PATENT EXAMINATION DECISIONS AND STRATEGIC TRADE BEHAVIOR

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PATENT EXAMINATION DECISIONS AND STRATEGIC TRADE BEHAVIOR[1]

Abstract–This paper examines whether strategic trade behavior can explain the fact that the US, Japanese and European Patent Offices – the USPTO, the JPO and the EPO – often make different decisions about whether to grant (or reject) a given patent application. We analyse this issue by considering whether examination decisions across the patent offices vary systematically by inventor nationality, patent quality and technology area using a matched sample of 33,305 non-PCT patent applications granted by the USPTO and subjected to examination decisions at the EPO and the JPO.

JEL Classification: F13, O31, O34

I. Introduction

An invention needs to satisfy three criteria before its inventor(s) can be granted a patent: novelty, non-obviousness and utility. These criteria form the basis of the patenting threshold which is enshrined in the legislation of all nations which are signatories to the World Trade Organization's Trade-Related Aspects of Intellectual Property Matters (TRIPS). However, empirical and anecdotal evidence suggests that patent examination decisions may vary across patent offices (see Quillen and Webster, 2001).

Various institutional factors have been shown to affect patent examination decisions. Cockburn et al. (2002), for example, have shown that heterogeneous patent examiners have significant effects on the breadth of patents granted and that the incentives provided by the USPTO to patent examiners influence the patent examination decision. Moreover,

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resource allocation decisions – including how much time is allocated to search for prior art – may affect the quality of patent examination (Merrill et al., 2004). Patent examination decisions may also be influenced by strategic trade factors such as favouring local patent applications in areas of strong R&D activity (see Linck and McGarry, 1993).

In this article, we analyse whether patent examination decisions reflect such strategic trade behavior using a matched sample of 33,305 single, common priority non-PCT patents granted by the USPTO and subject to a final examination decision (i.e. grant/reject) by the EPO and the JPO.[2] These three patent offices – known as the trilateral patent offices – account for more than 90 per cent of the world's total patenting activity. By using a matched sample of single, common priority patent examination decisions, we effectively control for the quality of the invention.[3] Our empirical approach is similar to Graham et al. (2002) who use a matched sample of patents to investigate whether EPO opposition procedures affect patent quality.

We use this dataset to analyse how much disharmony exists across the trilateral patent offices in terms of their examination decisions. Of those patents granted by the USPTO where there is a final examination decision at the other offices, we find that the JPO and EPO reject 19.9 per cent and 3.2 per cent respectively. We then examine whether patent examination decisions vary systematically by nationality of the inventor, patent quality and Revealed Technological Advantage (RTA), which is an index of technological specialization in each country. The results suggest that both offices favour local applicants in technology areas where domestic patenting activity is strong.

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[2] Ideally, we would include applications (rather than grants) at the USPTO. However, for the period of the study, the USPTO only published information on granted applications.

[3] However, since there is interaction between the applicant and the patent office which we do not observe, it is possible that the *ex post* claims for a common priority patent granted in each office are different. Therefore, the patent examination decisions compared here may be for slightly different inventions.

II. Patent Examination Decisions

In theory, patents are granted because they satisfy a patent office's examination of their novelty, inventive step and industrial applicability. In a perfect world, this should produce the same decision in each office where examination was undertaken. However, in practice, patent offices differ in their patent examination protocols. At the USPTO, for example, every application filed is assumed to be a request for examination, whereas at the EPO and the JPO patent applications are only examined upon request. The EPO also has a well-developed system of post-grant oppositions, where objections to patent grant decisions can be raised, while the USPTO has an (infrequently used) system of patent re-examinations (Graham et al., 2002). Moreover, Lemley and Moore (2004) have argued that the USPTO's system of patent continuations makes it almost impossible for a patent examiner to ever outrightly reject an application, which provides a perverse incentive to grant persistent applicants.

