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Who monitors TRIPS?

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Gaétan de Rassenfosse, Paul Jensen, T'Mir Julius, Alfons Palangkaraya and Elizabeth Webster

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Gaétan de Rassenfosse
Ecole polytechnique fédérale de Lausanne, Lausanne, Switzerland
gaetan.derassenfosse@epfl.ch

Paul Jensen
The University of Melbourne, Melbourne, Australia
pjensen@unimelb.edu.au

T'Mir Julius
Bureau of Meteorology, Australia
tdjempire@gmail.com

Alfons Palangkaraya
Swinburne University of Technology, Melbourne, Australia
apalangkaraya@swin.edu.au

Elizabeth Webster
Swinburne University of Technology, Melbourne, Australia
emwebster@swin.edu.au

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Abstract

The TRIPS agreement, administered by the World Trade Organisation, ensures the smooth functioning of the international patent system. It guarantees among others that local and foreign firms are treated in the same, non-discriminatory manner. We test for whether national treatment has been upheld in the five largest patent offices and document the existence of a local-inventor bias in patent examination decisions. Furthermore, we find that filing patent applications through the PCT route, which was introduced with a view of harmonizing and facilitating the international patenting process, further exacerbates this bias.

JEL Codes: O34, F13, F23, K2, K4

Keywords: appropriation; discrimination; global patent system; national treatment

1. Introduction

Supra-national treaties, covering ethical (health and human rights) and trans-border (environmental, business, transport and weapons) issues have flourished since World War II. The World Trade Organization (WTO), which evolved from the 1948 General Agreement on Tariffs and Trade, is one of the most prominent examples of supra-national organizations. It seeks to regulate, and enhance, international trade.

The Trade-Related aspects of Intellectual Property rights (TRIPS) agreement is a legal agreement between all the member nations of the WTO. It was established in 1995 in recognition that, as ideas are global public goods, they demand a global solution. It is backed by the WTO's powerful dispute resolution procedures.[1] A key part of this agreement is Article 3.1, the 'national treatment principle', which states that foreigners should be treated in the same, *non-discriminatory* manner as locals. The national treatment principle was already included in the 1883 Paris Convention for the Protection of Industrial Property. Its intention is to minimise international free-riding on R&D so that nations pay dues for the use of knowledge created and developed by residents of other countries. The national treatment principle is relevant in many trade-related policy domains, but one obvious area relates to patent examinations where national patent offices make determinations about whether specific local and foreign technologies are patentable or not.

As important as they are, the impact of trade agreements will be limited if they are not appropriately monitored and enforced. Given its influence in shaping the increasingly-global

[1] Common to other quasi-judicial decisions, patent granting is a jurisdiction-by-jurisdiction decision—typically a nation. To date, the international patent system operates as a loose federation of national patent offices that make quasi-independent decisions about the patentability of a specific invention based on its novelty, non-obviousness and usefulness.

innovation value chain, it is important that the national treatment principle be properly monitored and enforced. Failure to do so will weaken R&D investment incentives and inhibit international trade flows. At present, we see no credible evidence of a commitment by the WTO to regularly monitor and enforce the national treatment principle as it relates to international patent examinations. As with most forms of discrimination, monitoring necessitates statistical investigation. Agreements that stipulate forbidden behaviours such as weapons or trade treaties, need only hear about single cases of non-compliance to detect a breach. But this method cannot detect prejudicial behaviours such as bias. Instead, a statistical approach is required.

In this paper, we estimate whether there exists a statistical bias against foreign patent applicants in the five major patenting offices—the United States Patent and Trademark Office (USPTO), the Japanese Patent Office (JPO), the European Patent Office (EPO), the State Intellectual Property Office of the People's Republic of China (SIPO) and the Korean IP Office (KIPO)—collectively known as IP5 offices. Together, these offices account for about 80 per cent of worldwide patenting activity.

Our results confirm the presence of a bias against foreign firms in all five patent offices once invention quality is considered. Furthermore, local applicants that use the PCT route receive a disproportionately greater advantage than applicants that go through the traditional Paris route.

