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Patenting Strategies in the European Patent System

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October 23, 2018

Patenting in Europe

▷ Europe has national patent offices in each country, national courts for IP and

▷ the European Patent Office

▷ Currently examination takes place either at national offices or EPO (sometimes at both)

▷ After grant firms pay only national offices or fees are split if EPO granted the patent

This system should soon be complemented by a Unified Patent Court and a Unitary Patent

Surprisingly little is known about how firms make use the current system in which we have competing institutions.

Motivation

▷ Within the European Patent System (EPS) patents are granted by national offices (NPOs) and the EPO.

▷ EPO and the NPOs cooperate by sharing revenues, they do not coordinate on policy variables such as fees, grant rates or examination durations.
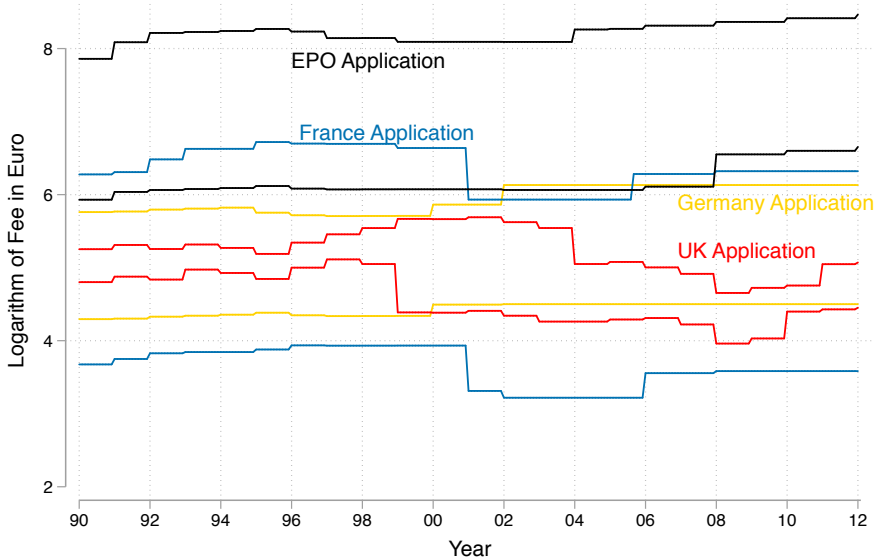
Questions:

▷ Does the EPS consist of two disjoint patent systems?

▷ If not, how do firms use the EPS?

Long term question:

▷ *What would an effective EPS look like?*

Changes in application and renewal fees

Literature

▷ Hall and Helmers (2017) analyse the extension of the EPS to new EU member states.

▷ Harhoff et al. (2009, 2016) study validation choices as functions of fees and costs, distances and sizes of economies.

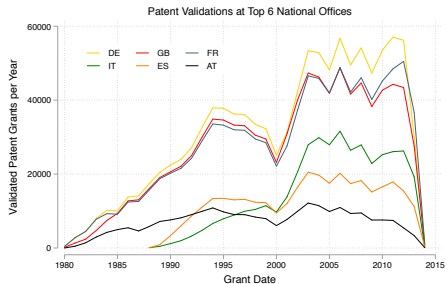▷ Mejer and van Pottelsberghe de la Potterie (2012) study EPS at aggregate level.

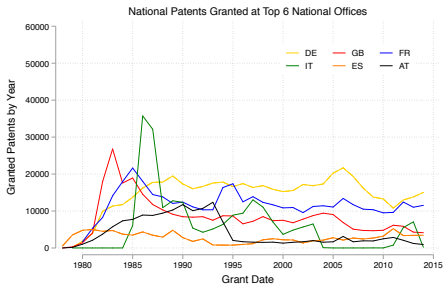# Choices within the EPS

- 0 How many patents to submit?
- 1 Which priority office? (usually an NPO)
- **2** Application to EPO or other NPO?
- **2*b*** How long does grant take?
- **3** How many patents to hold within EPS?

We analyse choices 2 & 3 and 2b

Granted patents: EPO and NPOs

Demand for NPO patents is stable, if significantly below demand for validations in same country.