The existence of these institutional effects raises the possibility that different patent offices will make different decisions about an invention's patentability i.e. a unique invention may be granted a patent in one jurisdiction but not another. There is limited evidence to suggest that international patent examination decisions differ (see Quillen and Webster, 2001).[4] The timing of the examination decision is also important since the lag between application and examination dates could be used for strategic reasons.[5] Regibeau and Rockett (2003), for example, provide a theoretical model demonstrating that administrative procedures – such as a patent examinations or new therapeutic drug

[4] However, this study only looks at aggregate patent statistics and therefore it is not possible to conclude that patent offices make different decisions regarding the same invention.
[5] Although they do not examine strategic behaviour, Popp, Kuhl and Johnson (2003) do find evidence that country effects are significant determinants of the lag in USPTO grant decisions.

approvals – can be used to enhance domestic policies by delaying decisions for foreign firms relative to their local counterparts. Empirical support for this is provided in Dranove and Metzler (1994), who find that there are significant differences in the speed-to-market for new product launches by foreign versus local pharmaceutical companies.

Although it is well-known that intellectual property rights affect trade flows between developed and developing nations (see Deardorff, 1992; McCalman, 2002; Grossman and Lai, 2004), much less is known about the effects of differences in patent regimes on trade between developed nations. Some have argued that the JPO uses patents as a non-tariff barrier by favoring local patent applicants over foreign applicants or by rejecting patent applications by foreign applicants in areas of strong local R&D (Wineberg, 1988; Linck and McGarry, 1993). However, the presence of such strategic trade behavior has not been verified in a systematic manner.

The economic effects of different patent examination decisions are profound since patents play a well-known role in inducing investment in inventive activity and affecting technology transfer. Patent examination decisions are also important indicators of patent quality: a patent which has undergone a rigorous examination is much more likely to be held valid if later challenged in court, thereby providing greater certainty for investment and reducing the effects of costly *ex post* dispute resolution proceedings (see Jensen and Webster, 2004). There is also increasing concern that lower patent examination standards, particularly in the US, have resulted in numerous “bad” (i.e. economically undesirable) patents (Farrell and Merges, 2004). This potentially has serious adverse effects for the rate of innovation since it may result in the creation of patent thickets (see Merges, 1999; Shapiro, 2004).

III. Data and Explanatory Variables

A. Dataset Construction

The data for this study were derived from four main sources:

(1) the OECD Triadic Patent Family (TPF) Database;[6]

(2) the EPO's public access online database (*esp@cenet*[7]);

(3) the JPO's public access online Industrial Property Digital Library (IPDL) databases (Patent & Utility Model Concordance, both English[8] and Japanese[9] versions, and the Japanese only database[10]; and

(4) the NBER Patent-Citations Data File (Hall et al., 2002).

The first database provides us with a list of triadic patent families defined as a set of patent applications for which the "priority application must have at least one equivalent patent at the EPO, at the USPTO, and at the JPO" (Dernis and Khan, 2004, p.11). To control for the individual invention, we only include patent families with a single priority application.[11] We constrained the dataset to include patent applications with priority years 1990-95 for two reasons. First, it enables us to minimise the amount of data truncation with regards to the examination decision, since this provides at least eight years to examine the priority application (the data was downloaded in late 2004). Second, it enables us to avoid problems associated with the effects of the introduction of the 1988 Japanese Patent Law reforms.[12] The second and third data sources provide information on the status of applications at the EPO and the JPO.

[6] http://www.oecd.org/LongAbstract/0,2546,en_2649_33703_30921914_1_1_1_1,00.html.
[7] http://ep.espacenet.com/search97cgi/s97_cgi.exe?Action=FormGen&Template=ep/EN/home.hts.
[8] http://www4.ipdl.ncipi.go.jp/Tokujitu/tjbansakuen.ipdl?N0000=116.
[9] http://www.ipdl.ncipi.go.jp/Tokujitu/tjbansaku.ipdl?N0000=110.
[10] http://www1.ipdl.ncipi.go.jp/SA1/sa_search.cgi?TYPE=000&sTime=1089941778920.
[11] For similar reasons, we also dropped any families involving continuation, continuation-in-parts, or divisional patent applications at the USPTO.
[12] See, for example, Sakakibara and Branstetter (2001).

