Max Planck Institute
for Intellectual Property and Competition Law

Deferred Patent Examination and the Value of Patent Applications

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November 2013

MAX-PLANCK-GESELLSCHAFT

Agenda

1. Motivation & Research Questions
2. Structural Model
3. Data
4. Estimation and Simulation Results
5. Summary & Outlook

Motivation

- Patent renewal studies:
  - Patent value estimation (Pakes ‘86, Lanjouw ‘98, Deng ’11, Serrano ‘13…)
  - Optimal patent fees (Scotchmer ‘99, Cornelli & Schankerman ‘99, Baudry & Dumont ’09,…)
- But:
  - Patents exist only once they are granted
  - Time period before grant often longer than after grant
  - Patentees apply tactics to postpone the grant decision
  - Most of the applications never get granted (CAD: 33% , GER: 35% of applications withdrawn before examination)

➔ **We need to know more about patent applications and the role of the patent system when the patent is still pending!**

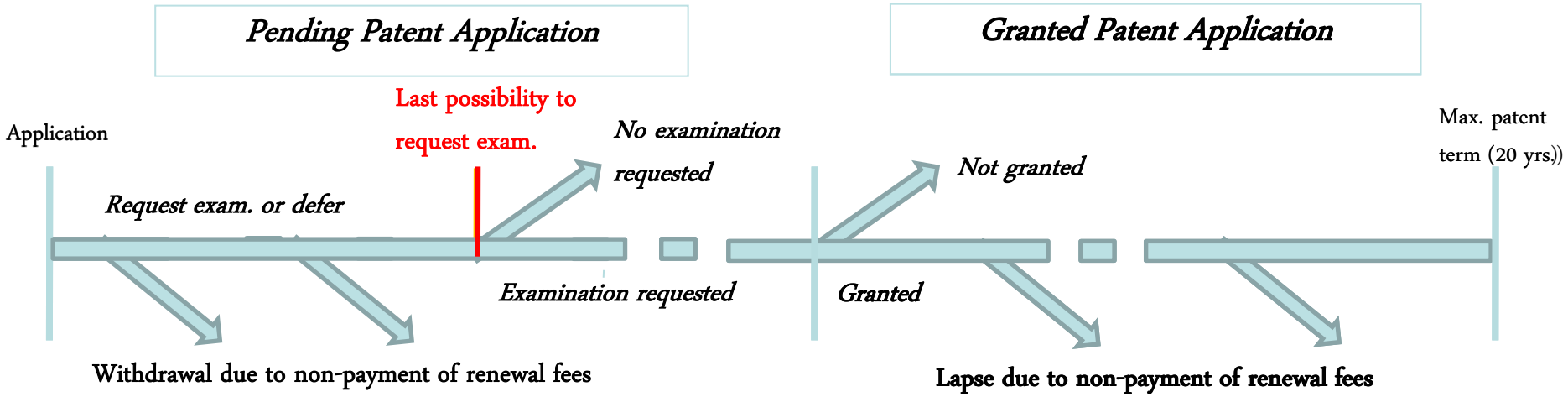
Main Contributions

1. Patent renewal model which incorporates application and examination stage

2. Estimation of the value distributions of Canadian patent applications

3. Analysis of *Deferred Patent Examination* as a policy tool to reduce patent offices‘ backlogs

Emprical Strategy



- Model of optimal examination and renewal decision
  - Examination, deferment and renewal are costly
- Identification
  - Variation in the fee structure before and after grant
  - Aggregated decisions of patent applicants
- Simulated Generalized Method of Moments (SGMM) estimator

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Model

Application Stage

- Initial (potential) **returns** from patent protection $\boldsymbol{r_1^{Pat}}$ are taken from a log-normal distribution
- In any year the patent can become **obsolete** with probability $\boldsymbol{\theta}$
- If it does not become obsolete $(1-\theta)$, the per year **returns evolve** in the following way over time:

$$r_t^{Pat} = \max\left(\delta\ r_{t-1}^{Pat}, z\right)$$

  where $\boldsymbol{1-\delta^{Appl}}$ represents the **depreciation rate** and $\boldsymbol{z}$ is drawn from an exponential distribution (represents **learning**)
- **Learning opportunities decrease** with application's maturity (drawing higher $\boldsymbol{z}$ becomes less likely over time)

Model

- Accounting for *pending patent application* status:
  - right to obtain royalties
  - right to notify potential infringers (damages, seizure, injunctions, once the patent is issued)
  - easier to secure financing (Häussler et al. 2009), reputation as an innovative firm (Henkel & Jell, 2010)
  - warning to would-be competitors

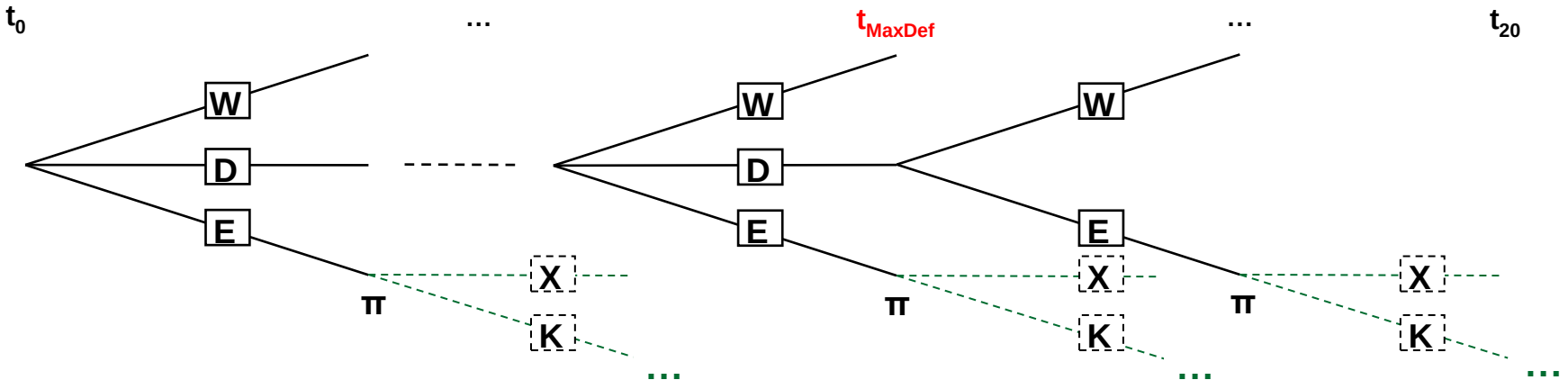
$$r_t^{Appl} = \boldsymbol{q}\, r_t^{Pat} \quad \text{with} \quad 0 < \boldsymbol{q} < 1$$

Model

Optimal decision rule:

In each period choose the strategy with the highest expected value!

