International Spillovers between Patent Examination Results: Evidence from Triadic X/Y Citations[*]

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This study detects and measures the influence (spillover) of patent examinations from Europe to the U.S., by way of comparing examiner patent citations that constitute the reason for refusal. Among patent examination standards, novelty and inventive step are very close in all three regions of Europe, the U.S., and Japan. This paper offers preliminary analysis on coincidences between "rejection citations" (i.e., those cited as grounds for rejections) added by the United States Patent and Trademark Office (USPTO) and "X/Y patent citations," which are also added as grounds for rejections at the European Patent Office (EPO) within the same patent family, based on more than forty thousand families of triadic application sample. We consider the timing of release of European search reports and the timing of rejection actions by the USPTO for the same family of patent applications. We find that the frequency of rejection (X/Y-equivalent) citation coincidences between the USPTO and the EPO generally increase after the release of European search reports. This suggests that the U.S. examiners capture spillovers of search efforts from the EPO; that is, the USPTO examiners rely on prior art information collected and disclosed by the EPO.

I. Background and research question

When a family of international patent applications is examined in many jurisdictions, a series of prior art search for the same invention is conducted separately by different patent offices in each jurisdiction. As a result, separate citations are added to the same family of patent applications across patent offices. As Wada (2018) has revealed, patent examiners at the trilateral offices of the EPO, the USPTO, and the Japan Patent Office (JPO) tend to cite different prior arts to reject applications in the same patent families, despite the fact that the general patentability criteria of novelty and inventive step are close together. On the other hand, examiners can refer to the results of search outcomes conducted at other offices, conditional on its availability. Thus, there are opportunities for examiners to utilize the same prior art, if prior search outcomes become available for them. We can

[*] This is a summary of the report published under the 2019 Collaborative Research Project on Harmonization of Industrial Property Right Systems under a commission from the Japan Patent Office.
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call this examination spillovers between patent offices.

There is very limited existing knowledge on how examiners in a patent office rely on prior citations generated by other offices. This paper proposes to track examiner citations, especially those for rejections, across patent offices. Generally, we can evaluate whether an examiner of one office utilizes the same prior art as another for rejecting the same patent application. When the same patent citation is employed sequentially at different patent offices, we can utilize the information to infer that there are spillovers between patent examination results. I first summarize coincidences of X/Y citations at the aggregate level. Then, those patent family citations added by the USPTO for the purpose of rejection (i.e., rejection patent citations, or X/Y equivalents) are examined at the citation level. We examine whether each U.S. rejection citation coincides with X/Y cited families given by European search reports (ESRs) for the same citing patent family, with special attention paid to the timing of European search reports and office actions by the USPTO, along with several control variables. By way of comparing USPTO rejection citations (at the level of international family-to-family citations) with prior art search results conducted by the EPO before and after the release of the ESRs, we can first make a reasonable inference concerning the existence of search result spillovers from the EPO to the USPTO, leading to convergent citations.

II. Prior studies

While patent citations have been widely employed as research tools, the varieties within patent citations, such as applicant citations and examiner citations, have also recently been studied. One of the recent research frontiers is the distinction within examiner citations. While examiner citations are considered to be noisy as a means for measuring knowledge flow between inventors, examiner citations have been shown to have an advantage over inventor citations for measuring the value of patents (Hegde and Sampat 2009). Recently, examiner citation as a basis of rejection have been gaining attention as an even better indicator of patent values (Cotropia and Schwartz 2018).

U.S. examiners should indicate specific prior art on which they rely as reasons for rejection, in particular for “102” novelty rejections and “103” obviousness rejections. That is, they must clearly show the reasons for an applicant’s rejection if it is attributable to prior art. At the USPTO, Section 706 “Rejection of Claims” of the Manual of Patent Examining Procedure (MPEP) states that “In rejecting claims for want of novelty or for obviousness, the examiner must cite the best references at his or her command.” There is no official name for this category of citations, but a recent work (Cotropia and Schwartz, 2018) calls it a “rejection citation” or “rejection patent” if a corresponding prior art is a patent. This data has been made available and is drawing attention by the recently released office action database of the USPTO (Lu et al., 2017). However, to the best knowledge of

the author, there has been no previous work which tries to combine examiner patent citation data across different jurisdictions, except the abovementioned article (Wada 2018).

III. Examination spillover: overview in the aggregate

This study takes advantage of a novel large-scale dataset of U.S. rejection patents obtained from rejection documents available as file wrappers on the "Public PAIR" database of the USPTO to compare patent citations employed by examiners as specific reasons for rejection. In other words, by way of approximating citation categories of X/Y for the USPTO, we are now able to measure the convergence and divergence of individual rejection reasons used by the two patent offices through family-to-family citations. Combined with the U.S. rejection patent database, the EPO PATSTAT database (Spring 2016 and Fall 2019) and EPO DOCDB (Backfile 2017 January version) have been used.

