Low-quality patents in the eye of the beholder: Evidence from multiple examiners

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"The West's intellectual-property system, for instance, is a mess, because it grants too many patents of dubious merit."

The Economist, January 12th, 2013

"There is widespread and growing concern that the [U.S.] Patent and Trademark Office issues far too many 'questionable' patents that are likely to be found invalid based on a thorough review."

Lemley and Shapiro (2005:83)

Low-quality patents may chill the R&D investment and commercialization processes

- There is no question about the reality of the phenomenon: discussed in the business press, academic circles, and policy circles.

- Scholars generally agree that low-quality patents are detrimental to welfare:
  - Jaffe and Lerner (2004) discuss it at length: generate background uncertainty about freedom to operate and creates implicit or explicit threat of litigation.
  - Farrell and Shapiro (2008) have modeled their impacts: lead to the public paying supra-competitive prices, and allocate rewards wrongly (thereby distorting incentives).

- Phenomenon is poorly measured.

Three different perspectives on patent ‘quality’

1. Quality of the underlying invention, as measured by technological merit and economic potential (Lanjouw and Schankerman, 2004). Somehow echoes the patentability criteria.

   Controlled for

2. Quality of the drafting style (excessive and broad claims, imprecise language, etc.).

   Controlled for

3. Quality of the underlying patent right. A low-quality patent would not have been granted if the legal requirements of novelty, non-obviousness and usefulness had been properly evaluated (Merges, 1999). Also `weak' patents (Farrell and Shapiro, 2008).

   Our objective

So far, scholars have been measuring quality using litigated patents

- Few studies have sought to quantify the prevalence of the phenomenon.

- Litigation studies provide valuable insights. Invalidity rates based on 100s of court decisions ranges between 25 and 80% (*e.g.*, Allison and Lemley 1998, Miller 2013, Cremers *et al.* 2014, Zischka and Henkel 2019).

- Besides the wide range of estimates, three issues with litigation studies:

1. It is not unlikely that the court applies a stricter standard than the office;
2. The court may make mistakes;
3. Litigated patents are not a random sample of the population—and the total population is extremely small.

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The ideal experiment

- Ideally, one would have qualified examiners take a second look at the question of whether granted patents indeed qualify for patent protection.
  – ‘Second-pair-of-eyes review’ program at the USPTO. Data are not publicly available and unclear how patents/examiners are selected and what the incentives are.
  – Paradise et al. (2005) manually examine the validity of 1167 claims of 74 U.S. patents on human genetic material. They find that 448 claims (38 per cent) were problematic.

- We seek to implement this approach in a far more widespread context—more than one million patent applications.

Trying to get closer to the ideal experiment

- We study examination outcomes of twin patents at five patent offices to infer invalidity rates (US, CN, EP, JP, KR).

- Consider the following: 25% of patents with priority year between 2000–2005 that were granted by the USPTO and filed at the 4 other offices were denied a grant at least once.

- If the novelty and non-obviousness principles were applied in exactly the same way across offices, then U.S. rate of weak patents would be 25%.

- In practice, non-obviousness requirement differs across countries, and we need to account for that.

A reduced-form model of patent examination decision

- We estimate:

$$y_{ij}^* = -\tau_j + c_i + \boldsymbol{x}_{ij}\boldsymbol{\beta} + \varepsilon_{ij}, \qquad y_{ij} = 1\left[y_{ij}^* > 0\right]$$

- Three sources of heterogeneity with respect to grant outcome
  - Systematic office differences (τ_j);
  - Systematic invention differences (c_i);
  - Application-patent office difference (*"ij" elements*) – $x_{ij}\beta$ captures observables that speak to the construction of the application (*e.g.*, number of claims, filing route). Specifications with β or β_j.

- ε_{ij} is the grant uncertainty once systematic factors have been taken into account. Randomness arising, *e.g.*, from the 'mood' of the examiner.