Table 1 shows that the total number of patent applications filed in all three offices was 190,583. Eliminating PCT and multiple-priority applications leaves 70,473 applications, of which 33,305 received a final patent examination decision (i.e. grant or reject) by the end of 2004.[13] The remaining 37,168 applications were either still pending or had been withdrawn in at least one office.[14] For those applications where a final examination decision was made in both offices, there were differences in the decision lag (i.e. the length of time between application and examination) for foreign and local applicants. At the EPO, the mean decision lag was 4.48 years for local applicants and 4.96 years for foreign applicants (the two are statistically different). At the JPO, it was 6.49 years for local applicants and 8.01 years for foreign applicants (once again, the two are statistically different).

TABLE 1: SUMMARY OF COMPLETE PATENT APPLICATIONS IN THE TRILATERAL OFFICES, 1990-1995

Office of Application	Complete Patent Families 1990-1995
All USPTO applications	843,435
All EPO applications	433,186
All JPO applications	2,191,084
All Triadic Patent Families	190,583
• PCT families	18,488
• Non-PCT families	172,095
-single priority	70,473
(examination decision in all 3 offices)	*(33,305)*
-multiple priorities	101,622

[13] The exclusion of PCT applications may lead to a sample selection bias problem since it is probable that PCT applications are more valuable than non-PCT applications (applicants only select the PCT route if they intend to apply for patents in four or more countries. Given the substantial application costs involved, this suggests the inventions also have considerable commercial potential). However, only 10 per cent of patent applications in the time period studied here used the PCT route.

[14] The high proportion of withdrawn and pending applications is alarming given the length of time since the patent applications were made. It suggests that there is something else going on: perhaps applicants are intentionally dragging out the examination process. However, we do not explore this issue here.

We then match-merged the data for these 33,305 patent applications with the NBER patent database using the USPTO patent numbers (Hall, Jaffe, and Trajtenberg 2002). This enabled us to collect more data on each patent application; data which is not available in the triadic patent families database such as application years, number and country of inventors, priority countries, number of claims, technology category, and the number of citations received.

B. Explanatory Variables

In this section, we provide a summary of the explanatory variables used to examine whether patent examination decisions are influenced by strategic trade behavior.[15] To proxy for the quality of the patent application (over and above the fact that we are using a matched sample), we include as an independent variable the ratio of the number of citations received (i.e. forward citations) over the average number of citations received for that technology area, year and US inventor status (*Citation ratio*). Similar to academic citations, we postulate that people – applicants, patent attorneys and examiners – find it easier to cite the 'stand out' publications from the past, and these tend to represent papers with the greatest set of new ideas for the time.[16]

In order to determine the relative strength of a country in a specific technology area, a revealed technological advantage (RTA) index[17] was constructed for the period 1975 to

[15] Table A1 in the appendix summarizes the definition and values of the explanatory variables used.

[16] Other studies – such as Harhoff et al. (1999) and Lanjouw and Schankerman (2004) – have used patent citations in similar ways as a proxy for patent value. Our proxy is slightly different in that we control for the following: the fact that some technology areas make more citations; that US inventions tend to be more cited in the USPTO; and the possible truncation issues associated with the year of application. Not only is there a considerable dispersion in the number of citations received in each technology area in our database, but patents with US inventors are twice as likely to be cited in USPTO applications as other patents and the average number of citations declines with time. Thus, we control for truncation of patent citations, but in a different way to Hall, Jaffe and Trajtenberg (2005).