- (**W**)ithdrawal: $V_t^W = 0$
- (**D**)eferment: $V_t^D = qr_t^{Pat} - c_t + OptionValue_t^{Defer}$
- (**E**)xamination: $V_t^E = qr_t^{Pat} - c_t - K^{Exam} + OptionValue_t^{Exam}$



Model

■Examination Stage (Canada)

- Examination length is 4 years for all applications
- Obsolescence with probability $\boldsymbol{\theta}$
- Grant probability π = 79%
- Private cost of examination: 3000 CAD$
- Part of uncertainty (learning) is resolved

■Post-grant Stage

- No learning possibilities, such that patent either becomes obsolete, or the per period returns depreciate at a constant rate $\mathbf{1} - \boldsymbol{\delta}^{\boldsymbol{Pat}}$ such that: $r_t^{Pat} = \delta^{Pat} r_{t-1}^{Pat}$
- Since renewal fees are non-decreasing with $\boldsymbol{t}$, (K)eep patent rotection if $r_t^{Pat} \geq c_t$ and let e(X)pire otherwise

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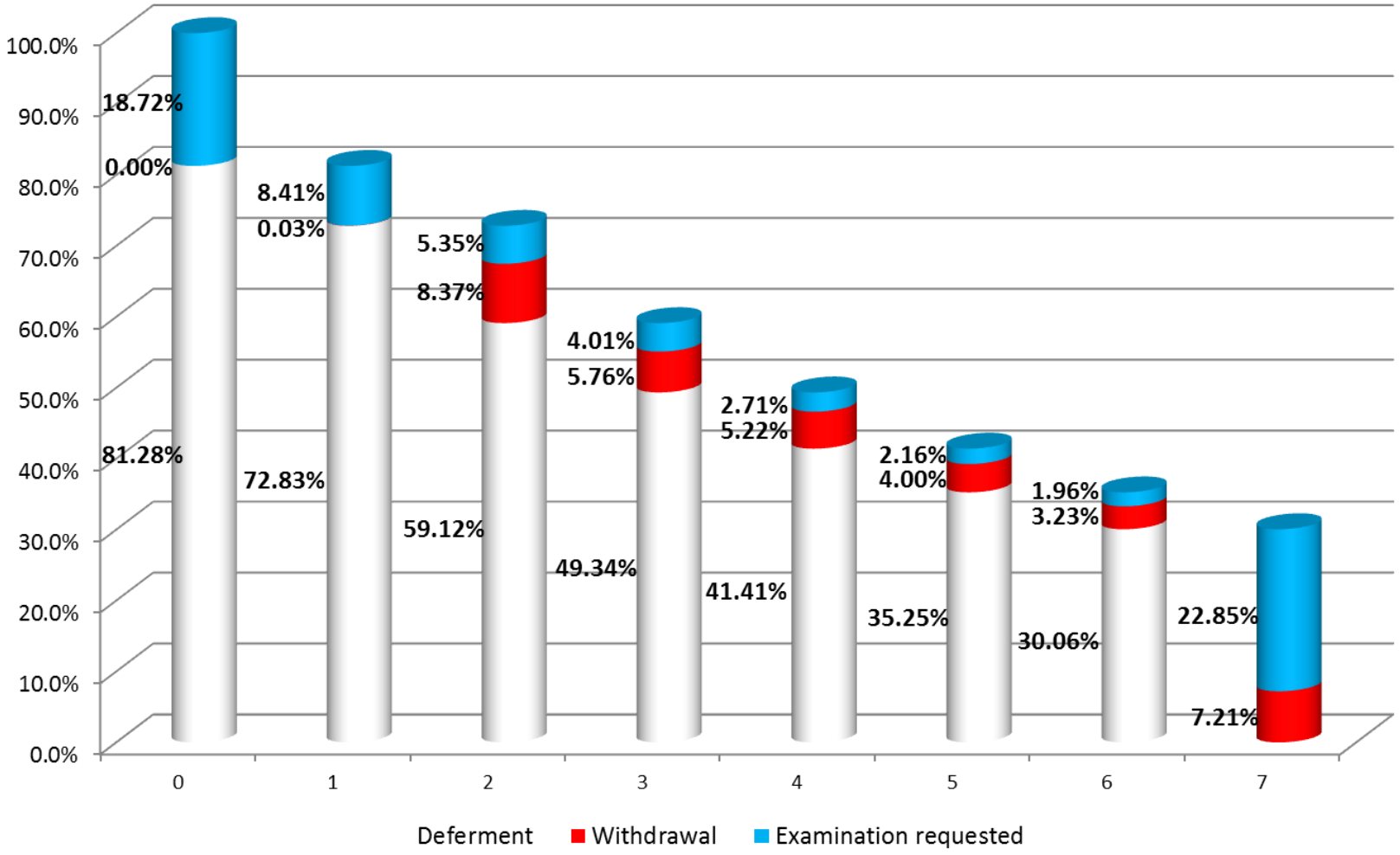
Data

- Legal events data for Canadian patent applications for cohorts 1989-96
- Maximum deferment period was 7 years
- Cohort 1989: 19 decision years, cohort 1996: 12 decision years
- 137,397 non-PCT patent applications (out of 211,550)
- For 33.8% the applications has been withdrawn and for 66.2% examination has been requested (44.23% of all applications have been granted)
- Only 18.72% requested examination within 6 months after application

Data


100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
18.72%
0.00%
81.28%
8.41%
0.03%
72.83%
5.35%
8.37%
59.12%
4.01%
5.76%
49.34%
2.71%
5.22%
41.41%
2.16%
4.00%
35.25%
1.96%
3.23%
30.06%
22.85%
7.21%
0
1
2
3
4
5
6
7
Deferment
Withdrawal
Examination requested

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Value Distribution of Canadian Patent Applications

- Value distributions in line with previous renewal model estimation results
- Value of "Patent Pending":

  q=73.1% of potential returns from patent protection can be realized with a pending patent application

Percentile	All Applications	Patents Overall Value	Patents Before Grant†	Not Granted Applications
50	2,132	15,361	42.15%	184
(s.e.)	(213)	(794)	(0.54%)	(36)
75	16,299	40,096	66.06%	2,093
(s.e.)	(894)	(1,915)	(0.36%)	(203)
90	50,870	99,029	88.97%	8,457
(s.e.)	(2,535)	(4,721)	(0.51%)	(701)
95	97,697	178,425	100.00%	17,445
(s.e.)	(4,844)	(9,284)	(-)	(1,281)
99	362,397	615,681	100.00%	70,463
(s.e.)	(21,352)	(40,859)	(-)	(5,076)
99.9	1,705,073	2,654,362	100.00%	400,452
(s.e.)	(125,165)	(225,414)	(-)	(30,818)
Mean Value	25,743	50,954	50.38%	4,547
(s.e.)	(1,536)	(2,961)	(0.43%)	(393)