- Estimated using a fixed effect linear probability model

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We collect data from seven offline and online sources

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Offline

1. PATSTAT October 2014 release for the backbone of the dataset
   Priority filings and their equivalent(s), inventor/applicant country of residence, technological fields, filing route (PCT/Paris Convention)

2. EPO's INPADOC PRS table for PATSTAT: *Legal status for China and EPO*

Online

3. JPO's public access on-line Industrial Property Digital Library Database
   Legal status and number of claims

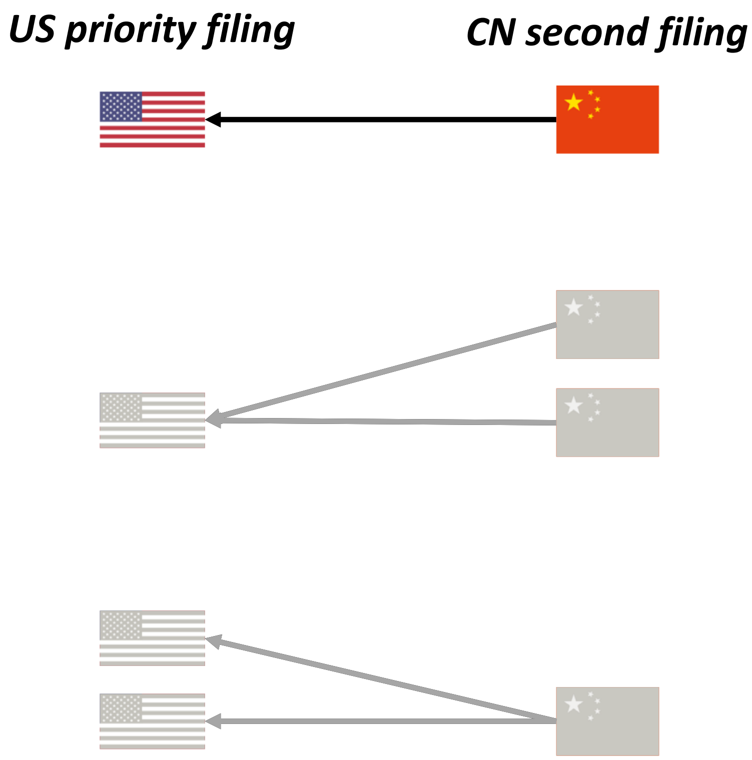
4. KIPO's public access on-line IPR Information Service
   Legal status and number of claims

5. USPTO Public Pair on-line database: *Legal status*

6. The lens.org: *USPTO number of claims of published patent applications*

7. SIPO's on-line patent search platform: *Number of claims*

Identification of one-to-one equivalents (=twins)



The second filing claims the priority filing.