[17] Following Archibugi and Pianta (1992) and Huang and Miozzo (2004).

1999. This index is a ratio of the proportion of national patent grants from the USPTO in a technology area to the proportion of world grants in that technology area. This index, which is presented in Table A2, indicates that Europe had a revealed comparative advantage in material processing and pharmaceuticals and Japan had a revealed comparative advantage in optics and audiovisual technologies. We also constructed dummy variables – *Local inventor* and *Foreign inventor* – based on whether a local inventor was present or not.[18] Thus, the foreign inventor dummy variable represents any application that does not have at least one local applicant. *US inventor* was included to test for possible bias for (or against) US nationals.

To control for differences in prior information, we constructed three dummy variables: *Prior grant*, *Prior reject* and *Prior US grant*. The first dummy indicates if the application was granted by the other office at an earlier date. That is, when estimating the EPO decision, the "other office" is the JPO, and *vice versa*. The second variable is similarly defined, but in this case in terms of a rejection. These dummy variables enable us to test whether the knowledge about whether to grant (or reject) a patent application at one office influences the examination decision at another office. The last dummy variable indicates if the application was granted by the USPTO at a date earlier than the examination request dates at both the EPO and at the JPO.

To control for differences in applicant persistence, we used the number of past applications that the applicant had made to each patent office. This variable, *Past applications,* was derived from our dataset and thus only includes past non-PCT triadic applications from 1990-95. It will vary however by time, office and application. In addition, we include two trend variables, *Decision year* and *Application year*.

[18] Priority country and country of residence are highly correlated.

C. Descriptive Statistics

Table 2 presents data on the characteristics of the patent applications at the EPO and the JPO by examination decision and explanatory variable. The first observation is the level of disharmony across the two offices: overall, the JPO rejected 19.9 per cent of the applications in this dataset, while the EPO rejected 3.2 per cent.[19][20] There were, however, some consistent patterns across the two offices. In relative terms, for example, the rejection rates for patent applications without a local inventor (for both low and high RTAs), or with a US inventor, were higher in both offices. However, there is a stark difference in the magnitude of the effects across the two offices: the JPO rejected 22.6 per cent of the applications made with a US inventor, whereas the EPO rejected 5.7 per cent. At the EPO, applications with a local inventor had a rejection rate of 1.6 per cent compared with a rejection rate of 4.1 per cent for applications without a local inventor. At the JPO, local inventors had a rejection rate of 15.1 per cent compared with a non-local rejection rate of 22.8 per cent.

Information from a prior examination decision at another office had a mixed effect: information about a prior rejection was negatively related to the grant decision, but information about a prior grant was also negatively related. The number of past applications also little effect on the likelihood of being granted or rejected in either office: regardless of whether the number of past applications filed by the applicant was in the first or fourth quartile, the rejection rate ranged from 3.3 to 4.1 per cent in the EPO and from 20.7 to 20.8 per cent in the JPO.

[19] The observed level of disharmony has important implications for the debate about patent quality: it suggests that either the JPO is rejecting “good” patent applications (i.e. committing Type I errors) or that the EPO (and the USPTO) are granting “bad” patents (i.e. committing Type II errors). We explore this issue in the next section of the paper.

[20] Although we do not present the cross tabulation here, there are only 439 cases (or 1.32 per cent) where both the EPO and the JPO rejected patents granted by the USPTO.