2. Background

Patents exist to provide incentives for non-rivalrous and (largely) non-excludable 'creations of the mind'. Although patent rights are territorial, the intent of patent laws is the same across developed countries—an invention must be new-to-the-world, non-obvious and useful to deserve patent protection.

If patents are 'unjustly' refused, the global incentive to invest in inventive activities for that business will be muted (Scotchmer 2004). Investors have shouldered the upfront costs of invention and if they only receive fragmentary patent protection across the world, then they must re-coup returns over a narrower set of (patented) markets than would otherwise have been the case. Over and above the incentive-dampening effects of free riding, there is increasing concern that discrimination against foreigners in the patent system could act as a 'behind the border' barrier to trade hurting both consumers and firms alike (Wineberg 1988; Lee 2007; Kotabe 1992; Linck and McGarry 1993; Maskus and Penubarti 1995; Smith 1999). Although the exact mechanism through which discrimination occurs is not established, there is some emerging evidence that discriminatory patent refusals do result in lower imports of high-tech goods into that country (Palangkaraya et al. 2017). Behind-the-border barriers can be especially damaging for smaller multinationals for whom breaking into global value chains is the main source of growth.

In a bid to both reduce the cost and unpredictability of the examination decision across national offices, it has become increasingly common for patent offices to share information on applications. The Patent Cooperation Treaty (PCT), introduced in 1970, provides a multi-office application process (150 offices as of January 2018) with a common international search report. Furthermore, the Global Patent Prosecution Highway, established in 2008, encourages work and information sharing between offices. Nevertheless, despite these measures and the increasing alignment of national patent laws (Lerner 2002), patent offices still make different decisions about the patentability of a specific invention. In our sample of patent applications, we find that only two-thirds of applications that have been submitted to all five IP5 offices in the period from 2000 to 2006 end up with the same outcome.

Differences in outcomes between offices might legitimately occur because of different definitions of patentable subject matter (for example, not all offices agree on whether software and business methods should be patented); because of variations in procedural matters or protocols; because offices have higher or lower standards of what determines an 'inventive step' worthy of patent protection; or for a range of other factors. However, to comply with the national treatment principle, there should be no systematic difference in the examination outcome between foreign and local applicants, once the quality (basically the non-obviousness) of the invention is taken into account. Simple comparisons of grant rates in each office by nationality of the applicant or inventor do not reveal discrimination against (or in favour of) foreigners, as it is reasonable to suppose that invention quality can vary by national source.

3. Empirical Strategy

One way to analyse the enforcement of the national treatment principle in a given office would be to develop a detailed model of the patent examination process. This approach would enable identification of whether there is a statistical bias, and possibly the cause(s) of any such bias, but it would require detailed information on the skills of the patent examiner (for example, whether she had a PhD or not), the resources dedicated to patent examination (for example, number of hours per examination) and a range of other factors (for example, difference in office protocols). Given that much of this variation is largely unobserved, we adopt a simpler approach. We test for the presence of a statistical bias in patent examination decisions by studying differences in examination outcomes for the same invention across multiple offices—thereby explicitly controlling for the quality of the underlying invention. For that purpose, we need to construct a sample of equivalent patent applications.

3.1 A Sample of Equivalent Patent Applications

The application (that is, invention) quality is proxied by the estimated fixed effects obtained from a panel data regression on a set of equivalent patent applications filed at offices other than the focal office. Our set of equivalent applications relate to the same underlying invention (i) that has been submitted to multiple international patent offices (h) during 2000 to 2006. The notion of 'equivalence' is crucial to our analysis. We define equivalent applications as patent applications that protect the same invention in *at least one other* jurisdiction, namely 'twin' applications. (Note that since we are compiling data from five patent offices, the dataset will include twins, triplets, quadruplets and quintuplets—thus we have an unbalanced panel.) More precisely, equivalent applications are patent applications that claim a one-to-one priority link with a focal priority filing (PF). For example, patent applications US-PF-1 at the USPTO and CN-SF-2 at the SIPO are equivalent if the US priority filing US-PF-1 is claimed only by the second filing CN-SF-2 in China and if CN-SF-2 claims US-PF-1 as sole priority filing (where SF is second filing). This definition of equivalent applications excludes applications citing multiple priority filings and applications cited as priority filing by multiple patent applications in the same jurisdiction. This restriction ensures that the proxy for invention quality is valid since it is derived from true 'twin' applications.