Is there any switching?
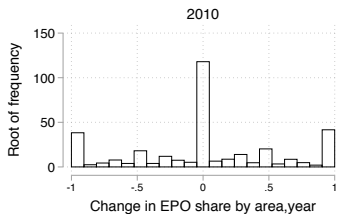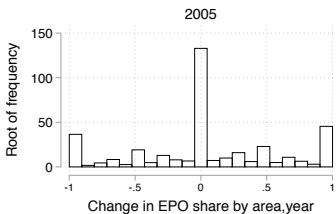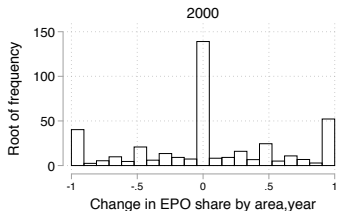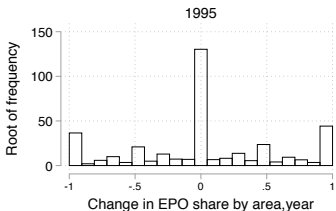
+1 - complete switch to EPO, -1 complete switch to NPOs relative to previous application.

Where firms patent
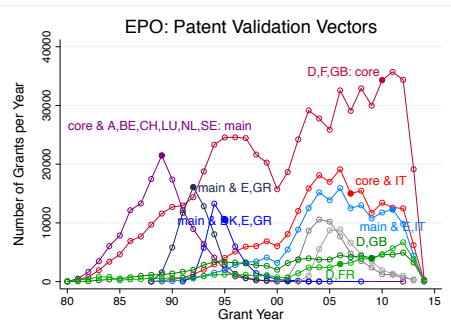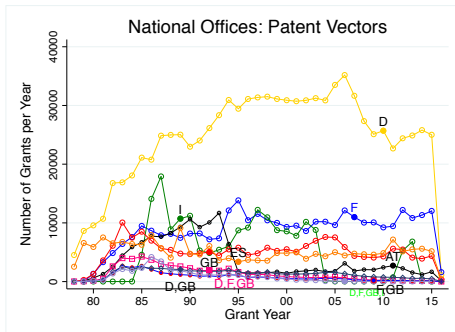
NPO applications are usually to one office, EPO applications usually to 3 or more.

Validation at EPO by technology
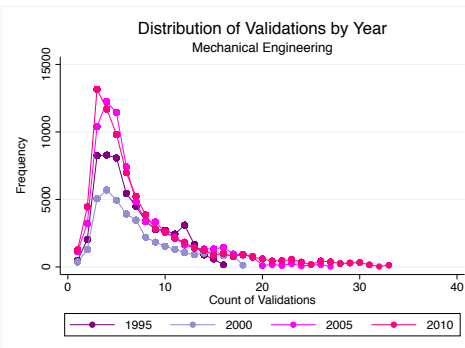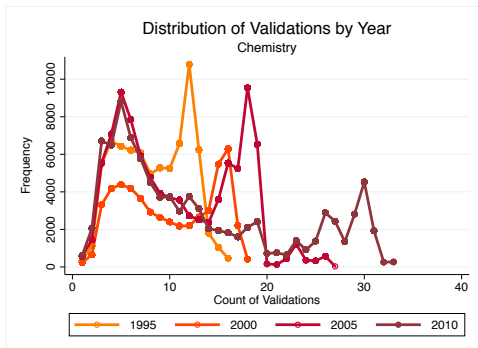
Patent vectors are defined over the space of countries to which applicants submit patents in a patent family (national offices) or in which patents granted by the EPO are validated.

Intuition for analysis:

Applicants:

> ▷ would prefer to minimise fee expenditure: optimum is to use one office within the EPS only;

> ▷ prefer offices with higher grant rates;

> ▷ prefer offices with lower examination durations
> *caveat: in surveys firms do not enunciate a preference for fast grants*

But:

> ▷ where costs of reengineering and manufacturing are sufficiently low, the patent must be held in multiple (all) countries within the EPS.

