive priority examination, a procedure usually available only when infringement is suspected. The subject matter requirement is very broad: to request accelerated examination, the applicant must simply provide an explanation as to why the invention helps advance environmental protection. The extra fees normally required for priority examination are not needed for green patents. After qualifying under the programme, these green patent applications are examined within three months.

2.7 Canada IPO

The Canadian Intellectual Property Office (CIPO) launched its fast-track programme for green patent applications in March 2011. To benefit from the programme, applicants must make a declaration stating that the invention could "help resolve or mitigate negative environmental impacts or help conserve the natural environment." No additional fee is required. Under the fast-track programme, the applicant will receive a first office action within two months instead of two to three years.

2.8 Brazil IPO

Brazil was the first emerging economy to launch a green patent fast-track programme. In April 2012, the National Institute of Industrial Property (INPI) launched a pilot programme to accelerate green patent applications. The pilot programme will be limited to the first 500 petitions granted. Eligible green technologies fall under the following categories: alternative energy, transportation, energy conservation, waste management and agriculture.[11] An additional fee of roughly USD 500 for "strategic priority examination" is required. The goal of the programme is to reduce the period of examination of patent applications related to green technologies to less than two years. The average examination time in Brazil is five years and four months.

2.9 China's IPO

China's State Intellectual Property Office was the last patent office to launch a green patent fast-track programme in August 2012. Eligible technologies must be related to energy saving, environmental protection, new energy, new energy vehicles, low-carbon technology and resource-saving technology. Interestingly, the fast-track scheme also covers some non-environmental technologies that are deemed crucial for China's economic development: new generation of information technology,

biology, high-end equipment manufacturing, and new material. Patent applicants must provide a search report together with the request for accelerated examination. Applications accepted under the programme will be examined within one year after the request has been approved.

Table 1 summarizes the information presented in Section 2.

Table 1: Description of green patent fast-track programmes

Country	Starting date	Technologies covered
UK	May 2009	All environmentally friendly inventions
Australia	September 2009	All environmentally friendly inventions
Korea	October 2009	Technologies funded or accredited by the Korean government, or mentioned in relevant government environmental laws
Japan	November 2009	Energy-saving & CO_2 reduction
US	December 2009*	Environmental quality, energy conservation, development of renewable energy resources, or greenhouse gas emission reduction
Israel	December 2009	All environmentally friendly inventions
Canada	March 2011	All environmentally friendly inventions
Brazil	April 2012	Alternative energy, transportation, energy conservation, waste management and agriculture
China	August 2012	Energy-saving technologies, environmental protection, new energy, new energy vehicles

** Note: the USPTO programme was temporary and closed after the 3,500th application was received for this scheme.*

Source: author

3. HOW MANY PATENTS HAVE GONE THROUGH THE FAST-TRACKING PROGRAMMES?

3.1 Distribution of Patents by Patent Office

Table 2 shows the number of green patents that went through each fast-tracking programme to date. The numbers go from a mere 43 patents in Australia to 3,533 patents in the US. Israel and Canada also experienced a rather low number of patents filed, with respectively 78 and 67 patents to date requesting accelerated examination. The UK has had the second largest programme so far, with 776 requests between March 2009 and June 2012. The The Korean IPO received 604 requests, but 158 were rejected (in comparison, only 1% of requests at the UK patent office were rejected). Japan received around 200 requests in 2010, but data for 2011 and 2012 has not yet been made public.

In order to take into account the time the programmes have been in place, Table 3 shows the annual number of requests for each patent office. The number of requests in Australia appears to be very small, with only around fifteen patents per year. Japan, Korea and the UK receive a comparable 200 to 250 requests per year. With 1,500 annual requests, the USPTO stands out as the programme with the highest number of requests, which is not surprising given the number of patent applications received by the USPTO in an average year (see below).

To assess the success of the programmes, Table 3 further compares the number of annual fast-track requests to the annual number of green patents[12] filed in each patent office (column 3) and to the total annual number of patent applications filed (column 5). Two results stand out. First, as can be expected, the number of patents requiring accelerated examination under the green patent programmes represent a tiny share of total patent filings in each patent office: between 0.05% in Australia and 0.90% in the UK. Second, only a small share of green patents chooses to request accelerated examination. The figures range from less than 1% of green patents in Australia to over 20% in the UK. The US and Israel stand in between with respectively 8% and 13% of the average number of green patents filed annually requesting accelerated examination. The proportion is between 1% and 2% in Canada, Japan and Korea. This suggests that either patent applicants are unaware of the existence of the programmes, or that it is not always in their best interest to request accelerated examination. We will explore this last point in the next subsection.

Table 2: Number of patents under each of the fast-track programmes

Country	Period of analysis	Fast-trackgreen patents
Australia	September 2009 – August 2012	43
Canada	March 2011 – August 2012	67
UK	May 2009 – June 2012	776
Israel	December 2009 – September 2012	78
Japan	November 2009 – December 2010	220
Korea	October 2009 – June 2012	604
US	December 2009 – March 2012	3,533

Source: author

Table 3: Number of annual patents in the fast-track programmes as a share of green and total patents

Country	Annual patents in FT programmes	Annual green patents		Annual total patents	
		#	%	#	%
Australia	14.3	1,896	0.76%	29,480	0.05%
Canada	44.7	2,720	1.64%	36,949	0.12%
UK	258.7	1,237	20.91%	28,638	0.90%
Israel	28.4	216	13.13%	8,004	0.35%
Japan	203.7	13,741	1.48%	349,193	0.06%
Korea	219.6	11,680	1.88%	168,646	0.13%
US	1514.1	18,421	8.22%	414,362	0.36%

Note: the numbers are the author's own calculations based on the PATSAT database
Source: author

3.2 Understanding the Low Usage Rate of Fast-Tracking Programmes

The analysis presented in Section 3.1 shows that only a small share of patents eligible for accelerated examination – between 1% and 20% depending on the patent office – actually goes through the various programmes. An analysis of the legal literature, complemented with interviews with patent attorneys and IP professionals in various sectors, may help to understand why patent applicants frequently choose not to make use of the fast-tracking programmes.

As mentioned above, there are several advantages to a reduced examination process. First, it may allow patent applicants to start licensing their technologies sooner, thereby increasing the company's revenue. Second, possessing a granted patent can help companies in the clean technology sector raise private capital (Lane, 2012). Finally, granting a patent may justify taking legal action in the case of suspected infringement.

However, there are also some disadvantages in accelerating the granting of a patent. To begin with, requesting an accelerated examination may add costs to the application for patent offices that also require these applicants to conduct a search report on the prior art, as is the case at JPO. Some programmes require additional commentary by the applicant, to explain the differences between the prior art and the application being prosecuted (e.g. in Japan). Since anything an applicant includes in an application may be used against him in terms of construing the scope of the application (i.e. the claims), applicants may be wary of such requirements.

More importantly, it is not always in the applicant's best interest to have his patent published or granted as soon as possible. Indeed, patent applicants must reach a compromise between the need to secure patent protection as early as possible, and the incentive to keep the design of the patent open as long as possible.

The first aspect of this compromise is quite intuitive. Inventors have strong incentives to file a first ("priority") application as soon as possible because, until then, they have nothing but secrecy to protect themselves from imitators. In this context, information leakage concerning the invention would be doubly damageable: it would enable competitors to use the invention legally and could prevent the invention from being ever patented (since, through the leakage, it has become prior art[13]). Even if the secret is well kept, there is a risk under the first-to-file rule[14] that the patent could be granted to another inventor who had filed a prior application. Applying for a patent alleviates these risks, as it freezes relevant prior art at the date of application and guarantees that the patent, once granted, can be used to oppose any infringer.