In all instances where i) a priority filing is split into several second filings in the same office; and ii) two priority filings are combined into one second filing, the set of observations is removed from the analysis since it does not pass our definition of equivalence. Although the decision to drop these observations comes at a cost (owing to the possible selection bias introduced), the substantial benefits of having a clean set of patent equivalents examined in multiple patent offices probably outweighs the costs.[2]

3.2 Econometric Model

To control for invention quality and differences in office patentability thresholds, we use a fixed-effects regression model (recall that all applications are from families of at least two members). We employ a reduced-form model of the patent examination decision. Accordingly, we say that the probability of granting (y^*) patent application for invention i by patent office h is a function of the unobserved quality of the underlying invention (α) and office-specific effects. The latter is captured by whether or not one of the applicants reside in the same jurisdiction as the patent office (n), the size of the inventive step demanded by the office (o), and other unobserved factors that we assume to be random and independently and identically distributed (ε).[3] Formally, the model is:

$$y_{ih}^* = f(\alpha_i + [n_{ih}, o_h]'\beta) + \varepsilon_{ih} \qquad (1)$$

And y_{ij} is the binary observed outcome of the patent examination

[2] However, we note that it is hard to say anything meaningful about the extent of this potential selection bias since it is so difficult to compare examination outcomes across offices once you include applications without this one-to-one equivalence.

[3] Note that the office effect (o) captures more than the inventive step threshold. It captures all unobserved factors that vary systematically across offices.

$$y_{ih} = \begin{cases} 1 \text{ if } y_{ih}^{*} > 0 \text{ (application is granted)} \\ 0 \text{ if } y_{ih}^{*} \leq 0 \text{ (application is refused or withdrawn)} \end{cases}$$

Note that our research design favours breadth over depth. The model allows us to study discrimination in five patent offices and is, therefore, very parsimonious. However, it does not allow us to investigate the sources of a potential bias. An alternative approach would have been to focus on a single patent office and collect a large number of variables related to the patent prosecution process and the various stakeholders (applicants, examiners, attorneys).