The domain of statistical analysis is the set of X/Y citations and equivalents for triadic applications through PCT and non-PCT applications. Triadic patent applications are defined here as EPO DOCDB families that contain all of the EPO, USPTO, and JPO applications recorded in the EPO's PATSTAT database. The citations concern an EPO DOCDB family where only a single DOCDB family ID is observed and where X/Y citations (and equivalents) are added by all of the trilateral offices, representing a "twin applications approach." The primary domain of the study is comprised of 301,186 family citations recorded as X/Y equivalents at the USPTO, found for 43,207 cited triadic families that have single DOCDB family IDs and priority years 2003–2010.

A simple aggregate measurement for a particular citing family is the "*EPO–USPTO family-to-family rejection citation coincidence ratio*," i.e., the ratio of coincidence of X/Y citations by the European search reports over all rejection (i.e., X/Y-equivalent) citations added by the USPTO to the same citing family. To obtain this "EPO–USPTO rejection family-to-family citation coincidence ratio" for an application, we first list X/Y-equivalent U.S. rejection citations added to the application in chronological order during its prosecution history. The number of repeated rejections in its prosecution history at the USPTO is also recorded. The same patent citation is often used repeatedly in the same prosecution history at the USPTO, so there can be multiple records of the same citation pair with different U.S. office action timing. We take the number of all these X/Y-equivalent U.S. examiner citations for the application as the denominator of the ratio for the family of the application. For each U.S. citation, we obtain a citation mapped onto a DOCDB citation pair from the PATSTAT data. We obtain a dichotomy on whether a citation is also coded as X/Y category at the EPO within the same family-to-family citation. When the European search report records the citation as X/Y, we define the citation as a coincidental X/Y EPO citation pair with the USPTO X/Y equivalent. Then,

we take the number of all coincidental X/Y EPO search report citations for the citing family as the numerator of the ratio.

The ratio equals one if all of the X/Y-equivalent citations at the USPTO are also coded as X/Y at the EPO in the same family. The ratio is zero if none of the X/Y equivalents at the USPTO for an application are recognized as X/Y by the European search report. In summary, this measurement indicates the proximity of a set of rejection citations employed by the USPTO to those X/Y citations indicated by the EPO, in terms of a single family. A figure shows the averages of the citation coincidence ratio over different sets of the sample, comprised of triadic applications with priority in the EPC countries, those with priority in Japan, and those with priority in the U.S. (i.e., geographical sources of applications from each of the trilateral offices). Each ratio is calculated according to two stages of U.S. citation timing: pre-ESR and post-ESR. As is evident from the figure, the ratio increases after the release of European search reports, although the effect is not very obvious for applications from the U.S. A simple interpretation of this would be that the U.S. examiners take advantage of the outcomes of European search reports, especially if an application is first made outside the U.S.

IV. Examination spillover at the level of family-to-family citation

To obtain more micro-level insights, we next focus on the dichotomy describing whether or not a U.S. X/Y-equivalent is coded as belonging to the X/Y category at the EPO as well. By taking this dichotomy as a dependent variable in logit regression, we can analyze correlating factors and their signs. The unit of analysis is a family-to-family citation given at the USPTO as an X/Y equivalent, with office action sequence data and other application-level attributes as explanatory variables. Specifically, let us define yi as a dichotomy taking a value of one when a family of rejection citation by the USPTO examiners to a triadic application family i coincides with a family of X/Y citation added by the EPO search report. Then, the following model can be estimated assuming that the function F() is a logistic cumulative distribution function. Vectors of explanatory variables are represented by Xj and β is a coefficient vector such as: $\Pr(yi=1)=F(Xj\beta)$.

We focus on key explanatory variables to analyze convergence and divergence of X/Y citations. One variable is another dichotomy, US_action_after_EP_SEA_date. It takes a value of one when a U.S. rejection citation was given at the USPTO after the release of the European search report (abbreviated as “EP SEA” on PATSTAT) for its EP family member application. Because of a “search result spillover” effect, we predicted that the coefficient would be positive. Along with this “before ESR” and “post ESR” distinction, we also employ another variable of the number of rejection actions at the USPTO. This measures the total number of U.S. rejections for a particular rejection citation

within a prosecution history. Spillover from the EPO search report to the USPTO, if any, should occur only once in a prosecution, since typically one European search report is issued for an application. In contrast, rejection reasons could drift through exchanges of actions (e.g., amendments as responses to past rejections), especially at the USPTO. To incorporate these processes, we employ another key explanatory variable, US_rejection_counts, which is the number of rejections (non-final and final) in a USPTO prosecution history. Because longer exchanges of rejections and responses mean evolution of bargaining issues in a prosecution, we expect the coefficient for this variable to be negative. In order to further incorporate longitudinal effect, we also employ "us_action_lag_from_appyear" which means the lag in years between the filing year and the office action year. We also predict the coefficient to be negative.