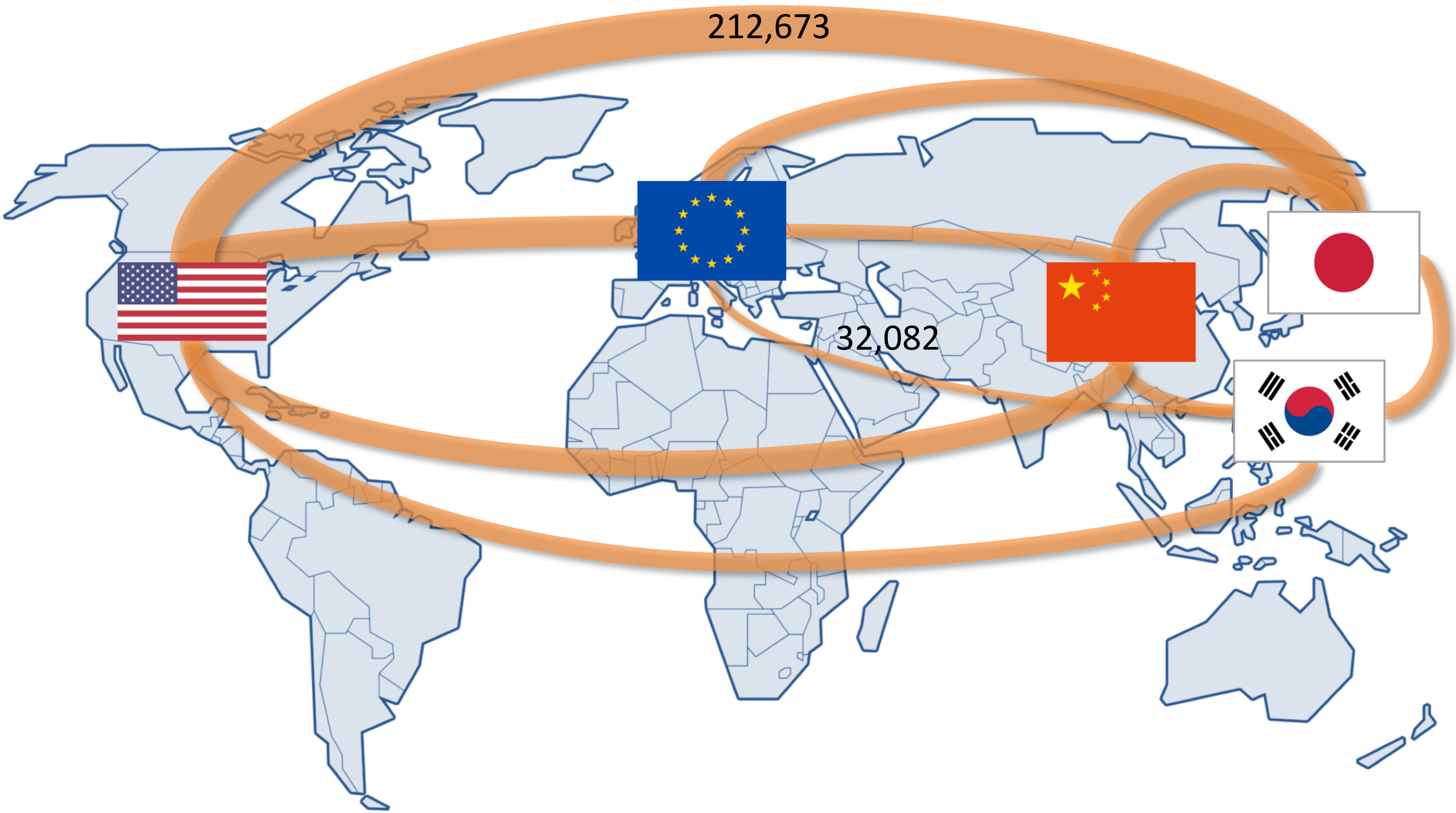
These patents can be seen as ‘twins’.

A priority filing can be ‘split’ into several second filings at the same office.

Priority filings can be ‘combined’ into one second filing.

Overall we have more than 1 million equivalent applications

Starting population: all patent applications filed in 2000–2005 at two of these offices.



We use two samples, and have four main controls

Capture (unobserved) heterogeneity

	N	Grant (%)	local applicant (%)	priority filing (%)	PCT (%)	claims
Panel A. Balanced sample						
EPO	10,822	84.9	27.7	6.3	44.2	14.7
USPTO	10,822	91.5	17.5	18.6	33.0	17.2
KIPO	10,822	88.3	14.7	14.6	4.5	14.9
JPO	10,822	82.6	36.5	36.7	37.7	11.1
SIPO	10,822	97.9	0.6	0.6	21.7	15.2
Panel B. Full sample						
EPO	163,012	76.8	44.2	9.8	45.3	15.6
USPTO	325,068	91.4	20.0	22.3	22.8	17.8
KIPO	127,314	84.4	41.5	41.0	2.3	14.9
JPO	278,760	72.2	56.3	56.4	26.5	10.3
SIPO	170,777	96.3	3.1	3.3	19.7	15.3

Our objective is to decompose inconsistency rates

- Share of patents granted at one office and refused elsewhere:

Office	Number of granted patents	Proportion refused elsewhere
EPO	125,195	21.3
USPTO	297,072	25.2
KIPO	107,501	25.7
JPO	201,335	13.9
SIPO	164,527	26.9

- We seek to decompose these rates into:
  - Arising from office threshold differences;
  - Weak patents; and
  - Mistakes at other offices.