TABLE 2: CHARACTERISTICS OF REJECTED PATENT APPLICATIONS, EPO AND JPO

Characteristic of application		EPO Percentage rejected	EPO Total number of examination decisions	JPO Percentage rejected	JPO Total number of examination decisions
Local inventor*low RTA	RTA<μ-σ	3.2	1,201	10.5	1,101
Foreign inventor*low RTA	RTA<μ-σ	4.8	5,345	21.0	3,015
Local inventor*high RTA	RTA>μ+σ	1.1	2,069	18.4	2,189
Foreign inventor*high RTA	RTA>μ+σ	4.3	1,973	28.4	2,217
Local inventor	yes	1.6	11,495	15.1	12,356
	no	4.1	21,810	22.8	20,949
US inventor	yes	5.7	8,786	22.6	23,986
	no	2.2	23,453	18.9	9,319
Prior grant	yes	2.9	246	27.7	11,613
	no	3.2	33,059	15.8	21,692
Prior reject	yes	8.3	60	49.3	203
	no	3.2	33,245	19.8	33,102
Prior grant in US	yes	4.6	8,833	22.5	22,297
	no	2.7	23,406	14.7	11,008
Local inventor*Citation ratio	1st quartile	1.5	2,879	15.7	3,092
Foreign inventor*Citation ratio	1st quartile	4.3	5,438	24.2	5,236
Local inventor*Citation ratio	4th quartile	1.7	2,874	13.1	3,084
Foreign inventor*Citation ratio	4th quartile	3.3	5,450	20.0	5,237
Past applications	1st quartile	3.3	8,258	20.7	8,258
	4th quartile	4.1	8,258	20.8	8,258
TOTAL		3.2	33,305	19.9	33,305

IV. Model and Estimation Results

In this paper, we argue that the decision to grant application *i* depends on the quality of the invention (q), strategic trade behavior (s), other influences (X) and a random error term (ε). Accordingly, if y is the examination decision:

$$y^* = f(q, s, X; \beta) + \varepsilon \quad (1)$$

$$y_i = \begin{cases} 1 \text{ if } y^* > 0 \text{ (application is granted)} \\ 0 \text{ if } y^* \leq 0 \text{ (application if rejected)} \end{cases}$$

where β is the associated vector of parameters to be estimated. Assuming $\Pr(y^*_i > 0 \mid q_i, s_i, X_i) = \left(\exp[q\, s\, X]_i\, \beta\right) / \left(1 + \exp[q\, s\, X]_i\, \beta\right)$, equation (1) can be estimated as a binary logit model (Greene, 2003).[21]

We estimated equation (1) separately for both the EPO and the JPO. Table 3 presents the estimated coefficients and marginal effects for each of the separate patent office equations. Using Harhoff et al.'s (1992) interpretation of forward citations as a proxy for patent value, our results show that patent value matters, especially in the JPO where both *Citation ratio* coefficients were positively related to the probability of a patent application being granted. The size of the effect at the JPO was greater for local inventors than for foreign inventors, suggesting that there is a systematic bias towards local inventors. However, the fact that invention value matters for both locals and foreigners suggests that the JPO does a good job in granting meritorious patent applications. The situation at the EPO is somewhat different. Although valuable patent applications from foreign inventors had a higher probability of patent grant, *ceteris paribus*, patent quality had no statistically significant effect on the probability of patent grant for local inventors.

This result has relevance for the debate about whether patent offices (particularly the USPTO) grant "bad" patents. Patent offices may be inclined to commit such Type II errors because of the revenue generated by patent applicant fees, or because they do not have adequate resources to examine the applications fully. On the other hand, patent offices may also have an incentive to commit a Type I error (i.e. reject a valuable patent application) since this enables local manufacturers and researchers to use important

[21] Equation (1) could also be estimated as a binary probit, as in Guellec and van Pottelsberghe (2000).

inventions in the domestic market without having to negotiate a license. If the citation ratio is a reasonable proxy for determining the minimum patentability threshold, our results imply that the JPO is not making Type I errors since patent granting decisions are strongly influenced by patent value. At the same time, it suggests that the EPO (and the USPTO) are possibly committing Type II errors since patent value is not an important determinant of patent granting decisions, particularly for local inventors.[22]