We employ a number of control variables. When an application in a sample is a PCT application and its International Search Authority (ISA) is the EPO, we give a value of one for a dummy variable ISA_EP, which means that a family has the EPO as its ISA. The PCT requires that a PCT application should be given an international search report prepared by a patent office. Approximately half of PCT applications from the U.S. choose the EPO as their ISA, whereas most PCT applications from Japan rely on the Japan Patent Office for their ISA, and European applicants are required by rule to ask for search reports from the EPO only. In any case, European search reports are issued for all triadic applications, but their issuance timing tends to become late when an international search report is already issued by another (non-EPO) ISA, and subsequently European search report is issued as supplementary search report. In order to control for the timing difference of search reports, this dummy variable ISA_EP is added. Within PCT applications, a dichotomy isr_cited_dummy is added as indicating that a citation is also listed in international search reports (ISRs). At the EPO, ESR is the ISR for PCT applications, so this variable contains a multicollinearity problem with the dependent variable if the domain is limited to the cases where ISRs are ESRs.

The location dummies for the first priority country, first_EP, first_US, and first_JP, are employed in the full sample estimation. We also controlled for priority years (2003–2010) and the World Intellectual Property Organization (WIPO) 35 technology fields (WIPO 2017) of each family. The variable techn_field_nr_counts is the number of WIPO technology fields covered by the family, representing the breadth of the technology.

We mostly run logit estimations on the full sample as well as on a sub-sample of applications from the EPC countries, Japan, and the U.S.

From the estimation results, EPO–USPTO family-to-family rejection citation coincidences are consistently more likely to occur after a release of a European search report. That is, we observe positive and significant coefficients for the explanatory variable, US_action_after_EP_SEA_date, indicating the convergence of U.S. rejection citations to EPO X/Y citations after the release of

European search reports.

The coefficients for us_rejection_counts are consistent throughout the results, being negative and significant. As predicted, U.S. examiners employ different rejection reasons from those used by the EPO on average, as prosecution takes longer. Therefore, we observe that the longer pendency results in divergence of U.S. rejection citations from EP X/Y citations. The additional pendency variable "us_action_lag_from_appyear" is also negative and significant for full sample, but not always significant for subsamples.

The coefficient for the dummy isr_cited_dummy is consistently positive and significant, and its coefficient value is very high compared to other variables. When an ISR is issued, patent offices can easily have access. Therefore, the coincidence is a necessary outcome. Put differently, even after controlling for this ISR effect, US_action_after_EP_SEA_date has a positive and significant sign, suggesting a stable spillover effect from the EPO to the USPTO.

The location dummies for the first priority country show that applications from the U.S. have lower coincidence ratios on average. With respect to technological fields, we do not observe consistent patterns. The technological breadth variable techn_field_nr_counts also seems irrelevant. "ISA_EP (EPO as an ISA)" added for PCT sample has positive and significant coefficient.

Results on limited sample ranges to each first filing region of the EPC countries, Japan and the U.S. are also shown. According to the results, US_action_after_EP_SEA_date has a positive and significant sign, except in the "PCT from EPC countries only" sample and the "PCT from the U.S. only" sample. As was discussed before, ESRs are the ISRs for PCT applications from the EPC countries. Therefore, this variable isr_cited_dummy is very close to the dependent variable when we focus only on PCT applications from the EPC countries. We still can interpret the results as that the USPTO examiners follow the EPO search report in the "PCT from EPC countries only" sample.

In the U.S. PCT only sample, both isr_cited_dummy and ISA_EP have a positive and significant coefficient. Approximately half of PCT applications from the U.S. choose the EPO as their International Search Authority. When the EPO prepares ISRs, we can interpret the results as that the likelihood of the citation being incorporated with U.S. office action increases. When the USPTO prepares ISRs, the variable US_action_after_EP_SEA_date is not significant, implying that the USPTO examiners do not incorporate EP search reports. However, in this case, EP search reports are supplementary reports, prepared after ISRs by the USPTO. Since the number of citations newly added by the supplementary is smaller, the results are not inconsistent with the general tendency for USPTO examiners to follow the EPO. We need to take note of this subsample, though, since U.S. examiners may not find the outcomes of European search reports for US-based applications as valuable as those for applications outside the U.S., possibly because examiners are more knowledgeable about prior art concerning local applications.

Generally speaking, the overall results support a stable spillover effect from the EPO to the USPTO, after controlling for many factors.

V. Conclusion and further issues

We generally find EPO–USPTO convergence of citations after European search report releases, implying the existence of spillover from the EPO to the USPTO, with a small fraction of exception where PCT applications are made from the U.S. with ISA being the U.S. The convergence of citations after the release of European search reports implies that there is benefit in search effort taken by the USPTO. Moreover, we find divergence of citations when prosecution takes longer. That is, we find divergence of U.S. rejection patent citations from those at the EPO as the process of a prosecution becomes longer, which is typically caused in the U.S. by persistent challenges from applicants appealing repeated rejections. These results imply interdependence between major patent offices with both converging and diverging forces, which have been found by a novel use of examiner patent citations. The finding suggests that there is benefit in collaborative search mechanisms between patent offices, which have policy implications (such as international search collaborations to reduce discrepancies between grant decisions). Moreover, it has an implication for citation study beyond patent citation study, in that sequential reviews of prior arts with respect to the same citing documents could result in different citation network structures, dependent on the possibility of information sharing between different citing entities.