Although inventors may want to file a priority application as early as possible, they also have serious motives to delay the moment when their patent will be granted as much as possible:

(i) An important advantage of a long examination period is that it delays the costs associated with the grant of the patent. It also gives patent applicants time to determine whether it is worth requesting the grant in the first place. Since a grant implies additional costs (renewal fees, etc.), applicants first need to make sure that the patent will be commercially viable before going any further with the grant process. A long examination period thus has an important option value for the applicant, which explains the success of mechanisms such as the Patent Cooperation Treaty (PCT). One of the key benefits of filing a patent under the PCT is that patent applicants then have thirty months to decide whether they want to proceed towards the grant of one or more national (or regional) patents.

(ii) Another major advantage of a delayed examination process is that it leaves applicants with the possibility to adjust the patent application – in particular the list of claims – during the examination process.[15] Early grants can occur when the invention and its market are not yet mature, which induces opportunity costs for the applicant. Indeed, if granted too early, the design of the patent may not perfectly match the final version of the invention, thus facilitating circumvention. To avoid such discrepancies, applicants need to delay the moment when the patent is granted with definitive claims. Patent offices worldwide offer some flexibility in this respect, through the use of divisional applications, continuations and reissued patents (see Dechezleprêtre and Ménière, 2010, for an analysis of these mechanisms).

(iii) There is also a potential issue with the early publication of the patent. When a patent is published, it reveals important information about ongoing R&D to competitors. This should provide an incentive for applicants to delay publication. Since patent applications must be disclosed when granted, a very early grant occurring before the end of the eighteen-month period after which patent applications are normally published could increase the risk of competitors being able to quickly design competing technology. Our interviews with IP professionals revealed however that this is unlikely to be an issue in practice.

The consequence of what precedes is that patent applicants have an interest in using fast-tracking programmes only under specific circumstances (suspicion of infringement, capital-raising activity, securing commercial partnerships, among others). This explains why only a small percentage of eligible patents are found to be using this opportunity. Since once filed, infringers will be opposed using the date of application and not the grant date, most applicants do in fact have an incentive to wait until the examination is conducted under the regular procedure.

3.3 Are Fast-Track Green Patents Crowding Out Other Patents?

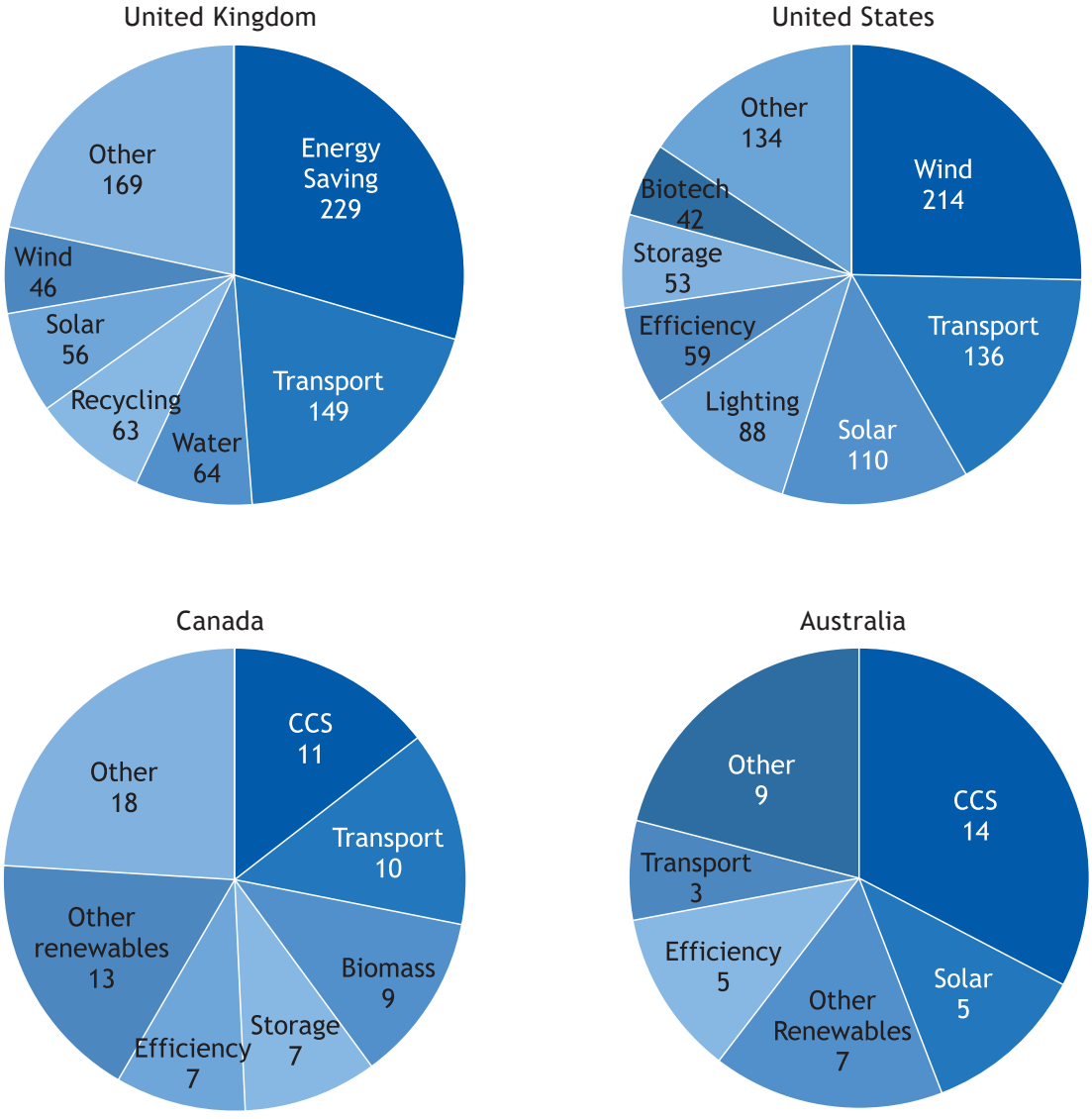
A potential problem of fast-tracking programmes for green patent applications is that they may delay examination of patent applications in other technologies. An important consequence of the compromise presented in Section 3.2 is that most patent applicants are actually happy to see the examination of their patent applications postponed. If, following Table 3, we assume that fast-tracking is appealing for at most 20% of patents in non-green technologies, this means that crowding-out is likely to be an issue for only 20% of patent applications delayed because of fast-tracking programmes. This only represents around 1,000 patents since 2009 worldwide, suggesting that crowding-out is unlikely to have been a significant issue so far.[16]

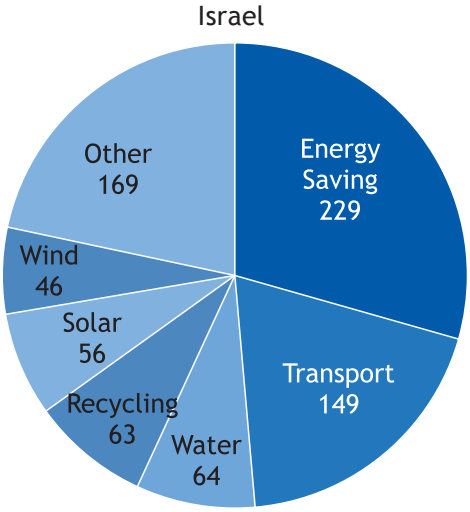
4. THE CHARACTERISTICS OF FAST-TRACK PATENTS

4.1 Distribution by Technology Type

The distribution of patents by technology type is presented in Figure 1 for the five countries for which detailed data could be obtained: the UK, the US, Australia, Canada and Israel. For presentation purposes, we have grouped patents by broad technology groups; however, the detailed technology breakdown for each of the five countries is presented in Annex 1.