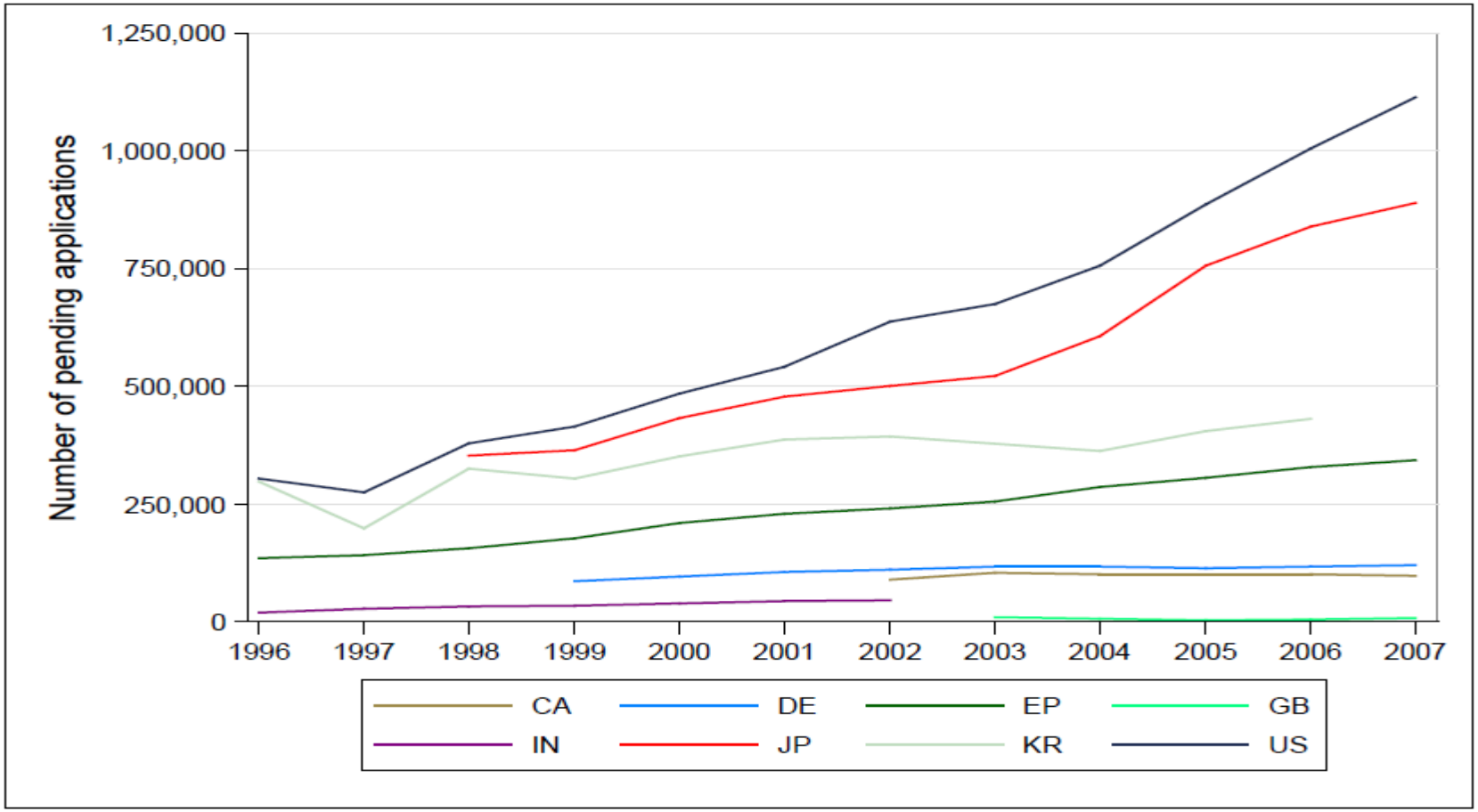
Age	2	3	4	5	6	7	8
$Pr(g_t^A \geq \delta^A)$	53.95%	52.78%	51.61%	50.41%	49.21%	47.99%	46.76%
(s.e.)	(0.81%)	(0.79%)	(0.77%)	(0.75%)	(0.73%)	(0.71%)	(0.69%)

Table 3.2: Learning Possibilities During the Application Stage

- Learning possibilities for applications are persistent!

Option to Defer Examination

Pending Applications under Examination



London Economics, Final Report to the IP Office, 2010

Option to Defer Examination

- 4% less examination requests (per additional deferment year)
- Two correction mechanisms!

Age	$L = 5$	$L = 6$	$L = 7$
1	58,914 (262)†	58,091 (250)	57,460 (240)
2	14,226 (199)	14,007 (201)	13,846 (202)
3	11,383 (116)	11,142 (128)	10,986 (128)
4	9,464 (89)	9,095 (99)	8,872 (115)
5	8,361 (88)	7,835 (94)	7,562 (108)
6	76,998 (292)	7,096 (96)	6,715 (102)
7		64,959 (276)	6,055 (97)
8			54,267 (270)
$\sum$	179,346 (352)	172,225 (338)	165,763 (340)

†Standard errors in parenthesis.

Table 3.4: Examination Requests

change in the	$5 \leftarrow 7$ years	$6 \leftarrow 7$ years
value/ all applications	-5.49%	-2.56%
(s.e.)	(0.168%)	(0.080%)
value/ patents	-4.81%	-2.25%
(s.e.)	(0.152%)	(0.081%)
mean value/ patents	-11.99%	-5.93%
(s.e.)	(0.398%)	(0.178%)
value/ not granted applications	-11.86%	-5.56%
(s.e.)	(0.561%)	(0.283%)
mean value/ not granted applications	-5.37%	-2.34%
(s.e.)	(0.660%)	(0.321%)

Table 3.5: Option Value of Deferment

- Average value of patents increases
- **But:** average value of not granted applications increases as well

➔ Incentive to act strategically!