} Two dimensions of quality in patent systems.

– counterpart of focal office mistake

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Grant outcome (1/0) of application *i* in office *j*

	M1	M2	M3	M4	M5
Regression model:	SUR[a]	FE	FE	FE	FE
Sample:	Balanced	Balanced	Full	Full	Full
Coefficients:	Constrained	Constrained	Constrained	Free[b]	Free[b]
local applicant (LA)	0.126*	0.142*	0.175*	0.138*	0.100*
	(0.007)	(0.006)	(0.002)	(0.002)	(0.002)
priority filing (PF)	0.003	0.018	0.084*	-0.081*	-0.092*
	(0.013)	(0.017)	(0.003)	(0.006)	(0.006)
LA x PF	-0.084*	-0.121*	-0.166*	-0.069*	-0.053*
	(0.016)	(0.019)	(0.004)	(0.006)	(0.006)
PCT	0.034*	0.030*	0.039*	0.127*	0.115*
	(0.004)	(0.004)	(0.001)	(0.003)	(0.002)
claims (log)	-0.007	-0.008	-0.020*	-0.037*	-0.040*
	(0.004)	(0.005)	(0.001)	(0.002)	(0.002)
Number of observations	43,288	54,110	1,064,513	1,064,513	1,064,513
Number of inventions	10,822	10,822	408,133	408,133	408,133
R-squared (within)	-	0.053	0.103	0.119	0.153

Notes: * $p < 0.001$; heteroskedastic-robust standard errors in models M2–M4; [a] iterated seemingly unrelated regression with demeaned data; [b] office-specific coefficients, but coefficients for the reference group (EPO) reported. Office-fixed effect estimated but not reported.

We obtain invalidity rates from the predicted scores

- We use models M5 to construct scores s_i for the likelihood of grant for application *i* at office *j*. The score is simply the linear prediction (including the estimated fixed effect).

- Applications with high enough score s_i should be granted. Hence:

a. The grant is incorrect given the focal office's inventive step threshold (focal office mistake = weak patent).

b. The grant is correct grant given the focal office inventive step threshold but:
   - the other office(s) made a mistake given that their correct decision should be to grant the application (other office mistake);
   - the other office(s) were correct in deciding a refusal (office threshold differences);

Decomposition of inconsistency rates (model M5)

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	Raw rate (Table 3)	Sources		
		Office threshold difference	Weak - Own office mistake	Mistakes at other office
EPO	21.3	8.5	4.0	8.8
USPTO	25.2	15.4	4.0	5.9
KIPO	25.7	10.6	4.8	10.3
JPO	14.0	2.1	5.7	6.2
SIPO	26.9	15.3	1.6	10.0

- Most inconsistent decisions are driven by office threshold differences.
- The rate of weak patents does not exceed single-digit figures.
- It is wrong to conclude that SIPO performs ‘better’ than the EPO.

We need to compute relative accuracy rates

- Absolute rates of weak patents tell us about the amount of patents that are potentially invalid, but they are silent on the efficiency of the examination process.

- SIPO has the lowest threshold: it grants ~96% of patents in the full sample. Should an examiner randomly issue patent applications knowing that she must grant 96% of them, she would make 0.96^2 =~ 0.92 correct grant decisions, (1-0.96)*0.96 = 0.0384 Type I and Type II errors (each).
→ SIPO made 0.016 Type II errors. It does barely better than a random job.

- EPO: 5.8, USPTO: 2.15, KIPO: 3.25, JPO: 4.8

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A neglected source of unobserved heterogeneity

- Unobserved heterogeneity in our model takes the form of non-random (i,j) elements.

- One possible candidate: differences in patentable subject matters across offices may lead to a legitimate grant at one office and a legitimate refusal at another office.

- Yes, but… it is unlikely that assignees file patent applications in jurisdictions where the subject matter is not patentable.