Figure 1 - Distribution of patents by technology





Source: author

Three results stand out from the analysis of technologies. First, despite the absence of any strict definition of what constitutes a green patent in most of the fast-track programmes, nearly all patents cover environment-related technologies.[17] Second, climate change-related technologies represent the majority of patents in all fast-tracking programmes, with the exception of Israel. Third, the top technologies differ greatly across countries, reflecting national specificities. Most patents in the US relate to renewable energy technologies, in particular wind and solar power. They are followed by transport-related technologies. However, most of these patents cover energy-efficient technologies for internal combustion engines and not electric and hybrid vehicles. Interestingly, CCS is the main technology for which accelerated examination is requested in Australia and Canada. This can be linked to Australia's dependence on coal-based electricity production and to Canada's booming tar sand mining industry. In Canada, CCS is followed by biomass patents, which reflects the abundance of biomass resources in the country. In Israel, 30% of fast-track patents cover water-related technologies, in particular grey water reuse and desalination technologies, which is not surprising given Israel's strong water scarcity problems. In the UK, other environmental technologies – such as recycling or water-saving technologies – also represent a significant share of patents. Interestingly, there are more solar patents in the UK programme than wind patents.

4.2 Time-to-Grant Compared to Regular Procedures

The main objective of fast-track programmes is to accelerate the examination and the potential grant of patents. In Table 4, we have computed the average time from application to grant for the fast-track patents and have compared this to the average time-to-grant for patents that were published during the same years but went through the regular examination procedure.

Table 4 shows that fast-tracking programmes have kept with their promises. In the UK, the average time from application to grant for patents published between 2009 and 2011 was three years and four months. In comparison, fast-track patents were granted within nine months on average. This represents a 75% reduction in the time-to-grant period. The other patent offices for which this information could be gathered also showed a significant, albeit slightly smaller, reduction in the time-to-grant period. In Canada, this period was reduced by 68%, from 7.8 years on average to 2.5 years only.[18] Australia and Israel also halved this period. In the US, the reduction rate was slightly lower, but we suspect this is due to the strict initial programme rules that have since been modified.[19]

Table 4: Time-to-grant for fast-track programmes compared with the regular examination process

Country	All patents	Fast-track patents	Reduction in time-to-grant
Australia	3.7 years	1.9 years	49%
Canada	7.8 years	2.5 years	68%
UK	3.3 years	0.8 years	75%
US	2.8 years	1.6 years	42%
Israel	5.4 years	2.8 years	48%
Japan	6.4 years	n.a.	n.a.
Korea	2.4 years	n.a.	n.a.

Source: author

4.3 The Value of Fast-Track Patents

Do fast-track patents differ from non-fast-track patents, in particular environmental ones? We will investigate this issue by looking at three different measures of patent value: the number of countries in which each patent has been filed (also called the family size of patents), the likelihood of becoming a "triadic" patent and the number of claims made in the patent. It has been empirically demonstrated that the number of countries in which a patent is filed is correlated with other indicators of patent value (see, for example, Lanjouw et al, 1998, Harhoff et al, 2003). International patent families also have the advantage of being rapidly available to researchers, as patent applicants must file all foreign extensions of a patent at most thirty months after the first (priority) patent has been filed. Another widely used measure of patent value is to focus on so-called triadic patents, i.e. patents taken out in all three of the world's major patent offices: the European Patent Office (EPO), the Japan Patent Office and the United States Patents and Trademark Office. Triadic patents have been used extensively as a way to focus on high-value patents (Dernis, Guellec and van Pottelsberghe, 2001; Dernis and Khan, 2004).

In order to compare fast-track patents with patents that did not participate in the programmes, we created a control group comprised of all the patents filed in the same patent offices[20] during the same years as fast-track patents. We then carried out econometric analysis to compare the value of fast-track patents and that of otherwise similar but "normal-track" patents. The results from the econometric analysis are presented in greater detail in Annex 2.

We consistently found a significant difference between the values of fast-track and regular patents. Fast-track patents are filed in 15% more countries on average than non-fast-track patents. This represents an increase from 2.5 countries to 2.83 countries on average. The results were even more compelling when we looked at triadic patents, which represent the high-end of patent distribution in terms of commercial value. Here we found that fast-track patents were up to 56% more likely to be filed in all major patent offices than non-fast-track patents. While an average 15% of patents are filed in the three major patent offices, the (conditional) likelihood that a fast-track patent will be a "triadic" patent jumps to over 20%. Finally, when we looked at the number of claims made in the grant publication, we found that fast-track patents had 31% more claims than non-fast-track patents. While patents published in the US list thirteen claims on average, this rises to seventeen for fast-track patents.[21]

Overall, our results consistently show that fast-track patents are of higher value than equivalent patents going through the normal procedure. Importantly, these results hold when we included patent applicant fixed effects,[22] meaning that among a company's patent portfolio, fast-track patents are of higher value than the average patent. This suggests that patent applicants – who have private information on the value of

their patent applications – request accelerated examination for patent applications that are of higher value, are more commercially viable and thus may have been the subject of commercial interest from potential business partners.[23]

4.4 Knowledge Spillovers From Fast-Track Patents

One of the main objectives of fast-tracking programmes is to accelerate the diffusion of green technological knowledge in the economy.

In this regard, patent citations offer an attractive way to analyse knowledge diffusion. When a patent is filed, it must include citations to previous patents upon which the inventor has built to develop the new technology. Therefore, patent citations have been used intensively to measure knowledge flows (see for example Jaffe et al., 1993; Peri, 2005).

Here, we implemented a similar econometric approach as in Section 4.3 to determine whether there was a systematic difference in the number of citations received between fast-track patents and normal-track patents. To deal with one of the most common problems associated with patent citations, we excluded self-citations by inventors. We also ran regressions where we restricted citations to those made by patent applicants only, thus excluding citations added by patent examiners, which might not capture knowledge flows. Note that patent citations not only capture knowledge spillovers but also patent value, so our regressions include controls for patent value such as family size.

Compared with patents filed in the same month, of similar value but not fast-tracked, fast-track patents received twice as many citations in the same time period. The estimated impact of fast-tracking on forward citations ranges between 50% and 150%, depending on whether citations made by examiners are included or not. Thus, there appears to be strong evidence that green patent fast-tracking programmes accelerate the diffusion of knowledge in green technologies in the short run – i.e. during the first years following the publication of the patents. It will be interesting to whether this effect remains in the long run, but the short-term impact is compelling. Given the urgency of addressing environmental issues, including climate change, this result is an encouraging feature of the fast-tracking programmes.