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Summary & Outlook

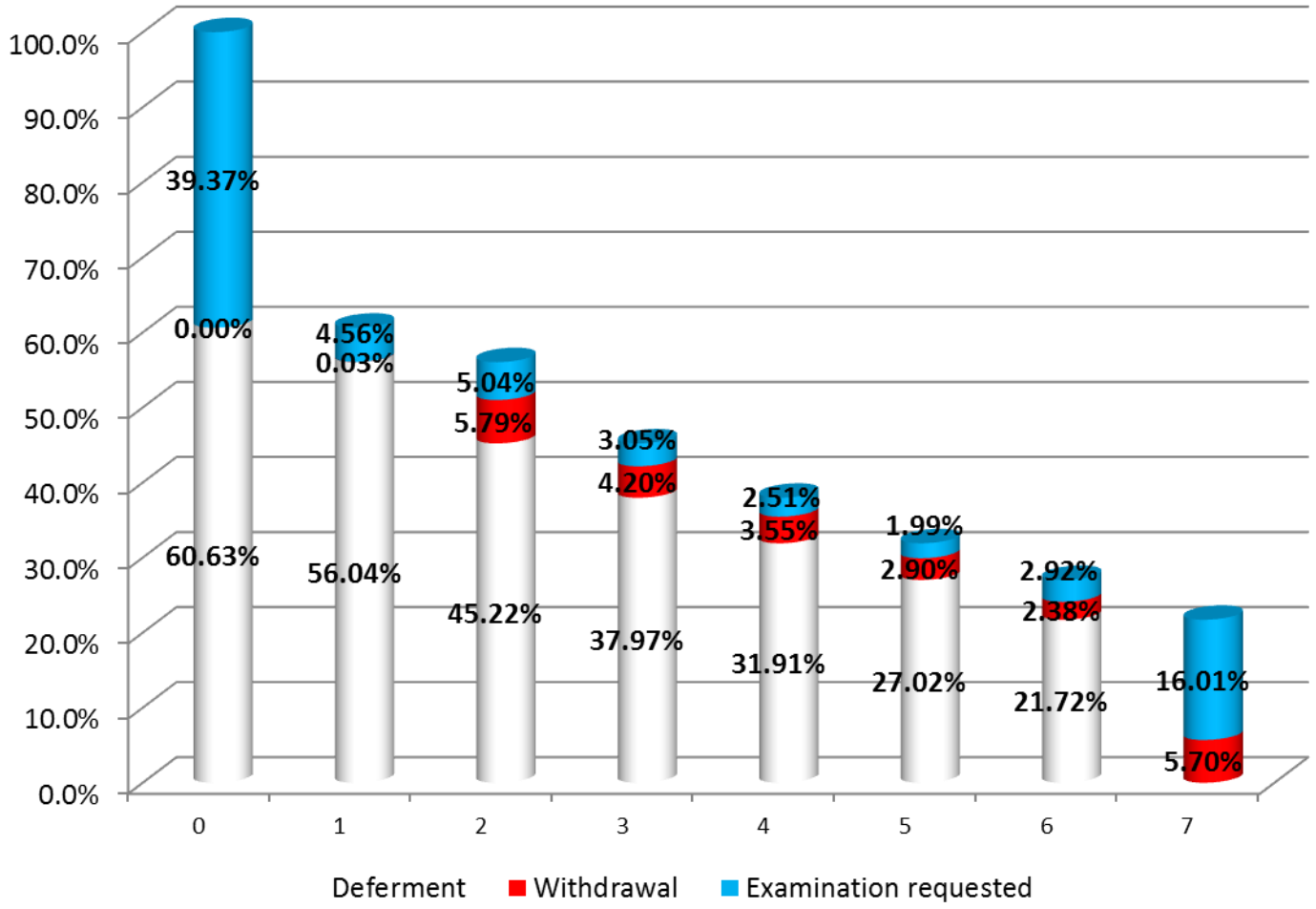
- Model that incorporates application, examination and patent stages
- Structural estimation of value distributions and evolution of returns for Canadian patent applications
  - 73.1% of (potential) per year returns with pending patent application
- Evaluation of the option to defer patent examination

- **Outlook:**
  - German patent applications
  - Optimal fee structure (pre vs. post grant fees)
  - Different technological areas