TABLE 3: COEFFICIENT ESTIMATES AND MARGINAL EFFECTS, EPO AND JPO, CROSS-SECTIONAL MODELS

Determinants	EPO Decision			JPO Decision		
	Coeff.	SE	dy/dx	Coeff.	SE	dy/dx
QUALITY						
Local inventor*Citation ratio	-0.038	0.051	-0.10	0.157***	0.024	2.34
Foreign inventor*Citation ratio	0.107***	0.034	0.27	0.092***	0.015	1.37
STRATEGIC TRADE						
Local inventor*RTA	0.906***	0.136	2.30	-0.092***	0.033	-1.38
Foreign inventor*RTA	0.197*	0.113	0.50	-0.320***	0.031	-4.79
US inventor	-0.665***	0.080	-1.96	-0.094***	0.036	-1.42
CONTROL VARIABLES						
Prior grant	0.645	0.392	1.22	-0.202***	0.039	-3.09
Prior reject	-0.532	0.476	-1.74	-1.174***	0.147	-23.65
Prior US grant	-0.045	0.078	-0.12	0.064	0.040	0.97
Past applications	-0.310***	0.080	-0.79	0.042	0.046	0.63
Decision year	0.136***	0.013	0.34	-0.194***	0.007	-2.91
Application year	-0.081***	0.022	-0.20	0.116***	0.010	1.74
Constant	2.210	0.170		3.334	0.079	
log(likelihood)	-4,489			-15,724		
pseudo-R^2	0.049			0.055		
Prob[Grant]	0.974			0.817		
sample size	33,305			33,305		

*** (significant at 1% level), ** (significant at 5% level), * (significant at 10% level)
Note: The base group consists of applications which have been granted at the USPTO at a date later than any substantive examination at the EPO or JPO.

The coefficients for the two interacted strategic trade effects highlight some interesting patterns across the two offices. At the EPO and the JPO, local inventors in a given technology area are *more* likely to be granted a patent than a foreign applicant, but

[22] A more exhaustive analysis of this issue – which is outside the scope of this study, but is the subject of current research –considers other ways to analyse this, such as whether those patent applications rejected by the JPO resulted in patent renewals in the other offices.

the effect is larger at the JPO, where the average difference between the marginal effects for local and foreign applicants is 3.41 percentage points. The two offices are also unanimous in their treatment of patent applications from US inventors: in both cases, *US inventor* is negative and statistically significant suggesting that both the EPO and the JPO are much less likely to grant an application from a US inventor (however, at 1.96 and 1.42 percentage points respectively, the effect is fairly modest in size).

With respect to the control variables, earlier decisions at other jurisdictions seem to be important mainly at the JPO. For example, on average, *Prior reject* in the JPO estimation is negative and significant, suggesting that applications which have been rejected at the EPO when the JPO begins its examination process have a much lower likelihood of being granted by the JPO. However, prior grants in the US have no significant effect on either of the other offices. And prior grants by the EPO have a negative effect on the probability of grant at the JPO, which seems somewhat counter-intuitive. *Past applications* was only significant at the EPO, but was negatively signed suggesting that applicant persistence does not have an effect on examination decisions.[23]

One of the strongest results is that both offices show clear preferences for local inventors relative to foreign inventors. To understand how these preferences vary across technology areas, we provide some results on the marginal advantage for local (vis-à-vis foreign) inventors by technology area in Table 4. This measure was constructed by taking the difference between the marginal effects on the interaction terms *Local inventor*RTA*

[23] To further test examine whether applicant behavior affects the examination decision, we estimated a fixed-effects model – not reported here – with the assignee as the fixed effect. We found that the fixed effects explained about half of the variation in the grant decision and that these fixed effects were correlated to the local and foreign inventor variables interacted with RTAs in a way which was consistent with the results in Table 3.

and *Foreign inventor*RTA* in each technology area in each office while holding the citation ratio, for local and foreign inventors, constant at the mean.