5. AN ANALYSIS OF FAST-TRACKING PROGRAMME USERS

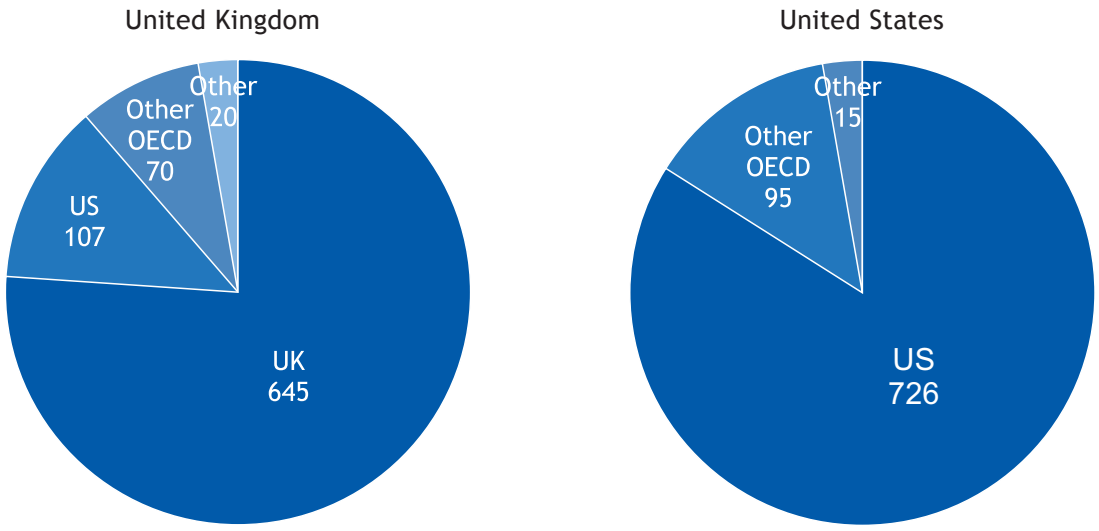
In this section, the characteristics of companies resorting to fast-tracking programmes will be examined.

5.1 Nationality of Applicants

We were able to obtain the nationality of applicants for the UK and the US programmes. The distribution of applicant countries is shown in Figure 2. A more detailed breakdown is available in Annex 3. As can be seen from Figure 2, the majority of requests for accelerated examination come from domestic applicants. UK-based applicants represent 76% of requests at the UK IP office, while US-based applicants are responsible for 86% of requests at the USPTO. Foreign applicants are mainly from OECD countries, most notably US applicants in the UK and applicants from Japan and South Korea in the US. Very few applicants from emerging economies can be found. For example, Chinese applicants only filed six requests in the UK and four requests in the US.

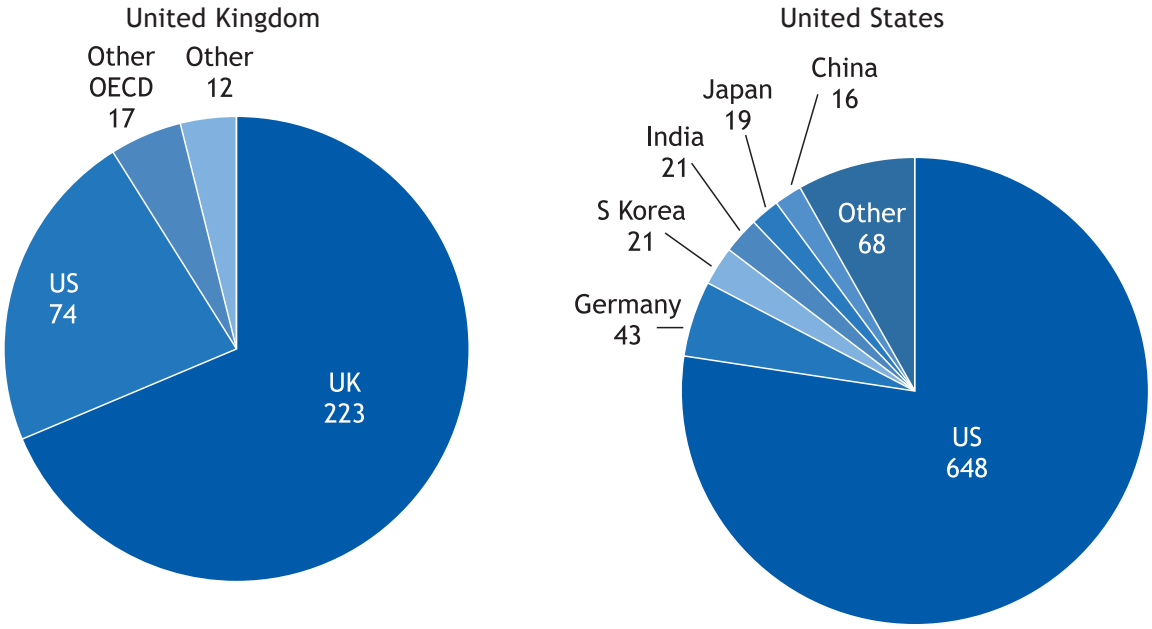
When we compared applicants requesting accelerated examination with all applicants for green patents at the UK and the US patent offices in the last few years, we found that domestic applicants were much more likely to participate in the fast-tracking programmes than foreign applicants were. 62% of green patent applications at the UK patent office were filed by domestic applicants. At the USPTO, domestic applicants filed only 50% of green patent applications. This suggests that foreign applicants might be unaware of the existence of these programmes. This is also likely the result of applicants only wanting to expedite the first application, which is usually filed in their home country. That first application filed will probably be prosecuted by the person who originally drafted the case. Since that practitioner may have the best overall context for the patent application, he/she may be in a better position to make the most strategic amendments.[24] This potential explanation is supported by the observation that, among all the US and UK fast-track patents, we did not find a single pair of patents belonging to the same international patent family.

Figure 2 - Nationality of patent applicants



Source: author

Figure 3 – Inventors' country of residence (USPTO)



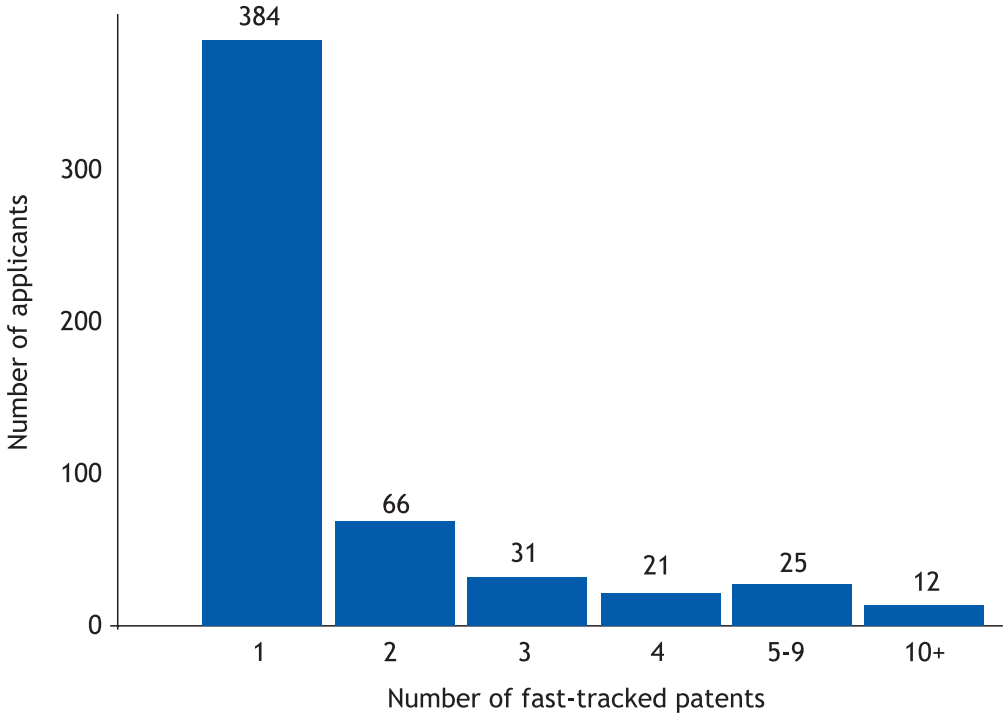
Multinational companies very often let their patent filings be handled by the local subsidiary. Therefore, looking at the location of applicants may fail to uncover all cross-border patent transfers. To mitigate this issue, we examined the country of residence of inventors instead, as reported on patent applications. The breakdown is shown on Figure 3 (a more detailed breakdown is available in Annex 3).