BACK-UP

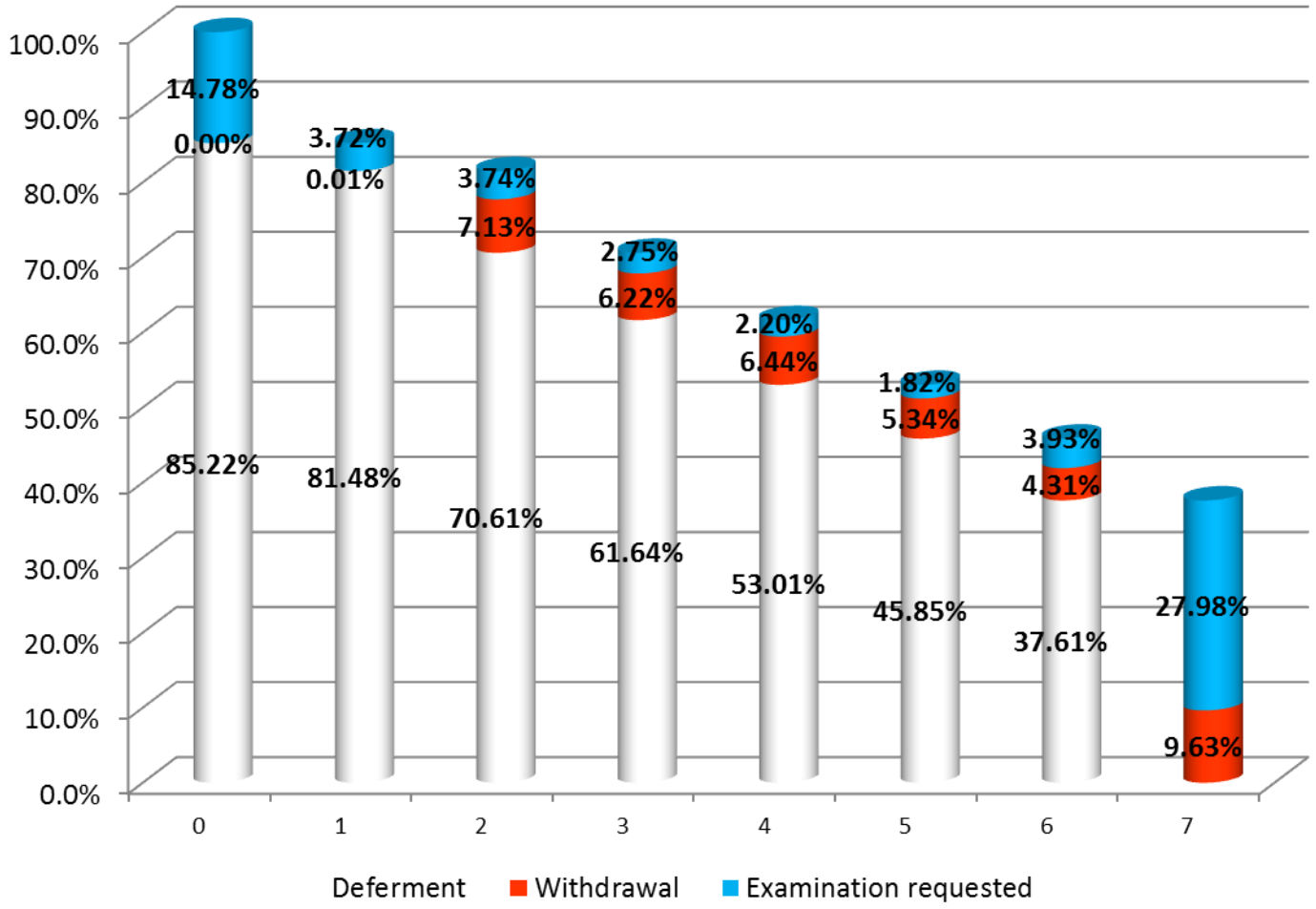
Electrical Engineering

- E. Req. 75.45%
- Wdr. 24.55%
- Gr.R. 77.02%



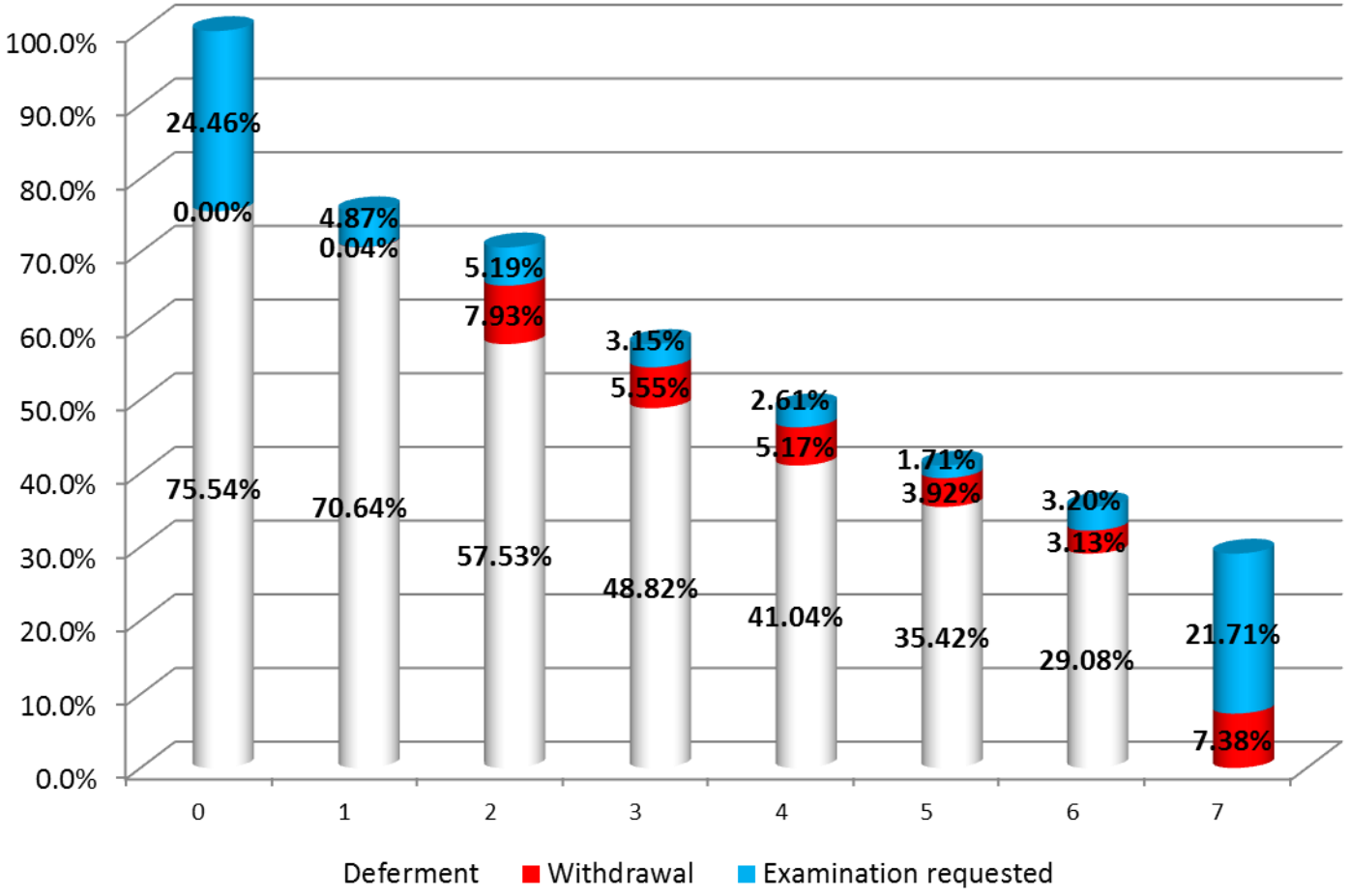
Chemistry & Pharmaceuticals

- E. Req. 60.91%
- Wdr. 39.09%
- Gr.R. 61.88%



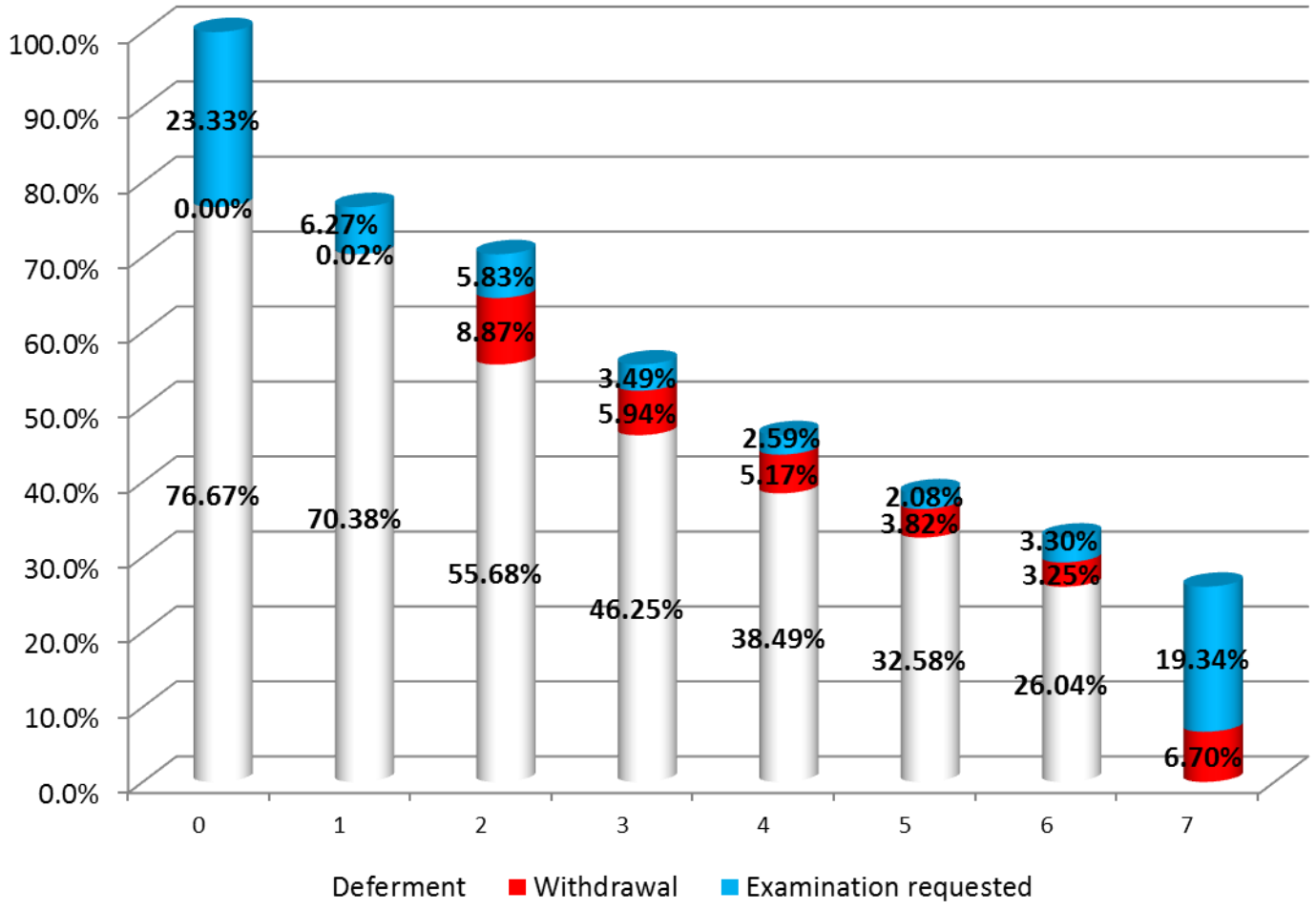
Instruments

- E. Req. 66.89%
- Wdr. 33.11%
- Gr.R. 68.96%



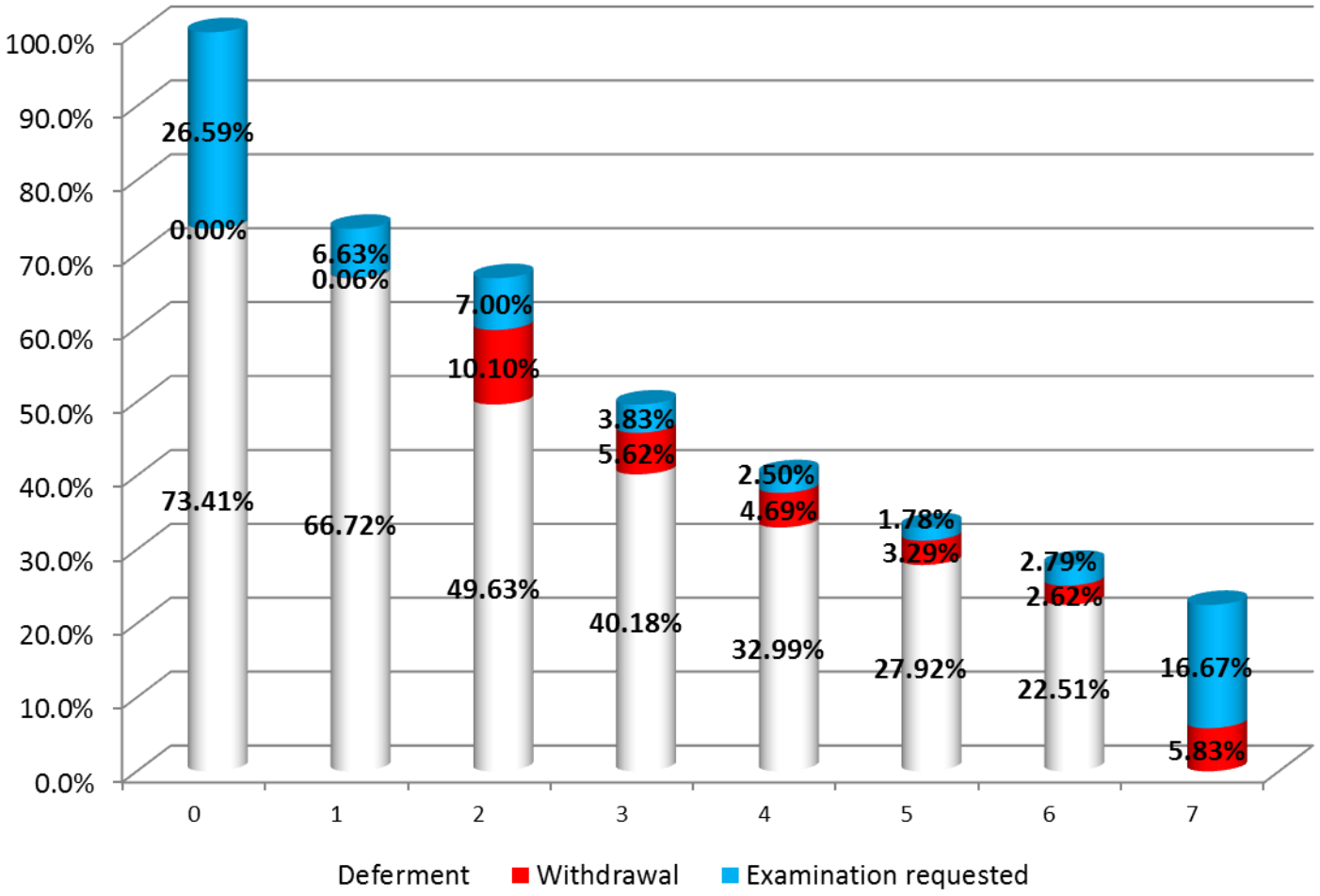
Process Engineering

- E. Req. 66.24%
- Wdr. 33.76%
- Gr.R. 69.65%