4. Data and Descriptive Statistics

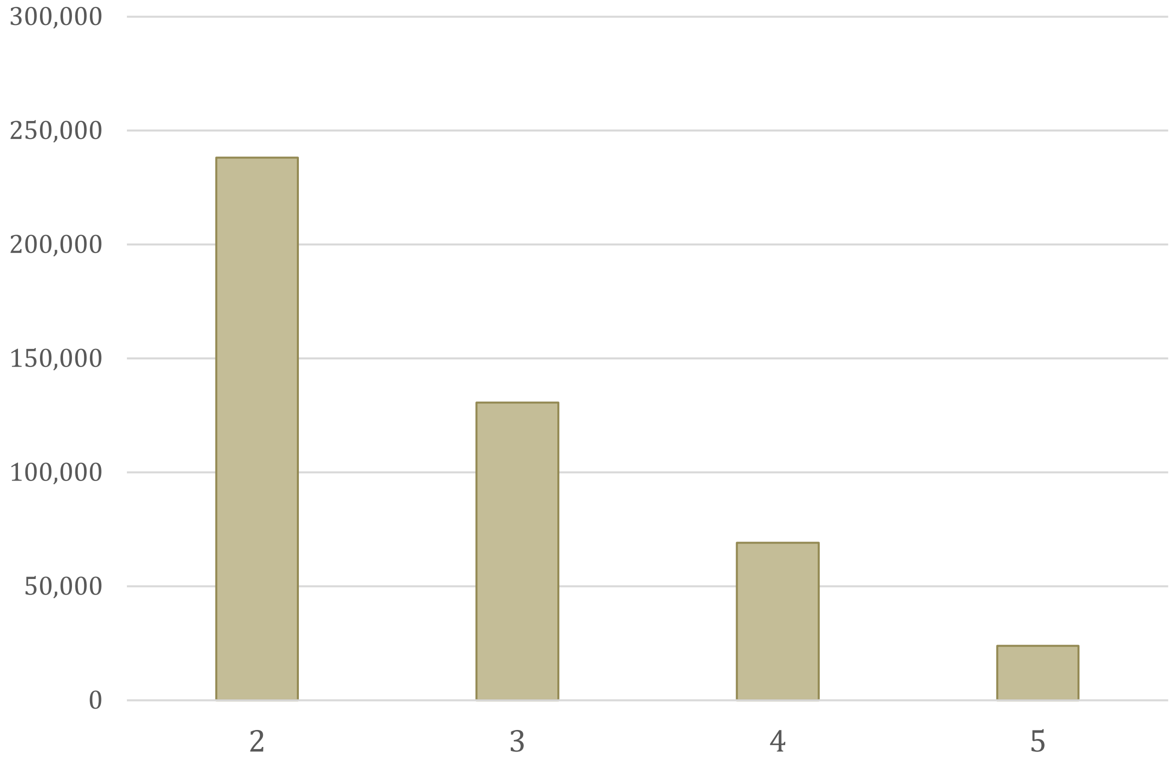
4.1 Data Sources

The dataset is assembled from four main sources. The main data source is the EPO Worldwide Patent Statistical database PATSTAT. The database contains bibliographical and legal status patent data from leading industrialised and developing countries. We extract from PATSTAT information on priority filings and their equivalent(s) and inventor/applicant country of residence. We use the EPO's INPADOC PRS table for PATSTAT to obtain legal status for China and the EPO. We probed the JPO's public access on-line Industrial Property Digital Library Database to recover the legal status for Japan. We crawled the KIPO's public access on-line IPR Information Service to recover the legal status for Korea. Finally, we recovered the USPTO legal status data from the Public Pair on-line database.

The complete number of applications to these five offices during 2000–2006 is 1,931,041. If we exclude families with some pending or status missing members and families with only one member, we are left with 1,110,786 applications (426,335 families).[4]

From Figure 1, we can see that about 240,000 applications have equivalents in two of the five offices, whereas approximately 24,000 families have equivalents in all offices.

Figure 1. Number of patent families by size, filing years 2000–2006



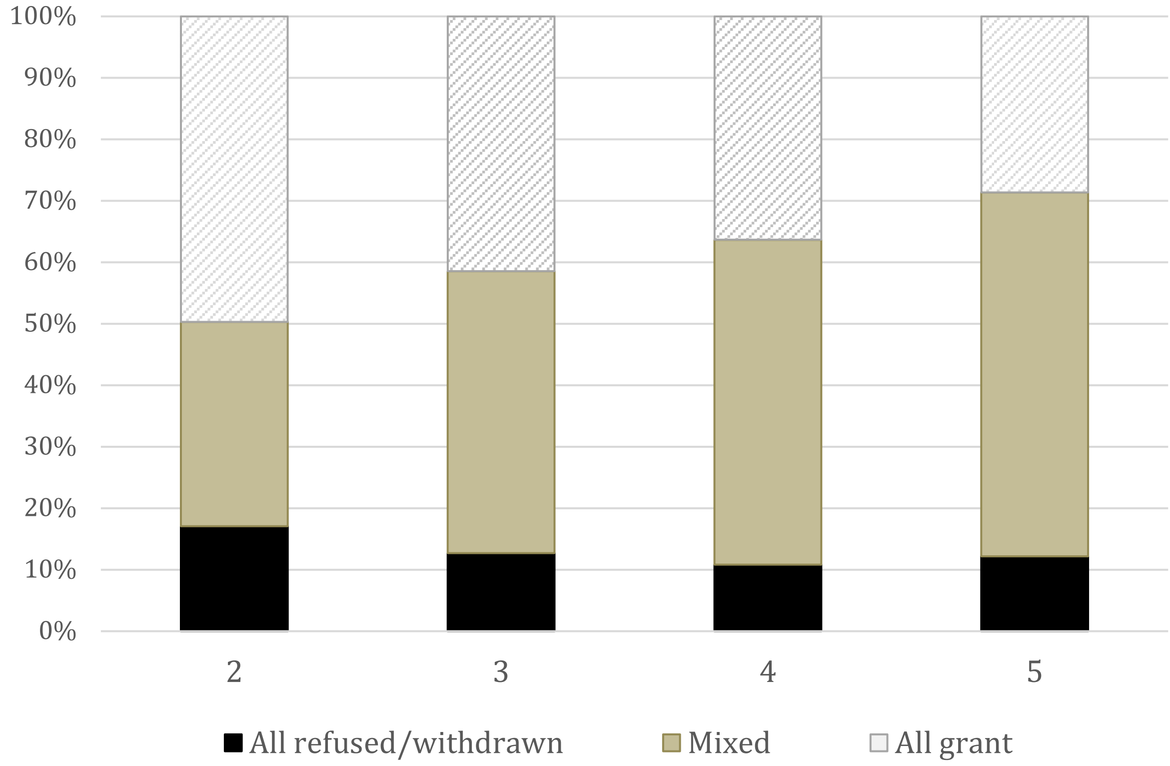
Note: We define equivalent applications as patent applications that protect the same invention in *at least one other* different jurisdiction where each secondary filing claims a one-to-one priority link with a focal priority filing. Excludes families with only one application. Includes all applications regardless of outcome (grant, refused, withdrawn or pending). See main text for additional details.