The picture does not change much for the UK, although it shows a larger share of US-based inventors than suggested by the applicants' data. Interestingly, only 77% of inventors of patents in the USPTO programme reside in the US (as compared to 86% of applicants). Over 5% of inventors are from Germany. Importantly, India and China appear in the top five foreign inventor countries, with respectively twenty-one and fifteen patent applications, suggesting that the patents are being transferred by Chinese and Indian multinational companies.

5.2 Fast-Track Patents in Companies' Patent Portfolios

The 1,304 UK and US-published patents on which detailed data is available were filed by 531 applicants. This means that applicants requested accelerated examination for 2.4 patents on average (the median applicant filed one request). 72% of applicants requested accelerated examination for a single patent and only 7% requested accelerated examination for five patents or more (see Figure 4). The top companies include Ford (the car manufacturer), General Electric, Bridgelux (a lighting company), ConocoPhillips (a chemical engineering company) and Mistubishi Heavy Industries (mostly for wind energy patents).

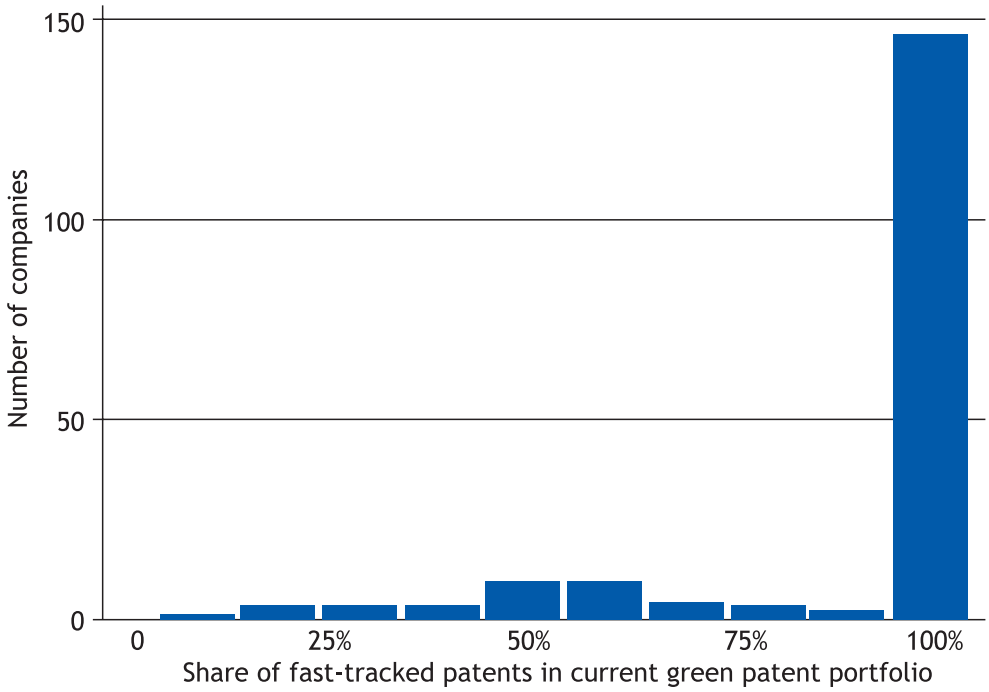
Figure 4 - Number of fast-track patents per patent applicant



Source: author

What share of their patent portfolio do fast-track patents represent? In Figure 5, we showed the proportion of patents in their current portfolio for which companies[25] have requested accelerated examination. We found that, while only 20% of companies requested accelerated examination for some of the patents in their portfolio, 80% of them requested accelerated procedure for all of their green patents. The procedure appears to be a systematic strategy for most applicants.

Figure 5 - Share of fast-track procedures in the patent portfolio

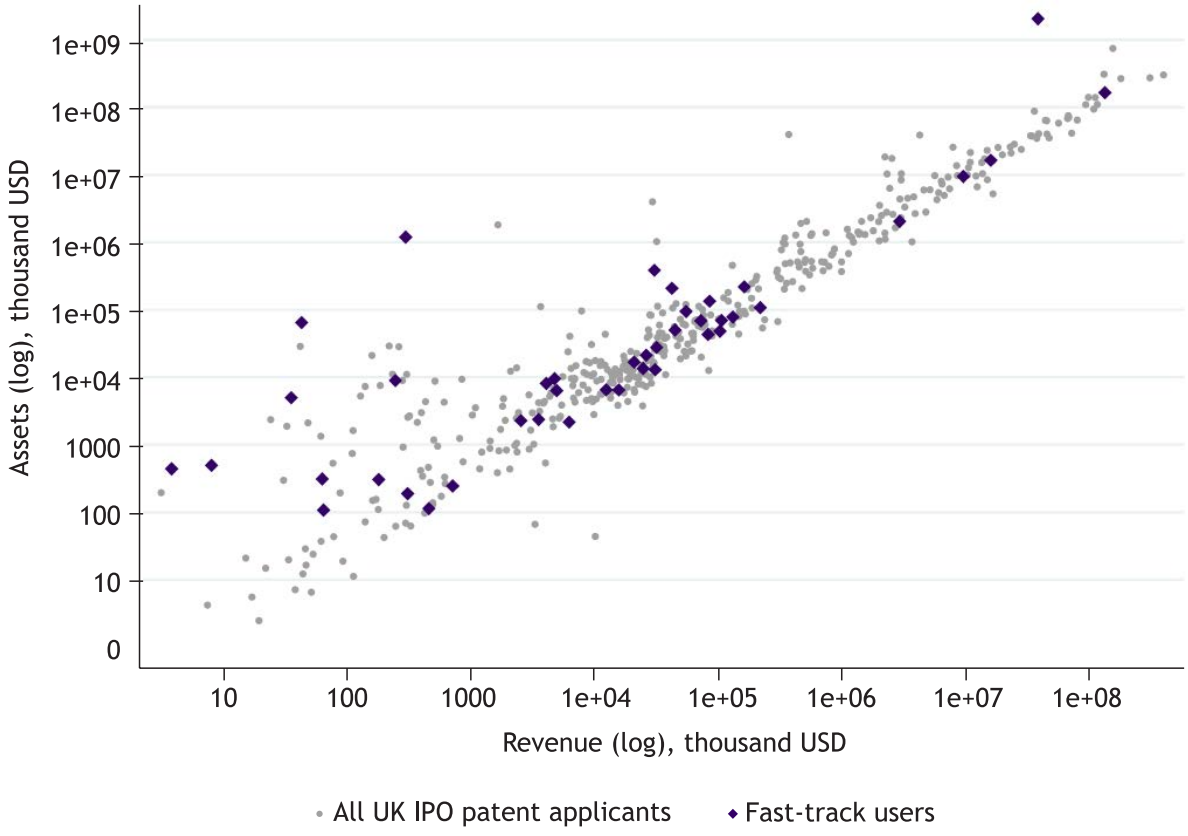


Source: author

5.3 The Specificities of Fast-Track Programme Users

The fact that most applicants systematically choose to request the accelerated procedure while only a few use it on an ad-hoc basis suggests that companies joining the programme might differ in some manner from companies that do not. In order to look at this issue, the data on patents filed at the UK IP office was matched with the ORBIS worldwide financial information database. This allowed us to obtain detailed information on the patent applicants, including assets, revenue and employment. Users of the programme (for at least one patent) were then compared with non-users (as defined by all other applicants of green patents[26] at the UK IP office) in terms of revenue, assets, number of employees and size of the patent portfolio. We found evidence that fast-track users differ statistically from non-users in that they tend to have smaller revenues and smaller but faster-growing assets. In other words, the fast-tracking programme seems to appeal particularly to start-up companies in the green technology sector that are currently raising capital but still generating small revenue. Figure 6 illustrates this result by plotting the population of green patent holders against revenue and assets and distinguishing between users and non-users[27] of the fast-tracking programme. This shows that fast-track users are overrepresented in the lower-left corner of the graph. The reason for this is that patents are more critical to the survival of start-up companies than to that of larger, established companies.