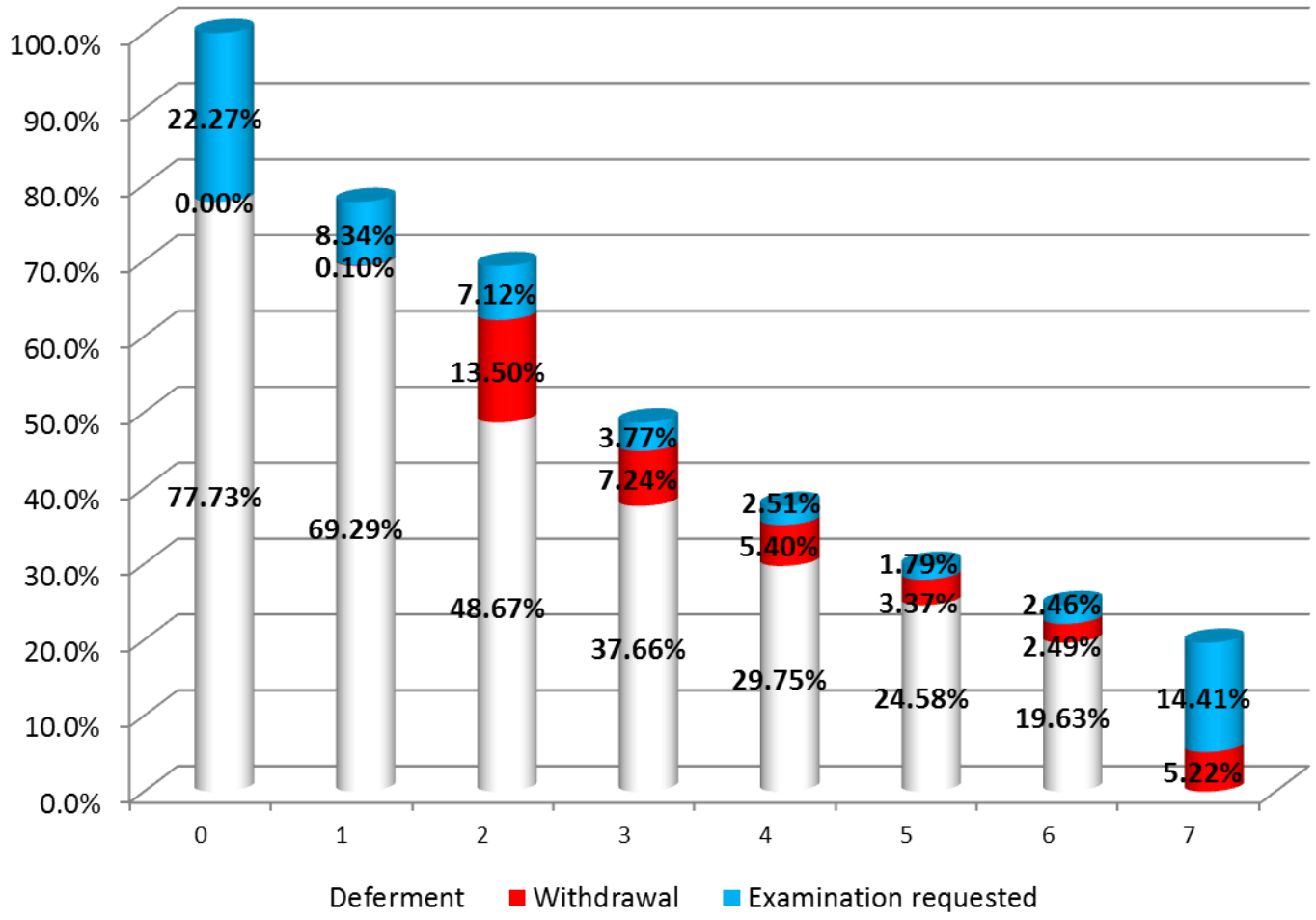
Mechanical Engineering

- E. Req. 67.80%
- Wdr. 32.20%
- Gr.R. 71.34%



Consumer Goods & Construction

- E. Req. 62.67%
- Wdr. 37.33%
- Gr.R. 68.72%



Model Assumptions

■*Anmeldephase:*

•Anmeldeentscheidung wird nicht modelliert, da keine Kosteninformation

•Nur ein Teil möglicher Patenterlöse kann mit schwebender Anmeldung generiert werden

•Vertagung der Prüfungsanmeldung aus Unsicherheit über Wert und strategischen Gründen

■*Prüfungsphase:*