Stage II - Decision How Many Countries to Protect

If patent is granted: how widely (n_e) do you protect it?

$$V(n_e) = S\Psi(n_e)\pi(\underline{c}, C) + S\left(\Psi(N) - \Psi(n_e)\right)\pi(\underline{c}, \tilde{c}(n_e)) - \Gamma(n_e) \tag{1}$$

Where

- S size of largest country market
- n_e number of countries to protect
- Γ fees for upholding granted patent
- Ψ concave market size function

Stage I - Decision Whether to Apply to EPO
Payoffs and assumptions

Duration of patent examination (τ) is a function of the probability of applying to EPO by all firms (e_j) - firms interact with each other at this stage!

$$\tau_E(\sum_M e_j, R_E), \text{ where } \frac{\partial \tau_E}{\partial e_j} > 0 \qquad \tau_k(\sum_M e_j, R_k), \text{ where } \frac{\partial \tau_k}{\partial e_j} < 0$$

(2)

Payoffs:

$$v_E(\omega_E, n_e) = S\left[\omega_E\left(\Psi(n_e)[\pi(\underline{c}, C) - \pi(\underline{c}, \underline{c})] + [\Psi(N) - \Psi(n_e)][\pi(\underline{c}, \tilde{c}(n_e)) - \pi(\underline{c}, \underline{c})]\right)\right.$$
$$\left. + \Psi(N)\pi(\underline{c}, \underline{c})\right] - F_{EPO},$$

(3)

$$v_k(\omega_k, n_e) = S[\Psi(k) - \Psi(k-1)]\left[\omega_k[\pi(\underline{c}, C) - \pi(\underline{c}, \tilde{c}(n_e))] + \pi(\underline{c}, \tilde{c}(n_e))\right] - F_k,$$

(4)

Stage I - Decision Whether to Apply to EPO

$$\tilde{v}_j = e_j \left(\tau_E \lambda v_E + (T - \tau_E) v_E \right) + (1 - e_j) \left(\sum_{k=1}^{n_e} \tau_k \lambda v_k + \sum_{k=1}^{n_e} (T - \tau_k) v_k \right) \tag{5}$$

Where

e_i probability of applying to EPO

τ_E Examination duration at EPO / Nat'l office

λ discounted value of pre-grant patent

T life of patent

Results

We derive two first order conditions that determine

$\hat{n}_e$ The number of countries in which to hold the patent;

$\hat{e}_j$ The probability of submitting the patent to EPO.

Results:

▷ Firms trade-off higher profits from protecting the patent against costs of grant (Stage II);

▷ Firms will shift towards EPO if application fees at national offices rise, application fees at EPO fall (Stage I);

▷ Firms will shift towards EPO if renewal fees fall, because at the margin this allows them to protect their patents more widely (Stage I).

Extensions:

▷ Welfare: Costs of prolonging patent application processes?

▷ Patent quality - introduce significant and marginal patents.

Data

▷ We use PATSTAT 2016

▷ Extract patents granted by 10 NPOs and EPO

▷ We identify common owners of patents across the two sets of patents. For this we use multiple approaches including cleaning and merging and Derwent's patentee codes.

Table 1: **Descriptive Statistics**

Variable	Mean	Std. Dev.	Median	Min.	Max.
Jurisdictions	3.178	3.53	2	1	34
Grant by EPO (1/0)	.471	—	0	0	1
Examination duration /30	57.01	30.85	51.4	0.233	1002
Lag between applications /30	6.34	20.79	.2	0	402.5
Entry (1/0)	.2385	—	0	0	1
Simultaneous application (1/0)	.3152	—	0	0	1
Multiple grant (1/0)	.0213	—	0	0	1
Portfolio in area at EPO /100	1.544	3.893	.07	0	47.75
Portfolio in area /100	3.509	8.849	.185	.000303	104.1
Others' share at EPO	.509	.1342	.5012	.07407	.8976
Citations to Portfolio at USPTO /100	.0273	.1119	.01	0	43.84
EPO Citations, 3 years	.6847	1.889	0	0	211
USPTO Citations, 3 years	3.447	16.21	0	0	4384
No EPO citations (1/0)	.3459	—	0	0	1
No USPTO citations (1/0)	.3447	—	0	0	1

Grant by EPO	N	Mean	Median	Min.	Max.
No	1099711	1.276	1	1	17
Yes	979305	5.314	4	1	34
Total	2079016	3.178	2	1	34

Analysis of fee changes at NPOs

▷ We start by analysing periods in which fees changed significantly to establish whether responses within the EPS are significant.