Figure 2 shows that 17 per cent of 'twin' families were refused/withdrawn in both offices, 50 per cent are granted in both offices and 33 per cent have a mixed grant outcome: they are

[4] Lazaridis and van Pottelsberghe (2007) have argued that applications to the EPO that were withdrawn after an 'X' or 'Y' citation should be regarded as 'quasi-refusals' as they were probably withdrawn in response to the negative feedback from the examiner.

granted in one office and refused/withdrawn in the other. The percentage of families with mixed grant outcome jumps to 59 for 'quintuplet' families.

Figure 2. Percentage distribution of application outcome by family size, filing years 2000–2006



Note: A family size of 'x' means that patent protection for an invention has been applied for in 'x' of the IP5 offices.

4.2 Variable Description

The dependent variable for equation 1 is a dummy variable that takes value 1 if the patent application was granted or 0 if it was refused, quasi-refused or withdrawn. The regression model includes four dummies for the office of application of the priority document as well as a dummy variable that takes value 1 if one of the applicants' addresses are local to the office and 0 otherwise. Locality is derived from the applicant's country of residence as listed in the patent document.

5. Results

Table 1 presents the results from estimating equation (1) using both the linear and logit functional forms in columns (1) and (2). The simulated marginal effects are presented in Table 2, columns (1) and (2). The estimates reveal that being a local applicant increased the probability of a grant by between 10.5 and 15.4 percentage points.[5]

The regression framework allows us to estimate the local applicant advantage for each patent office. The regression results when local applicant is interacted with the office of application are given in Table 1, columns (3) and (4). The associated simulated marginal effects are presented in Table 2, columns (3) and (4). The results show that the SIPO consistently has the smallest level of bias in favour of local applicants and the EPO and KIPO the highest. In fact, the SIPO shows no significant bias towards local applicants in the logit estimation.

Two remarks are in order. First, the absolute magnitude of the local applicant bias in an office must be contrasted with the overall grant rate in that office. To illustrate the point, consider the following two cases: (i) a very lax office that grants virtually all patent applications and for which the local inventor bias is a small one percentage point; corresponding for instance to a grant rate of 99% for locals and 98% for foreigners; and (ii) a stricter office for which the local inventor bias is 10 percentage points; corresponding for instance to a grant rate of 80% for locals and 70% for foreigners. In the former case, foreigners are twice as likely as locals to have their patent application refused whereas in the latter case they are only 50 per cent more likely than locals to be refused a patent. Comparing the magnitude of the office fixed

[5] In terms of the office effects on grant, the JPO has the most stringent test for a grant, followed by the EPO. The SIPO and the USPTO are similar and the least stringent.

effects with that of the interaction terms, we note that larger biases are found in offices that are also stricter (lower fixed effects).

Second, the number of observations differ between the OLS and the conditional logit estimates. This is due to the fact that only families with mixed grant outcomes are exploited in the logit model (as the fixed effect perfectly predicts outcome when there is no variation in outcome). This implies that estimated effects will be larger in the logit model because differences across offices are maximised. Thus, the coefficients are not directly comparable between the OLS and the logit models. What matters is the sign and the statistical significance of the local inventor bias.