•Prüfungskosten fallen graduell an, durchschnittliche Kosten angesetzt

•Unsicherheit über Patentwert wird beseitigt

•Fixe Prüfungszeit und konstante Erteilungswahrscheinlichkeit, jedoch kompletter Wertverlust möglich

•Alternativ: Fortsetzung der Prüfung als Entscheidung des Patentanmelders nicht des Prüfers ➔ aber: zu wenig Informationen

Canadian Data

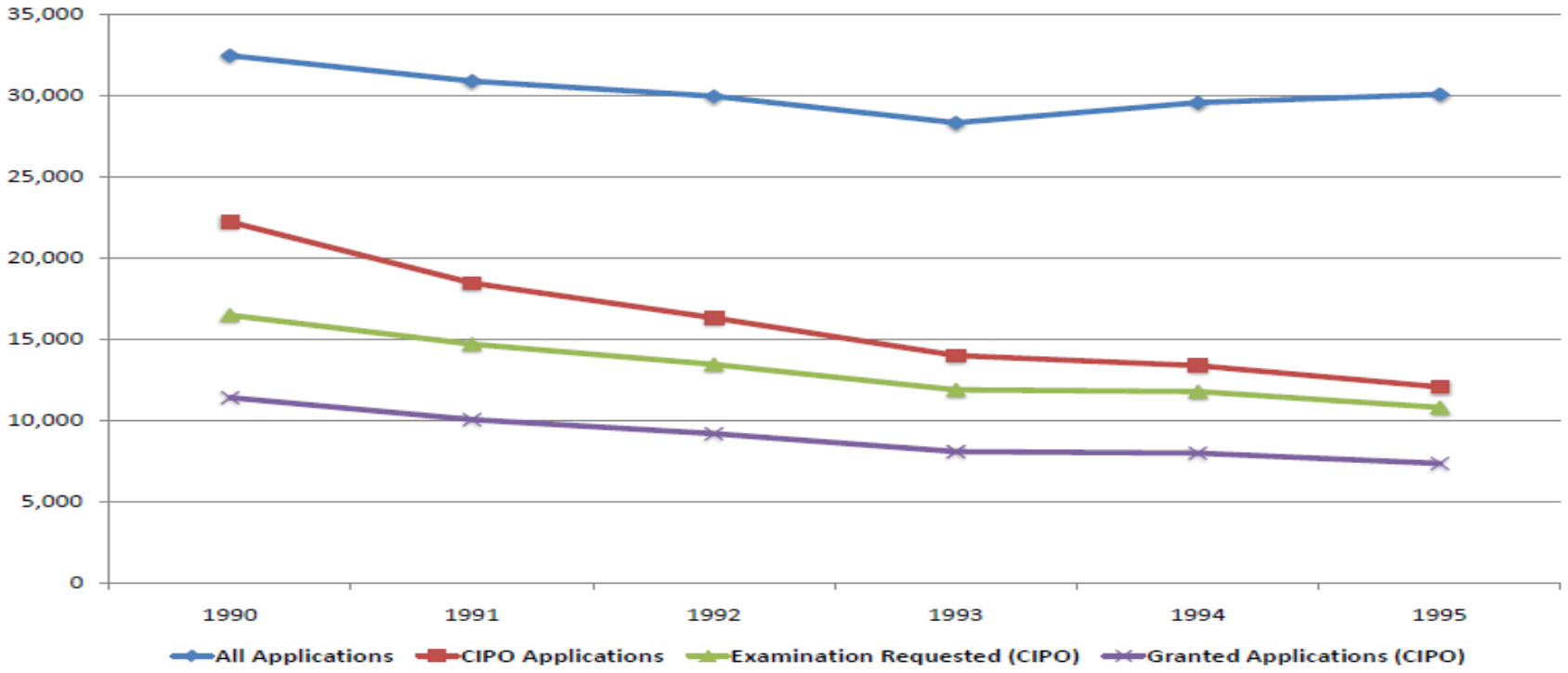


Figure 3: Canadian Patent Applications by Filing Year (1989-1995)