TABLE 4: MARGINAL ADVANTAGE FOR LOCAL INVENTORS IN TERMS OF THE PROBABILITY OF A GRANT, EPO AND JPO, BY TECHNOLOGY AREA

Technology Area (OST)	Marginal Advantage for Local Inventors			
	Japan		Europe	
	(%)	Ranking	(%)	Ranking
Optics	**8.9**	**1**	0.9	28
Audiovisual technology	8.7	2	1.0	29
Engines pump turbine	5.8	6	2.1	10
Semiconductors	7.5	3	0.9	30
Material processing	4.0	14	2.8	2
Materials metallurgy	4.9	8	2.2	7
Telecommunications	5.9	5.	1.4	25
Organic fine chemicals	3.5	21	**2.9**	**1**
Mechanical element	3.9	16	2.3	6
Macromolecular polymers	4.9	9	2.1	11
Surfaces coatings	5.1	7	1.7	21
Mechanical tool	3.7	17	2.2	8
Electrical devices	4.8	10	1.6	22
Transport	4.3	12	1.8	18
Nuclear engineering	3.7	20	2.4	5
Pharmaceuticals	3.1	24	2.7	3
Environment pollution	3.9	15	1.9	15
Miscellaneous unclassified	4.4	11	1.8	19
Basic chemical processes, petroleum	3.3	23	2.5	4
Handling printing	3.7	19	2.0	12
Analysis/measurement	4.2	13	1.7	20
General processes	3.0	26	2.1	9
Thermal techniques	3.4	22	1.8	16
Information technology	6.0	4	**0.9**	**31**
Agriculture food	3.0	25	1.9	14
Biotechnology	3.7	18	1.8	16
Civil engineering, building, mining	1.9	30	1.6	23
Consumer goods equipment	2.5	27	1.2	27
Agriculture food machinery	2.1	29	1.4	26
Space technology weapons	**1.3**	**31**	2.0	13
Medical engineering	2.4	28	1.4	24

Notes: OST is the Observatoire des Sciences et des Technologies patent catergorization system.

The advantage for local inventors in lowly-ranked RTAs was small (0.9 per cent for semiconductors and information technology in the EPO, and 1.3 per cent for space technology weapons in the JPO). However, it was much more substantial in the highest-ranked RTAs, particularly at the JPO. For example, local inventors with patent applications in the highest-ranked technological specialization area in Europe – organic fine chemicals – were 2.9 per cent more likely than foreigners to receive a grant, *ceteris paribus*, at the EPO. However, local inventors in highest-ranked technological specialization area in Japan – optics –received an 8.9 per cent advantage over non-locals at the JPO. Overall, this indicates that Japan is much more likely than Europe to give an advantage to local inventors in areas of importance to the domestic economy.

V. Conclusion

This papers looks at the whether national strategic trade factors are a determinant of patent examination decisions at the trilateral patent offices. The empirical model is estimated using a newly constructed data set of 33,305 non-PCT patent applications granted by the USPTO and subjected to final examination decisions at the EPO and the JPO. We then compare the pattern of examination decisions at the EPO and the JPO across inventor nationality, area of technological specialization and patent value.

This study makes a number of important contributions to the literature. First, it provides new evidence on the level of disharmony in international patent office examination decisions. Prior to this study, little attempt has been made to explain the existence of the observed cross-country/region variations in patent examination decisions while controlling for the objective quality of the underlying invention (see Lerner 2002). This is rather surprising given the importance of the patent examination decision on the *ex ante* investment decision and the recent debate on international harmonization of patent policy. The results also suggest that – despite the fact that the JPO rejects a lot more patent applications than the EPO – it consistently grants patents which have economic value.

Second, we examine the pattern of examination decisions across technology areas. We find strong evidence that examination decisions at both the EPO and the JPO do depend on strategic trade factors. While both offices give preferential treatment to local inventors, *ceteris paribus*, the advantage is greatest for applications in their strongest areas of technological specialization, especially in Japan. The converse of this is that it is harder for foreign applicants to get a patent in each jurisdiction's dominant R&D areas. Such discrimination provides assistance to local researchers and manufacturers since they are able to use these inventions without licensing from the patent owners.