Table 1: Determinants of a patent grant, 2001–2006, all families > 1 member, equation (1)

Explanatory variables	(1) OLS	(2) Logit	(3) OLS	(4) Logit
Application office[a]				
USPTO	0.135**	1.188**	0.169**	1.377**
	(0.001)	(0.011)	(0.002)	(0.015)
KIPO	0.068**	0.567**	0.070**	0.462**
	(0.001)	(0.014)	(0.002)	(0.017)
JPO	-0.088**	-0.610**	-0.063**	-0.302**
	(0.001)	(0.011)	(0.002)	(0.015)
SIPO	0.191**	2.290**	0.214**	2.468**
	(0.001)	(0.018)	(0.002)	(0.019)
Residence of application				
Local applicant	0.105**	0.815**		
	(0.001)	(0.008)		
Local applicant * EPO			0.155**	1.207**
			(0.002)	(0.021)
Local applicant * USPTO			0.056**	0.550**
			(0.002)	(0.021)
Local applicant * KIPO			0.158**	1.667**
			(0.002)	(0.026)
Local applicant * JPO			0.100**	0.458**
			(0.002)	(0.016)
Local applicant * SIPO			0.048**	0.067
			(0.006)	(0.081)
Estimation method	FE	FE	FE	FE
Observations	1,110,786	358,255	1,110,786	358,255
R-squared	0.106		0.108	
Number of patent families	426,335	132,463	426,335	132,463
Rho	0.361		0.360	

Note: [a] The reference office is always the EPO. Only includes patent families with at least two known grant or refuse decisions, and a known decision for all members. The OLS includes a constant. Standard errors in parentheses ** p<0.001, * p<0.00.

Table 2: Simulated marginal effects of being a local versus foreign, all families >1 member, all applications

	(1) OLS[a]	(2) Logit[b]	(3) OLS[c]	(3) Logit[d]
No interaction	0.105	0.154		
EPO			0.155	0.192
USPTO			0.056	0.098
KIPO			0.158	0.240
JPO			0.100	0.083
SIPO			0.048	0.013

Note: [n] not significant at the 5% level

Source: [a]Table 1, column 1. [b]Table 1, column 2. [c]Table 1, column 3, [d]Table 1, column 4.

We also estimate the degree of bias towards local applicants if at least one member of the family uses the PCT route, and the advantage by technology area.[6] These results are given in Table 3. The implied marginal effects, using both a linear and a logit model, are presented in Table 4. The result show that, far from reducing bias, applying through the PCT route enhances the advantage given to local applicants. Local applicants who applied through the PCT route were between 7.3 and 16.2 percentage points more likely to be awarded a patent. The advantage for local applicants also varied by technology area, being greatest in biotechnology and least for instruments.

[6] In our sample, 65.3 per cent of patent families have all applications via the Paris route, 10.4 are all via the PCT, and the remaining 24.4 per cent use a mixed route. If we model use of the PCT route as specific to each application outcome, the advantage given to local applicants via the PCT route is greater than the marginal effects given in Table 4. Results available from authors on request.

Table 3: Determinants of a patent grant, 2001–2006, all families > 1 member, by PCT and technology class status, equation (1)

VARIABLES	(1) OLS	(2) Logit	(3) OLS	(4) Logit
Application office[a]				
USPTO	0.138**	1.221**	0.137**	1.198**
	(0.001)	(0.011)	(0.001)	(0.011)
KIPO	0.082**	0.713**	0.071**	0.586**
	(0.001)	(0.014)	(0.001)	(0.014)
JPO	-0.073**	-0.462**	-0.085**	-0.588**
	(0.001)	(0.011)	(0.001)	(0.011)
SIPO	0.198**	2.371**	0.193**	2.311**
	(0.001)	(0.018)	(0.001)	(0.018)
Residence of application				
Local applicant	0.076**	0.519**	0.139**	1.128**
	(0.001)	(0.010)	(0.003)	(0.039)
Local applicant * PCT	0.073**	0.875**		
	(0.002)	(0.017)		
Local applicant * Biotechnology			0.054**	0.344**
			(0.009)	(0.089)
Local applicant * ICT			-0.039**	-0.254**
			(0.004)	(0.042)
Local applicant * Software			-0.002	0.065
			(0.003)	(0.032)
Local applicant * Electrical			-0.045**	-0.454**
			(0.004)	(0.042)
Local applicant * Instruments			-0.054**	-0.529**
			(0.004)	(0.043)
Local applicant * Chemicals & pharmaceuticals			0.001	0.050
			(0.004)	(0.049)
Local applicant * Process engineering			-0.021**	-0.152*
			(0.004)	(0.047)
Local applicant * Mechanical engineering			-0.031**	-0.389**
			(0.004)	(0.043)
Observations	1,110,786	358,255	1,110,754	358,243
R-squared	0.109		0.107	
Number of id	426,335	132,463	426,322	132,458
Rho	0.363		0.361	