Figure 6 – Fast-track users and non-users in terms of revenue and assets



Source: author

These differences seem to be particularly high when comparing companies that use the programme for all of their patents with occasional users and non-users. The comparison is presented in Figures 7 and 8 for asset growth and revenue respectively. These dispersion diagrams represent the spread of values in the distribution of the variable for the three groups considered. The grey box shows the values under which 50% of the distribution falls.

Figure 7 – Asset growth of systematic fast-track users, occasional users and non-users

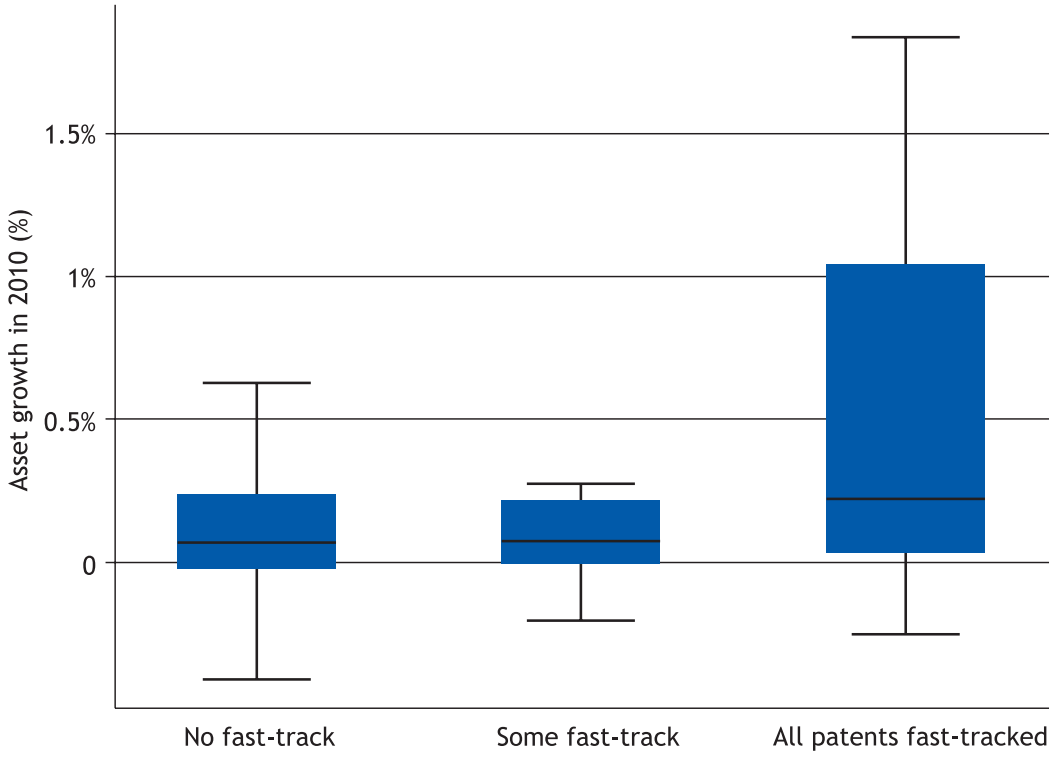
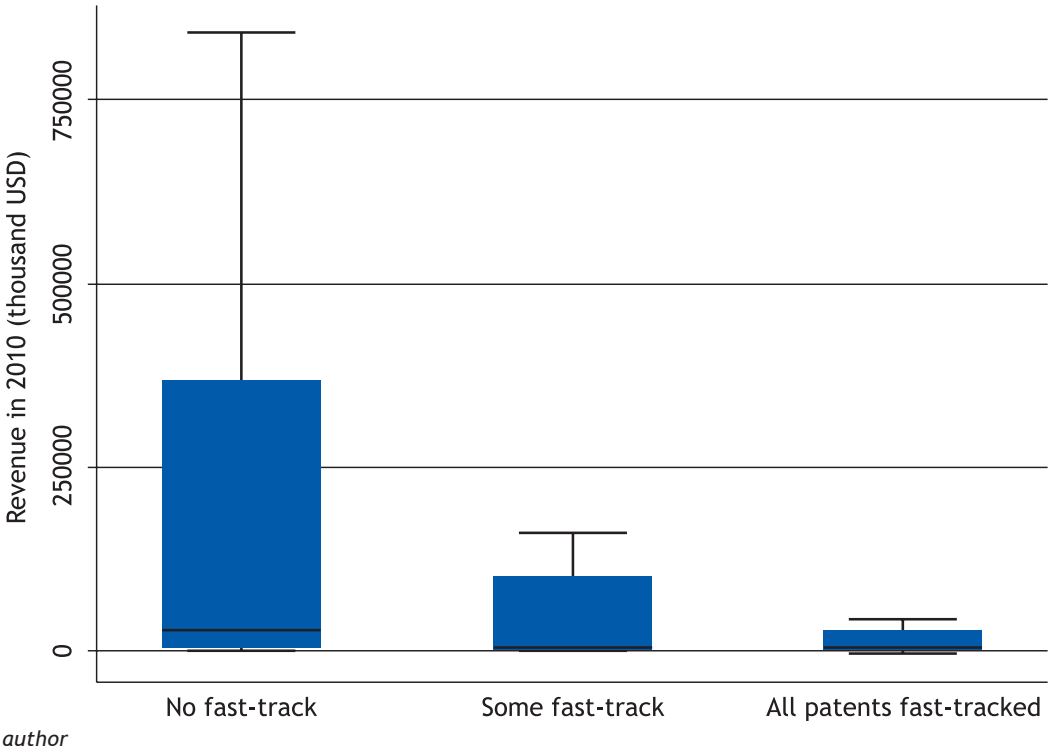


Figure 8 – Revenue of systematic fast-track users, occasional users and non-users



Source: author

Figures 7 and 8 clearly show that companies that systematically resort to fast-tracking programmes have a higher growth rate of assets and lower revenue than non-users. Occasional users stand somewhat in the middle in terms of revenue and are similar to non-users in terms of asset growth. These results confirm that the fast-tracking programme is particularly relevant for green start-up companies.

6. CONCLUSION

In this paper, we conducted the first empirical analysis of the green patent fast-tracking programmes that have recently been put in place in various patent offices worldwide. For this purpose, we assembled detailed data from Australia, Canada, Israel, the UK and the US, along with some more aggregated data from Japan and Korea.