- Discussions with patent attorneys suggest that mechanical engineering has the most uniform patentable subject matter across offices.

Different patentable subject matters do not drive the results

Proportion of weak patents by technology field

	EPO	USPTO	KIPO	JPO	SIPO
Electrical	5.3	4.2	4.2	5.8	1.8
Instruments	4.4	4.0	5.1	5.6	1.7
Chemicals & pharmaceuticals	3.1	6.3	6.0	7.2	1.6
Process engineering	3.5	5.0	5.4	6.1	1.4
Mechanical engineering	**3.0**	**3.3**	**5.4**	**4.9**	**1.2**
Biotechnology†	3.7	7.3	6.3	7.9	2.6
Software††	6.4	6.3	4.7	7.7	2.2

- Field of mechanical engineering exhibits similar pattern than overall results: differences in patentable subject matters do not drive our results.

- High rate of weak patents in software and biotech.

Considerations on external validity of findings

- Our sample is considerably less selected than in previous litigation studies.

- Selection on economic value, not technological merit of the invention. However, both dimensions could be correlated.

- We assess selection on the filing decision with respect to quality: are higher-quality inventions more likely to be filed abroad?

- Idea of the test: estimate model M5 without one office (*e.g.*, EPO), extract the fixed effect, and estimate mean fixed effect by filing status (filed/not filed) at the office. Redo for all offices.

Evidence of some selection on quality

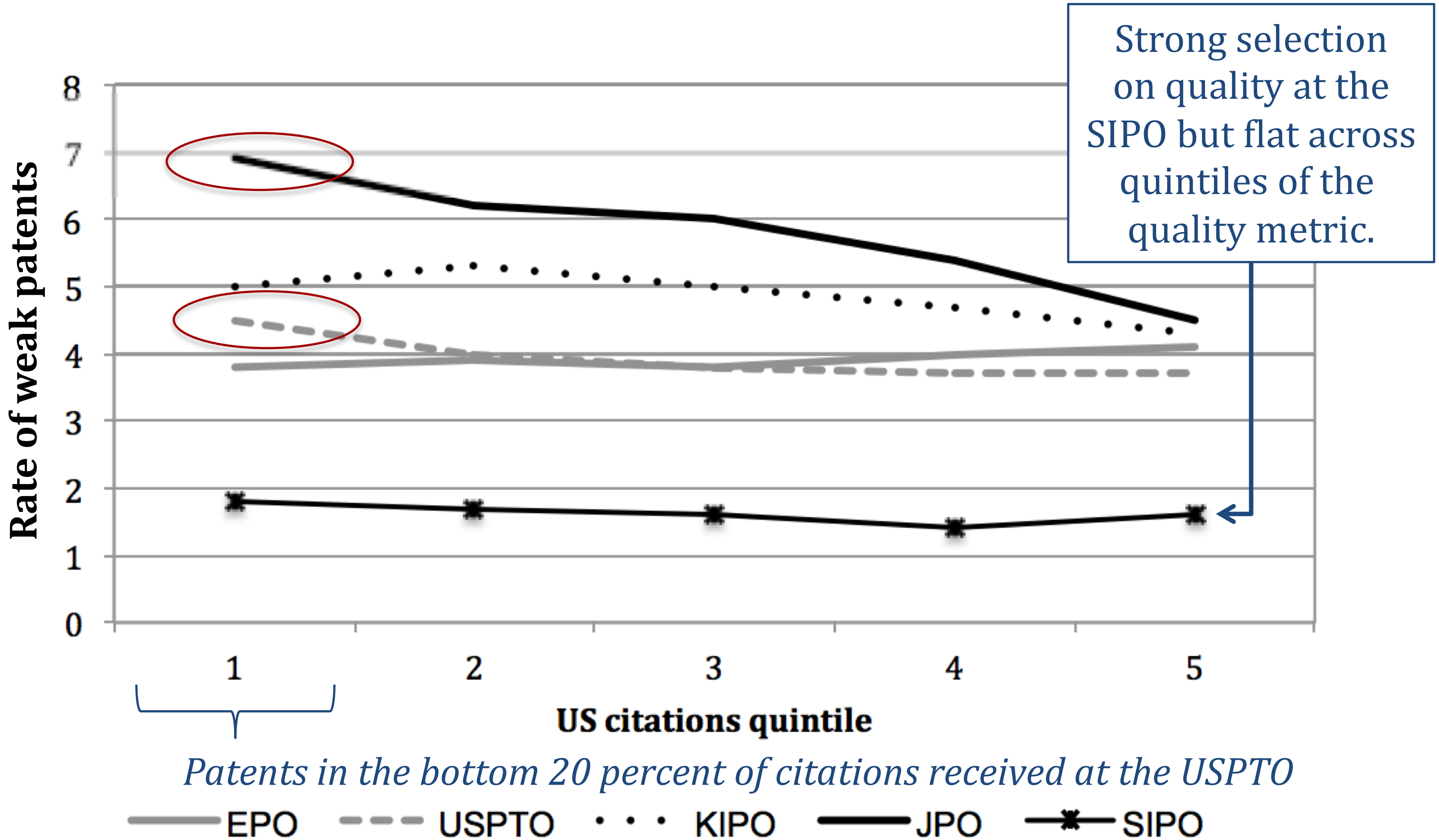
- A one-std dev increase in quality (fixed effect) increases probability of filing at the EPO by 3.7 per cent (at the mean).