▷ In 1999 UK IPO **decrease** renewal fees and **increase** application fees, 2000/2002 DPMA **increase** application fees and in 2001 INPI **decrease** application and renewal fees;

▷ in 2005 INPI increase both application and renewal fees.

We compare Core (GB, F, D) and all applicants and study:

1) The decision to apply to EPO;
2) The duration of patent examination.

Table 3: External Effects of Fee Changes on Applications to EPO

	Core, 97-03	All, 97-03	Core,03-06	All,03-06
British applicant $\times$ D1999	-0.00859	-0.0377^{***}		
	(0.00939)	(0.00958)		
German applicant $\times$ D2000	0.0306^{***}	0.0227^{*}		
	(0.00862)	(0.00965)		
French applicant $\times$ D2001	-0.000205	-0.0302^{**}		
	(0.0110)	(0.00951)		
German applicant $\times$ D2002	0.0690^{***}	0.0140		
	(0.0110)	(0.00796)		
French applicant $\times$ D2005			0.0312^{*}	0.00488
			(0.0153)	(0.00754)
German applicant $\times$ D2005			0.0460^{**}	0.0336^{***}
			(0.0157)	(0.00862)
British applicant $\times$ D2005			0.0611^{***}	0.00119
			(0.0159)	(0.00894)
Constant	-0.999	-0.851	4.561^{**}	1.548
	(1.132)	(0.881)	(1.519)	(0.857)
Observations	234469	809716	140589	530123
R^2	0.379	0.330	0.142	0.326

Elasticities

Table 2: Summary of Fee Changes and Effects

	Office: Year:	UKIPO 1999	DPMA 2000	INPI 2001	DPMA 2002	INPI 2005
Application fee change in €		35	0	−366	108	158
Renewal fee year 5 change in €		−76	12	−24	0	10
Change in application probability per 10 €		0.14%	2.55%	−0.06%	0.64%	0.17%
Elasticity of the application probability			0.184	−0.06	0.225	0.146

Table 4: External Effects of Fee Changes on Examination Durations (1997-2003)

	Core Offices	EPO excl. core	EPO
D1999 × proportion British applicants	-29.4030^{**}	-41.7237^{**}	-27.3667^{*}
	(9.0672)	(13.8676)	(12.4950)
D2000 × proportion German applicants	4.8430	18.8422^{***}	20.5055^{***}
	(3.6352)	(2.6432)	(2.4836)
D2001 × proportion French applicants	16.3292^{***}	-23.7639^{*}	-26.5784^{**}
	(4.2195)	(10.2094)	(9.5464)
D2002 × proportion German applicants	2.0953	14.5940^{***}	10.3711^{***}
	(3.3118)	(3.2492)	(2.9877)
Constant	340.4433^{***}	442.2968^{***}	465.1321^{***}
	(99.6421)	(65.0511)	(60.4714)
Observations	215282	359965	420815
R^2	0.1034	0.1180	0.1211

▷ Average proportion of applicants at EPO from Germany(22%), France(7.4%) and Britain (3.8%)

▷ This implies that duration of examination changed by 4 months(+) in 2000 and 1.76 months(-) in 2001 at EPO for those applicants not from a Core country.

Table 5: External Effects of Fee Changes in France on Examination Durations (2002-2008)

| | 2005 (X= 5) | | | 2003 (X= 3) | 2008 (X= 8) |
	non french at EPO	EPO	France	EPO all [†]	EPO all [†]
D200X × prop. F app.	29.2933^{***}	28.9729^{***}	-0.4980	-8.5091	0.5389
	(8.3127)	(8.2960)	(5.1629)	(9.8828)	(6.9607)
D200X × prop. D app.	11.1810^{***}	11.2299^{***}	-11.6257^{**}	8.3552^{**}	9.9124^{***}
	(2.4119)	(2.4053)	(4.1364)	(3.1592)	(1.8269)
D200X × prop. GB app.	-2.0250	0.0720	-1.5913	86.7485^{***}	-4.6897
	(14.4339)	(14.4131)	(9.6706)	(16.0918)	(12.1883)
Constant	397.5549^{***}	396.7361^{***}	35.9203	216.3115^{***}	306.2272^{***}
	(50.7291)	(50.4775)	(67.9758)	(63.5536)	(43.8356)
Observations	302565	303893	192032	249565	216227
R^2	0.1577	0.1572	0.0915	0.1172	0.2105

▷ Average proportion of applicants at EPO from Germany(22%), France(7.5%) and Britain (3.2%)

▷ This implies that duration of examination changed by 4.65 months in 2005 at EPO for those applicants not from France.