Only a small share of green patents request accelerated examination. However, there is an important discrepancy across patent offices: the numbers range from less than 1% of green patents in Australia to over 20% in the UK. The participation rate is very low in Canada, Japan and Korea (less than 2% of green patents) and significantly higher in the US (8%) and Israel (13%). However, as our interviews with patent attorneys reveal, the participation rate for green patent fast-tracking programmes cannot be expected to reach 100%, since patent applicants usually have a strong incentive to keep their patent applications in the examination process for as long as possible. However, the high participation rate in the UK (20%) shows that there is a demand for this type of mechanism from patent applicants and that participation could be enhanced in other patent offices, maybe by increasing communication about the programmes. In particular, it appears that domestic applicants are vastly overrepresented in the fast-track programmes, suggesting that participation of foreign applicants might be enhanced.

The data assembled for this paper suggests that fast-tracking programmes do keep their promises. The time from application to grant has been reduced by up to 75% for patents entering the accelerated process. More importantly, analysis of patent citation data shows that fast-tracking programmes have accelerated the diffusion of knowledge in green technologies over the first few years that followed the publication of the fast-track patents. Whether this effect will remain in the long run, however, remains to be seen.

The main advantage of fast-tracking programmes is that they bring a welcome differentiation to patent examination procedures. Patent applicants who can benefit strongly from an early grant can choose to request accelerated examination.[28] The data shows that this mostly applies to fast-growing start-up companies in the "green tech" industry, who can use a granted patent to raise capital or to license their technology and start making revenue. Other patent applicants who prefer to keep learning about how the market for their technology develops before requesting a grant can do so by not opting in.

In fact, similar differentiation mechanisms not restricted to green technologies already exist in several patent offices. For example, the EPO has an accelerated examination procedure in place that applicants can request at no additional cost. Under the USPTO's three-track prioritized examination system (which is not yet fully implemented), applicants can choose between three examination procedures: prioritized examination, "normal" examination, and delayed examination. The Korean Intellectual Property Office has a similar system in place.[29] Should patent offices, then, restrict such programmes to green patents only? Given the urgency of environmental issues, it might make sense to prioritize green patents for the time being, but we believe that they should ideally be open to all types of technologies, for at least two reasons. First, it is sometimes difficult to foresee the environmental benefits of a newly discovered technology.[30] Second, accelerated procedures open to all technologies would be completely free of any potential crowding-out issues, since no patent application willing to be examined as a matter of priority could be excluded from the scheme.

One of the main limitations of this analysis is that we have not been able to assess to what extent fast-tracking programmes have accelerated the diffusion of green patented technologies, in particular through licensing. A survey of programme users could help answer this question and refine our understanding of accelerated examination. This is left for future research.

ENDNOTES

1 In the US, the programme was designed to be temporary and was closed after the 3,500th application under the scheme was received.

2 The European Patent Office (EPO) does not have a fast-tracking programme for green patent applications. However, the EPO has an accelerated examination procedure that is open to all patent applications irrespective of the technology covered.

3 Note that accelerated procedures have not been specifically put in place for green patents. Such procedures exist in various patent offices. See Tran (2012) for an overview of these procedures.

4 Many studies have documented a strong growth in the number of patent applications protecting green technologies, suggesting that patents are considered as a useful means of protection against imitation in this sector (see Dechezleprêtre et al. 2011).

5 We do not have comprehensive data for all patent offices. The highest quality data could be obtained for the UK, Canada, Australia and the US. The most detailed results in the report are based on data from the UK and the US patent offices.

6 This section draws heavily on Lane (2012), Patton (2012) and Sterne, Kessler, Goldstein & Fox (2012).

7 In the empirical analysis that follows, we show that almost all fast-tracked patent applications actually cover green technologies.

8 See UK IPO Fast grant guide, available on the IPO website.

9 For example, products developed with the help of the recent "Low-Carbon Green Growth Basic Act" government programme are eligible for the super-accelerated examination.

10 The application must have three or fewer independent claims, twenty or fewer total claims, and no multiple dependent claims. The application must also "claim a single invention directed to environmental quality."

11 Nuclear energy was explicitly excluded following the nuclear power plant accident in Fukushima, Japan, in March 2011.

12 Since each programme has its own requirements in terms of what constitutes a green patent (see Table 1), the number of green patents filed annually is calculated differently for each patent office to reflect the requirements of each programme.

13 In some countries, a grace period may however allow for public disclosure of an invention (under certain conditions) without affecting the validity of a subsequent patent application up to a set deadline.

14 In a first-to-file system, the right to be granted a patent for a given invention lies with the first person to file a patent application for protection of that invention, regardless of the date of actual invention.

15 Note however that an applicant must fully disclose their invention at the time of filing.

16 Crowding-out issues could be completely avoided if, as we argue in the conclusion of this paper, accelerated examination was extended to non-green technologies.

17 An exception is for example Canada IPO patent number 2628144, which covers a "Method and system to promote actions such as environmental and charitable actions". Such exceptions are very rare.

18 The period from application to grant in Canada is typically very long, as applicants have to request the examination of the patent for the procedure to start. The examination is thus requested at a very late stage, when applicants are certain of the economic value of the patent. The average time from request of examination to grant for "regular" patents for the last three fiscal years was 4.2 years. In comparison, the average time from request of examination to grant for fast-tracked patents was 1.7 years.

19 The initial rules of the programme made patents eligible only if they had been filed before 8 December 2009. This rule was changed in November 2010, so the time-to-grant is likely to go down as more recent data becomes available. Our detailed USPTO data, which includes time-to-grant, only covers the first 800 patents that went through the programme.

20 We focused the analysis on UK and US patents for which we had the most detailed information.

21 The PATSTAT database does not have information on the number of claims made for UK patents.

22 Results not reported for brevity; they are available from author upon request.

23 Note that this finding might not be specific to green patents. It might be robust to all fast-track patent applications, but in the absence of data on non-green fast-track patents, we cannot investigate this possibility.

24 We are very grateful to Allison Mages (GE) for pointing this out.

25 Note that this analysis only includes patent applicants for which we were able to collect the complete patent portfolio. This explains why the total number of companies is smaller in Figure 3 than in Figure 2.

26 Applicants of green patents might differ systematically from companies not involved in clean technologies. Thus, it is important to compare fast-track users with other green patent holders and not with the population of patent applicants. Moreover, companies in non-green sectors cannot use the fast-tracking programmes, so they cannot help us understand why some companies *choose* to use the programme.

27 Users are represented by diamond figures and non-users in grey circles.

28 As economists would put it, they self-select into the scheme.

29 Applicants can choose between Accelerated Examination (examined within three months of filing), Regular Examination, and Customer-deferred Examination (examined within three months of the date requested by the customer).

30 For example, GPS for road users helps save fuel by determining the shortest itinerary, but would GPS have been considered a green technology from the outset?