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APPENDIX

TABLE A1: EXPLANATORY VARIABLE DEFINITIONS

Variable	Definition
Granted	$\begin{cases} 1 \text{ if the EPO (JPO) grant date is filled (or later than reject date)} \\ 0 \text{ if the EPO (JPO) reject date is filled (or earlier than grant date)} \end{cases}$
Prior grant	$\begin{cases} 1 \text{ if the EPO (JPO) grant date} < \text{the JPO (EPO) exam request date} \\ 0 \text{ otherwise} \end{cases}$
Prior reject	$\begin{cases} 1 \text{ if the EPO (JPO) reject date} < \text{the JPO (EPO) exam request date} \\ 0 \text{ otherwise} \end{cases}$
US inventor	$\begin{cases} 1 \text{ if any inventor's address is in the US} \\ 0 \text{ otherwise} \end{cases}$
Past applications	Number of past applications (/1000) made by an assignee at each patent office
Prior US grant	$\begin{cases} 1 \text{ if the US grant date} < \text{EPO (JPO) exam request date} \\ 0 \text{ otherwise} \end{cases}$
Citation ratio	Citations received for each application/average citations made at the USPTO in the relevant technology, year and US inventor status category
Local inventor	$\begin{cases} 1 \text{ if any inventor's country of residence is an EPO member state (Japan)} \\ 0 \text{ otherwise} \end{cases}$
Foreign inventor	$\begin{cases} 1 \text{ if an application has no local inventors} \\ 0 \text{ otherwise} \end{cases}$
Decision year	The year of the decision (grant/reject) at the EPO (JPO), 1990=1
Application year	The year of the filing of the application at the EPO (JPO), 1990=1

TABLE A2: TECHNOLOGICAL SPECIALIZATION IN THE US, JAPAN AND EUROPE, 1975-99

Technology area (OST)	US (RTA)	Japan (RTA)	Europe (RTA)
Optics	0.710	**2.303**	0.667
Audiovisual technology	0.742	2.250	0.554
Engines pump turbine	0.812	1.395	1.168
Semiconductors	0.819	1.910	0.480
Material processing	0.835	0.893	1.575
Materials metallurgy	0.848	1.155	1.247
Telecommunications	0.926	1.450	0.769
Organic fine chemicals	0.934	0.746	**1.601**
Mechanical element	0.950	0.842	1.267
Macromolecular polymers	0.964	1.138	1.157
Surfaces coatings	0.977	1.192	0.961
Mechanical tool	0.979	0.800	1.197
Electrical devices	0.982	1.126	0.904
Transport	0.985	0.977	1.004
Nuclear engineering	0.990	0.786	1.338
Pharmaceuticals	1.004	0.627	1.487
Environment pollution	1.011	0.852	1.045
Miscellaneous unclassified	1.017	0.983	0.995
Basic chemical processes, petroleum	1.020	0.671	1.382
Handling printing	1.023	0.788	1.117
Analysis/measurement	1.044	0.934	0.967
General processes	1.058	0.585	1.185
Thermal techniques	1.062	0.698	1.012
Information technology	1.064	1.473	**0.475**
Agriculture food	1.126	0.590	1.073
Biotechnology	1.138	0.797	1.012
Civil engineering, building, mining	1.203	0.271	0.903
Consumer goods equipment	1.229	0.446	0.681
Agriculture food machinery	1.241	0.327	0.756
Space technology weapons	1.251	**0.095**	1.112
Medical engineering	1.298	0.398	0.777

Notes: RTA is the number of country applications to the USPTO in each OST technology area as a proportion of the total number of country applications to the USPTO expressed as a ratio of all applications to the USPTO in each OST technology are as a proportion of all applications to the USPTO.
Source: NBER database.