Note: [a] The reference technology is 'other'. Only includes patent families with at least two known grant or refuse decisions, and a known decision for all members. The OLS includes a constant. Standard errors in parentheses ** p<0.001, * p<0.00.

Table 4: Simulated marginal effects of being a local versus foreign interacted with PCT status and technology area, all families >1 member

	(1) OLS[a]	(2) Logit[b]	(3) OLS[c]	(3) Logit[d]
Local applicant (no interaction)	0.076	0.096	0.139	0.212
Local applicant				
*PCT	0.073	0.162		
*Biotechnology			0.054	0.064
*ICT			-0.039	-0.048
*Software			-0.002	0.012
*Electrical			-0.045	-0.085
*Instruments			-0.054	-0.099
*Chemicals & pharmaceuticals			0.001	0.009
*Process engineering			-0.021	-0.028
*Mechanical engineering			-0.031	-0.073

Note: [n] not significant at the 5% level
Source: [a]Table 3, column 1. [b]Table 3, column 2. [c]Table 3, column 3, [d]Table 3, column 4.

6. Discussion

In an earlier study, we investigated the prevalence of statistical bias in international patent office examination outcomes and found evidence of its existence (Webster et al. 2015). In the present study, we confirmed the existence of local inventor bias in patent examination decisions using a more recent dataset and a broader cross section of countries. Coupled with previous work, this now suggests strong evidence for the conclusion that statistical bias against foreigners exists—that is, that the national treatment principle is not being upheld. This issue should be of serious concern for technology-focused multinational enterprises and the WTO. In this study, we also examined whether the PCT application route reduces this bias. The PCT was introduced with a view of harmonizing and facilitating the international patenting process. Yet, we found that it enhances the advantage given to local applicants.

The WTO is responsible upholding the Trade-Related Aspects of Intellectual Property Rights Agreement via a dedicated council. This council receives notifications in respect to national treatment but to date these appear to refer only to countries seeking exemptions.[7] There appears to be no regular monitoring, despite the evidence and data being available to support such evidence since the creation of the worldwide PATSTAT database in 2006. Although, all WTO members must also undergo periodic peer review of their trade policies and practices, the verification of national treatment in patent law has been consistently overlooked.

Patents are neither the beginning nor the end of innovation policy. Yet in some markets they matter. There is a slew of evidence, which shows that the legal right has an effect on commercial outcomes, over and above the technological merits of an invention.[8] If a case can be made for using governmental prerogative to establish and maintain a patent system, then it follows that it should operate in an efficient and non-discriminatory manner. As yet, we don't know the causes of the observed statistical bias, but it is important to note that we do not believe that any discrimination is explicit—rather it likely relates to some form of implicit discrimination as has been observed in other contexts (for example, Price and Wolfers 2010; Hamermesh and Biddle 1994).

[7] For example confirming '… that it will not apply the criterion of fixation referred to in Article 5, paragraph 1(b) of the Rome Convention as regards the protection of producers of phonograms'.

[8] Studies have recently revealed that firms with a granted patent (relative to applications that were refused) have higher: stock market capitalizations, and, for patent-assertion entities, litigation rates (Feng and Jaravel 2017); inventor tenure (Melero et al 2017); rates of progress to commercialization (Webster and Jensen 2011); and, for startups, employment and sales growth (Farre-Mensa et al 2017).

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