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ANNEX 1 – DISTRIBUTION OF PATENTS BY TECHNOLOGY

Table A1 - Distribution of patents by technology - Australia

Green technology	Number of patents	Share
CCS	14	32.6%
Solar	5	11.6%
Agriculture	3	7.0%
Combustion	3	7.0%
Transport	3	7.0%
Wood	3	7.0%
Others	3	7.0%
Lighting	2	4.7%
Smart grids	2	4.7%
Geothermal	2	4.7%
Hydro	1	2.3%
Wind	1	2.3%
Insulation	1	2.3%

Table A2 -Distribution of patents by technology - Canada

Green technology	Number of patents	Share
CCS	11	14.7%
Biomass	9	12.0%
Biofuel	8	10.7%
Other	6	8.0%
Depollution	6	8.0%
Storage	4	5.3%
Waste	4	5.3%
Marine	4	5.3%
Wind	4	5.3%
Hydrogen	3	4.0%
Gas	3	4.0%
Other renewables	3	4.0%
Transport	2	2.7%
Solar	2	2.7%
Combustion	2	2.7%
Heating	1	1.3%
Efficiency	1	1.3%
Agriculture	1	1.3%
Insulation	1	1.3%

Table A3 -Distribution of patents by technology - UK

Green technology	Number of patents	Share
Wind	46	5.9%
Water	64	8.2%
Recycling	63	8.1%
Solar	56	7.2%
Energy Saving	229	29.5%
Vehicle	149	19.2%
Other	169	21.8%

Table A4 - Distribution of patents by technology - US

Green technology	Number of patents	Share
Wind	214	25.63%
Solar	108	12.93%
Lighting	88	10.54%
Internal combustion engine	75	8.98%
Energy efficiency	58	6.95%
Bioengineering	42	5.03%
Storage	34	4.07%
Chemical engineering	28	3.35%
Fuel cell	19	2.28%
Electric vehicle	19	2.28%
Emissions controls	19	2.28%
Biofuel	16	1.92%
Wastewater treatment	16	1.92%
Materials	13	1.56%
Renewable	11	1.32%
Hybrid vehicle	10	1.20%
Production	10	1.20%
Fossil fuel	9	1.08%
Recycling	6	0.72%
Green building	6	0.72%
Vehicle	6	0.72%
Hydroelectric	6	0.72%
Wave	4	0.48%
Geothermal	3	0.36%
CCS	2	0.24%
Photovoltaics	2	0.24%
Fluid flow	2	0.24%
Trading & offsets	2	0.24%
Generation	1	0.12%
Distribution efficiency	1	0.12%
Roadway	1	0.12%
Fertilizer alternative	1	0.12%
Yield enhancement	1	0.12%
Liquid purification	1	0.12%
Disaster	1	0.12%

Table A5 – Distribution of patents by technology - Israel

Green technology	Number of patents	Share
Water	23	29.49%
Other	16	20.51%
Solar	8	10.26%
Electric vehicle	5	6.41%
Hydro	3	3.85%
Waste	3	3.85%
Energy efficiency	3	3.85%
Wind	2	2.56%
Wastewater	2	2.56%
CCS	2	2.56%
Marine	2	2.56%
Storage	2	2.56%
Internal combustion engine	1	1.28%
Materials	1	1.28%
Recycling	1	1.28%
Pollution	1	1.28%
Transport	1	1.28%
Buildings	1	1.28%
Geothermal	1	1.28%

ANNEX 2 – RESULTS OF THE ECONOMETRIC ANALYSES

Table A7 — Patent quality

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	**Family size**		**Triadic patent**		**Claims**	
Fast-track	0.151***	0.144***	0.278***	0.561***	0.312***	0.343***
	(0.029)	(0.029)	(0.056)	(0.104)	(0.015)	(0.015)
Patent office X Month FE	yes	yes	yes	yes	yes	yes
Observations	2,255,141	2,255,141	2,255,141	2,255,141	850,210	850,210

*Notes: *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level. The dependent variable is the number of patent offices in different countries in which a patent is filed (family size) in columns (1) and(2) and the number of claims made by each patent in columns (5) and (6). Columns (1) and (5)are estimated by Poisson pseudo-maximum likelihood and columns (2) and (6) are estimated by negative binomial maximum likelihood. The dependent variable is a dummy variable that takes on the value of 1 if the patent is triadic in columns (3) and (4). Column (3) is estimated by probit and column (4) is estimated by logit. All equations include 166 dummy variables for each office -the application month, a dummy variable for "green" patents according to the EPO classification and a constant. Robust standard errors are in parentheses.*

Table A8 — Knowledge diffusion

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	**All forward citations**			**Forward citations by applicants**		
Fast-track	1.534***	1.536***	1.322***	0.559***	0.536***	0.562***
	(0.064)	(0.064)	(0.069)	(0.153)	(0.152)	(0.164)
Family size		-0.004***	0.007***		0.036***	0.031***
		(0.001)	(0.001)		(0.002)	(0.003)
Claims			0.015***			0.012***
			(0.000)			(0.000)
Patent office X Month FE	yes	yes	yes	yes	yes	yes
Observations	2,221,075	222,107,5	849,465	2,221,075	2,2210,75	849,465

*Notes: *=significant at the 10% level, **=significant at the 5% level, ***=significant at the 1% level. The dependent variable is the total number of citations received by each patent in columns (1) to (3) and the number of citations received by each patentand made by applicants only in columns (4) to (6). All columns are estimated by Poisson pseudo-maximum likelihood. All equations include 166 dummy variables for each office -the application month, a dummy variable for "green" patents according to the EPO classification and a constant. Robust standard errors are in parentheses.*

ANNEX 3 – NATIONALITY OF APPLICANTS

Table A9 -Nationality of applicants - UK

Country	Number of patents	Share
UK	645	76.60%
US	107	12.71%
Norway	11	1.31%
Israel	10	1.19%
Denmark	8	0.95%
Germany	6	0.71%
Ireland	6	0.71%
Japan	5	0.59%
Singapore	4	0.48%
China	3	0.36%
Hong Kong	3	0.36%
Mexico	3	0.36%
Portugal	3	0.36%
Switzerland	3	0.36%
Taiwan	3	0.36%
Australia	2	0.24%
Belgium	2	0.24%
Finland	2	0.24%
France	2	0.24%
Mauritius	2	0.24%
Spain	2	0.24%
Sweden	2	0.24%
Czech Republic	1	0.12%
Estonia	1	0.12%
Netherlands	1	0.12%
New Zealand	1	0.12%
Russian Federation	1	0.12%
Thailand	1	0.12%
UAE	1	0.12%
Uganda	1	0.12%

Table A10 – Nationality of applicants – US

Country	Number of patents	Share
United States	726	86.84%
Japan	24	2.87%
South Korea	21	2.51%
United Kingdom	14	1.67%
Switzerland	10	1.20%
Canada	8	0.96%
Denmark	6	0.72%
Cayman Islands	5	0.60%
Austria	3	0.36%
Israel	3	0.36%
Peoples' Republic of China	2	0.24%
Hong Kong, China	2	0.24%
Singapore	2	0.24%
Taiwan	2	0.24%
Australia	1	0.12%
Brazil	1	0.12%
France	1	0.12%
Germany	1	0.12%
Italy	1	0.12%
Luxembourg	1	0.12%
New Zealand	1	0.12%
Saudi Arabia	1	0.12%

Table A11 – Nationality of inventors – US

Country	Number of patents	Share
United States	648	77.51%
Germany	43	5.14%
India	21	2.51%
South Korea	21	2.51%
Japan	19	2.27%
Peoples' Republic of China	15	1.79%
Netherlands	14	1.67%
United Kingdom	12	1.44%
Canada	7	0.84%
Denmark	6	0.72%
Israel	6	0.72%
Taiwan	6	0.72%
Austria	4	0.48%
Spain	4	0.48%
Australia	2	0.24%
Switzerland	2	0.24%
Brazil	1	0.12%
Hong Kong, China	1	0.12%
France	1	0.12%
Luxembourg	1	0.12%
New Zealand	1	0.12%
Saudi Arabia	1	0.12%

Table A12 – Nationality of inventors – UK

Country	Number of patents	Share
UK	223	68.20%
US	74	22.63%
Germany	5	1.53%
Ireland	4	1.22%
Taiwan	3	0.92%
Australia	2	0.61%
China	2	0.61%
Mauritius	2	0.61%
Singapore	2	0.61%
South Africa	2	0.61%
Spain	2	0.61%
Canada	1	0.31%
Denmark	1	0.31%
Norway	1	0.31%
Portugal	1	0.31%
Sweden	1	0.31%
Uganda	1	0.31%

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