Summary

▷ Fee changes in the EPS induce coordinated switching to/from EPO;

▷ This affects examination durations of all applicants at EPO;

▷ In some cases the effects are quite large.

Next: estimation over the entire sample period.

Estimation

▷ Firms may respond to fees as they are at date of application (application & renewal) or at date of grant (renewal) *and*

▷   .. renewal fees are set as a schedule: many variables.

   ⇒ *We use LASSO to select variables to include.*

▷ Decision to apply to EPO and decision to on examination duration may be endogenous.

   ⇒ *We instrument these decisions using lagged firm and EPO characteristics.*

▷ The empirical model is recursive: decision on number of patents the firm will hold is taken several years after application and duration decisions.

▷ Estimate using Roodman's CMP package in Stata.

Empirical model

$$
\begin{aligned}
D_{EPO,i} = {} & \beta_0 + \boldsymbol{\beta}_{I,e}\boldsymbol{I}_e + \boldsymbol{\beta'}_{\omega_{NAT}}\boldsymbol{\omega}_{NAT} \\
& + \beta_q q_i + \boldsymbol{\beta'}_f \boldsymbol{X}_f + \boldsymbol{\beta'}_O \boldsymbol{X}_O + \boldsymbol{\beta'}_A \boldsymbol{D}_A + \boldsymbol{\beta'}_T \boldsymbol{D}_T + w_i
\end{aligned}
\tag{6}
$$

$$
\begin{aligned}
Dur_i = {} & \delta_0 + \boldsymbol{\delta}_{I,d}\boldsymbol{I}_d + \delta_{EPO}D_{EPO,i} + \boldsymbol{\delta'}_{\omega_{NAT}}\boldsymbol{\omega}_{NAT} \\
& + \delta_q q_i + \boldsymbol{\delta'}_f \boldsymbol{X}_f + \boldsymbol{\delta'}_O \boldsymbol{X}_O + \boldsymbol{\delta'}_A \boldsymbol{D}_A + \boldsymbol{\delta'}_T \boldsymbol{D}_T + v_i
\end{aligned}
\tag{7}
$$

$$
\begin{aligned}
n_i = {} & \gamma_0 + \gamma_{EPO}D_{EPO,i} + \gamma_D Dur_i + \boldsymbol{\gamma'}_R \boldsymbol{R}_O + \boldsymbol{\gamma'}_{\omega_{NAT}}\boldsymbol{\omega}_{NAT} \\
& + \gamma_q q_i + \boldsymbol{\gamma'}_f \boldsymbol{X}_f + \boldsymbol{\gamma'}_O \boldsymbol{X}_O + \boldsymbol{\gamma'}_A \boldsymbol{D}_A + \boldsymbol{\gamma'}_T \boldsymbol{D}_T + u_i
\end{aligned}
\tag{8}
$$