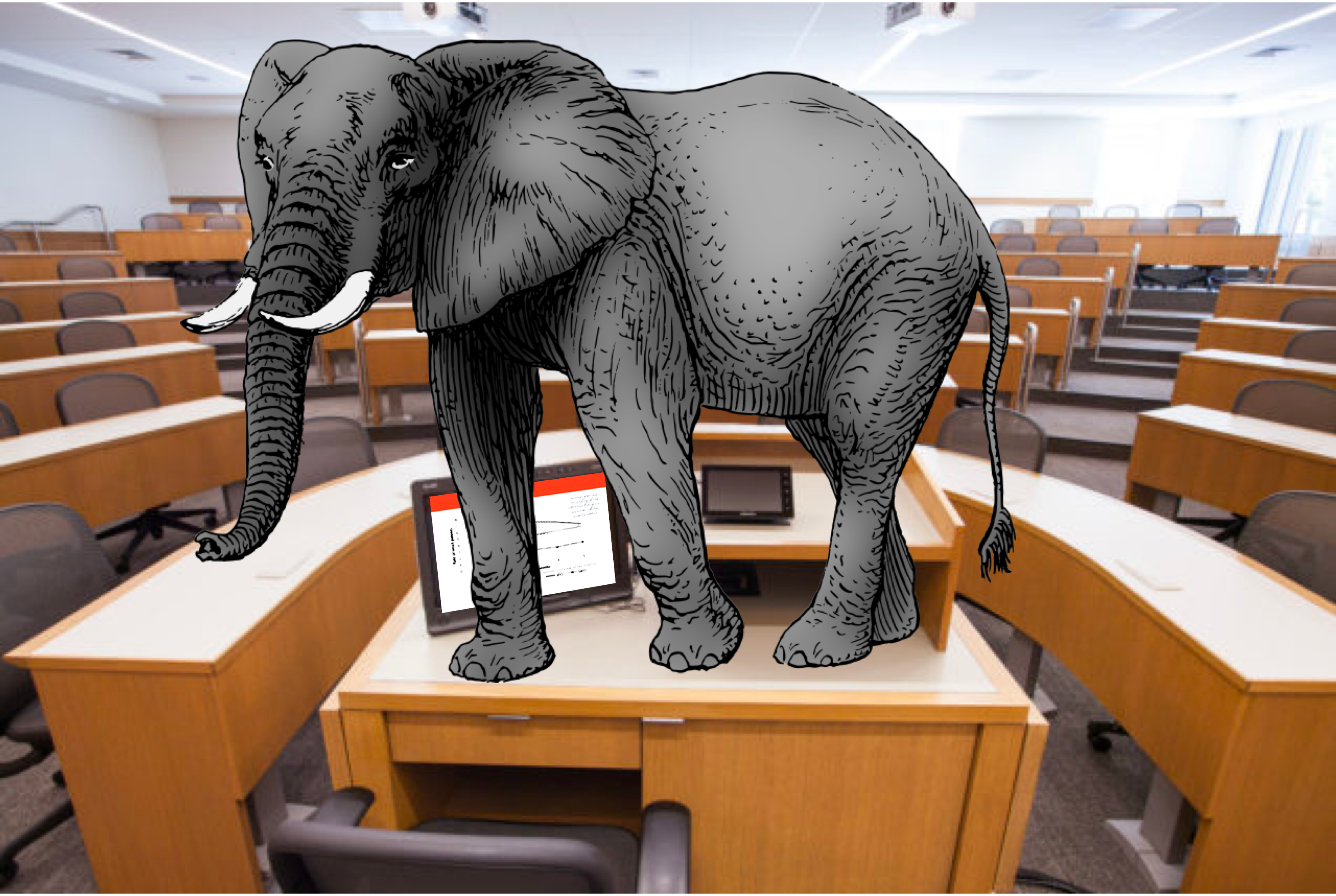
	Not filed	Filed	Δ	Marginal effect
EPO	-0.019	0.016	-0.035*	0.037
USPTO	-0.121	0.045	-0.165*	0.115
KIPO	-0.025	0.030	-0.055*	0.052
JPO	-0.042	0.021	-0.062*	0.064
SIPO	-0.042	0.053	-0.096*	0.087