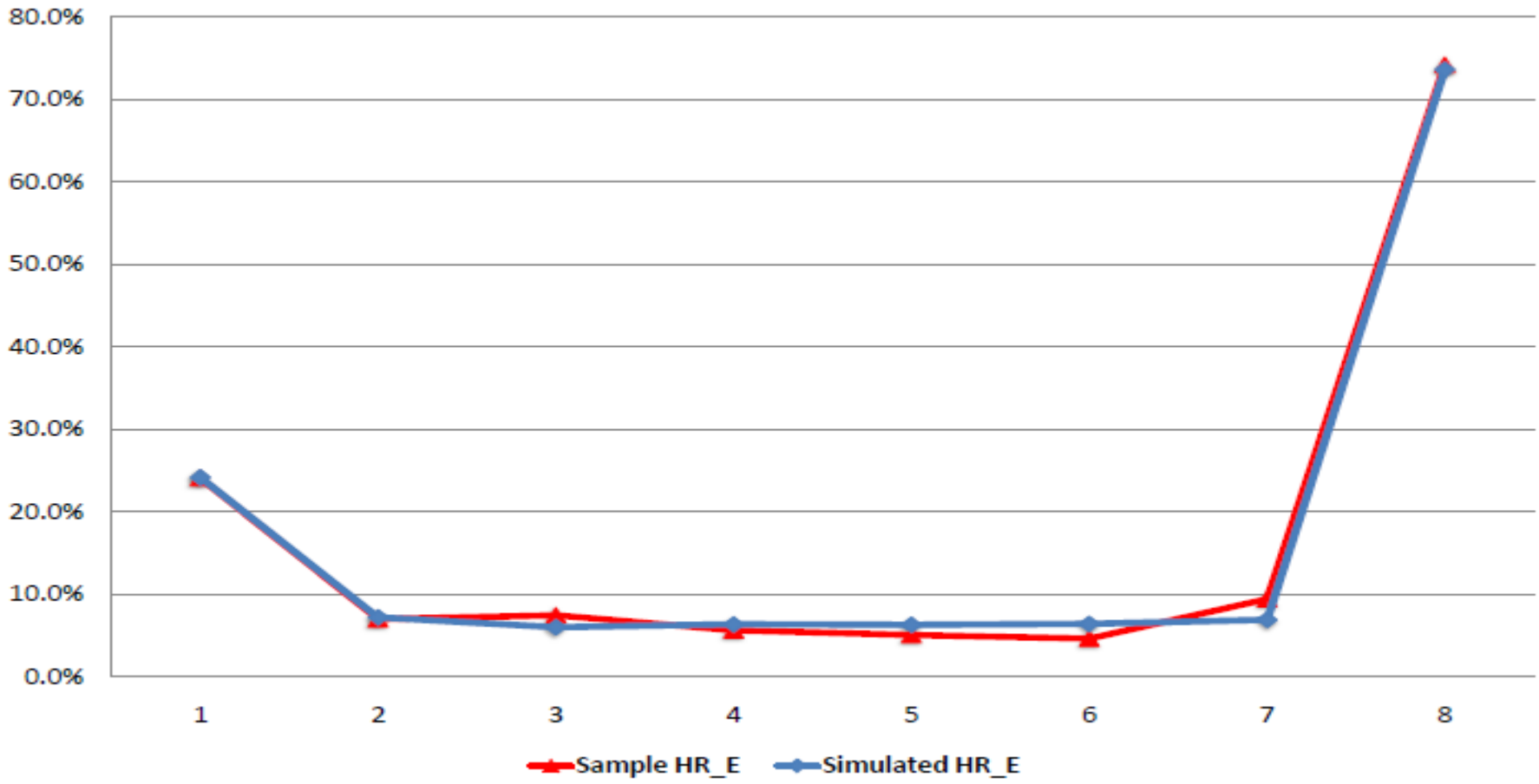
Estimates

Parameter	Estimates	(s.e.)
β (fixed)	0.9500	-
θ (fixed)	0.9535	-
μ_{IR}	5.9015	(0.0491)
σ_{IR}	1.8865	(0.0222)
q	0.7307	(0.0032)
ϕ^A	0.9659	(0.0011)
σ_0^A	1.4090	(0.0238)
δ^A	0.8400	(0.0101)
δ^G	0.9363	(0.0026)
Age-Cohort Cells	212	
Size of Sample	137,427	
Size of Simulation	412,281	
$Var_{All}(h_N)$	0.117316	
MSE_{All}†	0.000855	
$1 - MSE_{All}/Var_{All}(h_N)$	99.27%	
$Var_E(h_N)$	0.050834	
MSE_E	0.000115	
$Var_D(h_N)$	0.002848	
MSE_D	0.000154	
$Var_X(h_N)$	0.000586	
MSE_X	0.000619	

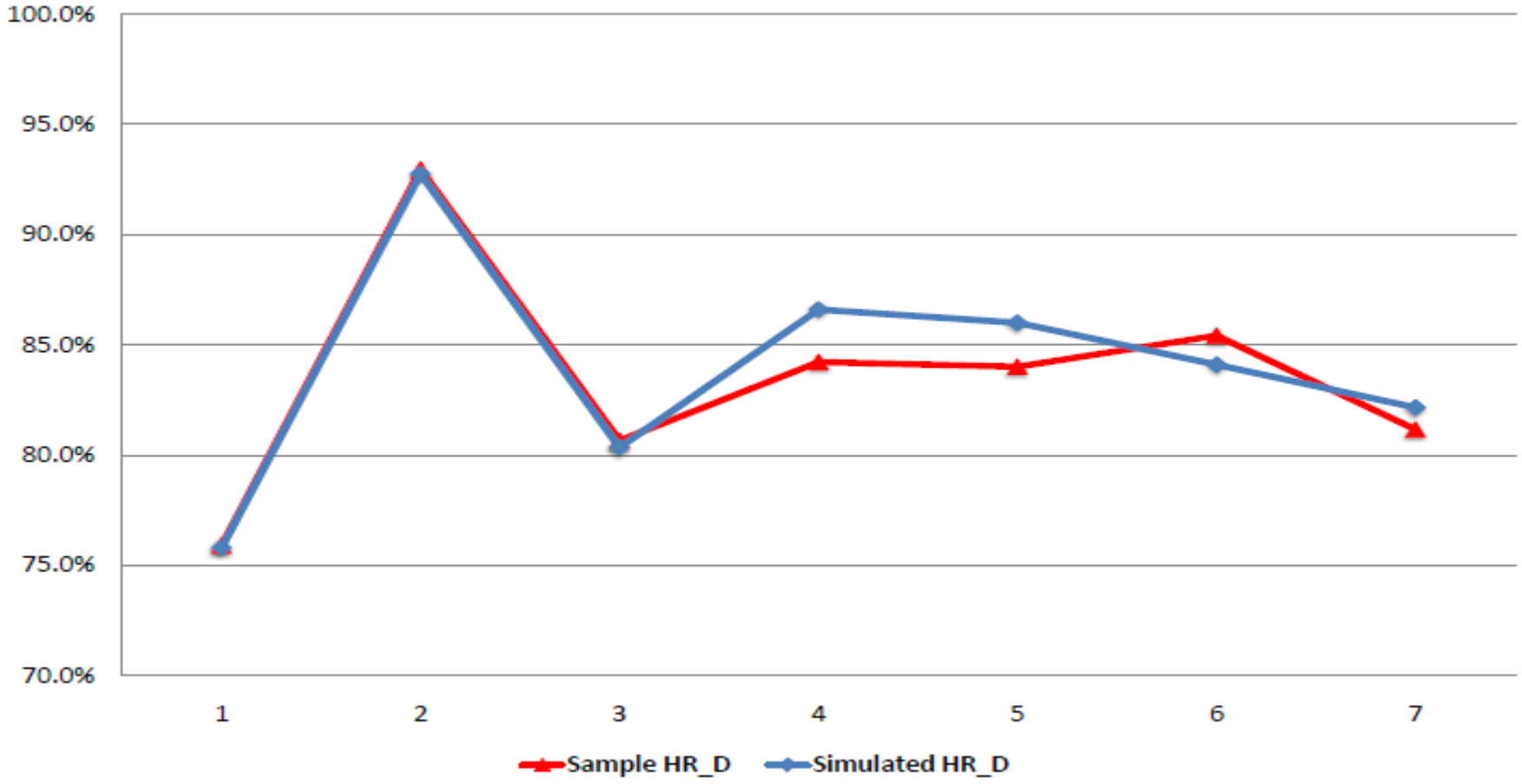
†MSE is the sum of squared residuals divided by the number of age-cohort cells.

Table 1: Parameter Estimates

Simulation vs. Sample Hazard Proportions: Examination



Simulation vs. Sample Hazard Proportions: Deferment



Simulation vs. Sample Hazard Proportions: Expiration