Application to EPO / examination duration

	(3) EPO	(4) EPO	(3b) EPO	(3b) Duration	(2b) EPO	(2b) Duration
DE application Fee					0.0063	
					(0.0048)	
UK application Fee					−0.0034	
					(0.0020)	
ln Portfolio in area	−0.0008***		−0.0009***			
	(0.0001)		(0.0001)			
EPO exam duration		−0.0002***		0.3960***		0.3939***
		(0.0001)		(0.0185)		(0.0189)
EPO grant rate		0.0089		9.3254***		9.3569***
		(0.0122)		(2.4673)		(2.5568)
Application to EPO (1/0)				137.4802*		
				(62.9005)		
Trend, appl. years	−0.0005	−0.0006	−0.0006	0.4416***	−0.0006	0.3646***
	(0.0004)	(0.0005)	(0.0004)	(0.1105)	(0.0003)	(0.0943)
Rivals' EPO Share	0.0260***	0.0177*	0.0276**	4.1461***	0.0221***	1.9137***
	(0.0059)	(0.0080)	(0.0059)	(0.6805)	(0.0062)	(0.5282)
Entry (1/0)	−0.0040***	−0.0031**	−0.0041**	15.9428***	−0.0032***	19.1600***
	(0.0008)	(0.0007)	(0.0008)	(1.4167)	(0.0007)	(0.5970)
Simultaneous appl. (1/0)	−0.0118***	−0.0170***	−0.0108***	0.4731***	−0.0162***	0.5807***
	(0.0009)	(0.0013)	(0.0008)	(0.0790)	(0.0013)	(0.0603)
Multiple grant (1/0)	0.0130***	0.0162***	0.0198***	0.0558***	0.0234***	0.0499***
	(0.0019)	(0.0020)	(0.0025)	(0.0098)	(0.0028)	(0.0091)
Citations EPO	0.0006***	0.0006**	0.0008***	0.1828	0.0008***	−0.6047***
	(0.0001)	(0.0001)	(0.0001)	(0.3944)	(0.0001)	(0.1166)
Citations USPTO	−0.0001***	−0.0001***	−0.0000*	−2.3849***	−0.0000**	−3.5896***
	(0.0000)	(0.0000)	(0.0000)	(0.5508)	(0.0000)	(0.2080)

Notes: ***, **, * denote significance at the 0.1%, 1%, 5% level.

Logarithm of number of jurisdictions

	(1)	(2)	(3)	(4)	(3b)
Application to EPO (1/0)	1.1461^{**}	1.1461^{**}	2.4159^{**}	2.5550^{**}	2.4658^{**}
	(0.0136)	(0.0128)	(0.8524)	(0.9874)	(0.7888)
Examination duration	0.0031^{***}	0.0031^{***}	0.0026^{***}	0.0025^{***}	0.0022^{*}
	(0.0003)	(0.0003)	(0.0005)	(0.0005)	(0.0009)
Trend, appl. years	-0.0145^{***}	-0.0145^{***}	-0.0139^{***}	-0.0138^{***}	-0.0139^{***}
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Rivals' EPO Share	0.1424^{***}	0.1424^{**}	0.1158^{**}	0.1124^{*}	0.1156^{**}
	(0.0423)	(0.0423)	(0.0444)	(0.0498)	(0.0443)
Entry (1/0)	-0.0589^{***}	-0.0589^{**}	-0.0549^{***}	-0.0545^{***}	-0.0549^{***}
	(0.0039)	(0.0039)	(0.0055)	(0.0053)	(0.0054)
Simultaneous appl. (1/0)	0.0569^{***}	0.0569^{***}	0.0785^{***}	0.0808^{***}	0.0800^{***}
	(0.0058)	(0.0058)	(0.0111)	(0.0155)	(0.0098)
Multiple grant (1/0)	0.1409^{***}	0.1409^{***}	0.1202^{***}	0.1180^{***}	0.1264^{***}
	(0.0104)	(0.0104)	(0.0152)	(0.0177)	(0.0238)
Citations EPO, 3 yrs	0.0151^{***}	0.0151^{***}	0.0144^{***}	0.0143^{***}	0.0146^{***}
	(0.0009)	(0.0009)	(0.0010)	(0.0011)	(0.0012)
Renewal fee DE, 1.yr	-0.0001^{**}	-0.0001^{**}	-0.0001^{**}	-0.0001^{**}	-0.0001^{**}
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Renewal fee FR, 1.yr	-0.0003^{***}	-0.0003^{**}	-0.0003^{***}	-0.0003^{***}	-0.0003^{***}
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Renewal fee UK, 1.yr	-0.0004^{***}	-0.0004^{**}	-0.0004^{***}	-0.0004^{***}	-0.0004^{***}
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Notes: ***, **, * denote significance at the 0.1%, 1%, 5% level. We report robust standard errors, clustered at the firm level. All models contain application year, first authority and technology area fixed effects.

Conclusion & Questions

▷ Evidence that EPO and NPOs are not operating independently (switching data and some fee change results)

▷ Evidence that NPOs are preferred by entrants

▷ Evidence that firms respond particularly to changes in examination durations

▷ Some evidence that the largest NPO's are best placed to extract fee income from applicants

$\Rightarrow$ Encaoua et al. (2006) suggest patent systems could extend the menu logic that currently applies to renewal fees to other dimensions. Would that work for EPS?

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