- Selection is strongest at the USPTO, weakest at the EPO.

- Still, tells us nothing about possible bias in our estimates.
- Estimate model M5 by quintile of citations received at the USPTO.

Rates of weak patents as a function of invention quality






Hiding

The elephant calf in the room

- The decomposition of invalidity rates critically relies on an estimate of invention quality… which we obtain from a maximum of 5 observations. Possible small sample bias!
- We have set up a Bayesian model that allows invention quality to be a random variable.
- Work in progress: we are still figuring out the best modeling strategy…

Estimates using Bayesian econometrics

Table 6 Grant outcomes for EPO: Numbers (proportions)

		Realised	
		Granted	Not granted
Model outcome	Grant	77,713 (0.477)	12,150 (0.075)
	Do not grant	47,275 (0.290)	25,665 (0.158)

Table 7 Grant outcomes for USPTO: Numbers (proportions)

		Realised	
		Granted	Not granted
Model outcome	Grant	207,134 (0.637)	14,599 (0.045)
	Do not grant	89,938 (0.277)	13,397 (0.041)

- Higher proportion of weak patents.
- Fairly low proportion of mistakenly refused patents

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Summing up results

- To push the point: differences in grant outcomes are primarily driven by policy choices (different requirements for grants) rather than poor implementation of these requirements (weak patents).
- The prevalence of weak patents much smaller than reported in litigation studies.
- EPO and JPO make five times less mistakes than if they were to take random grant decisions. USPTO and SIPO ‘only’ make half as many mistakes.

Our results are complementary to those of litigation studies

- Why do we get so low rates of weak patents?

1. Litigated patents are selected towards those most likely to be found invalid.
2. Litigation studies implicitly assume that courts apply the same standard as that of the patent office, and do not make mistakes themselves.
3. Court review is an adversarial proceeding. The adverse party may bring new prior art to the court attention.

Implications for discussions about how to fix the patent system

- Assuming that invalidity in the view of the courts is significantly higher than invalidity in the view of the office

1. Much of the debate/discussion around quality focuses on improving examination. This effort is somewhere between misguided and only marginally useful.

2. Raising the U.S. threshold to the level of the highest country would have only a modest impact on weak patents.

3. General tone to the debate that the uncertainty around validity is the PTOs' fault. It seems inherent in the examination process that a non-trivial number of invalid patents will be approved.

Thank you

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