Deferred Patent Examination and the Value of Patent Applications

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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  - Most of the applications never get granted (CAD: 33%, GER: 35% of applications withdrawn before examination)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 $r_{1}^{Pat}$ are taken from a log-normal distribution.
- In any year the patent can become obsolete with probability $\theta$.
- If it does not become obsolete ($1 - \theta$), the per year returns evolve in the following way over time:

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

where $1 - \delta^{Appl}$ represents the depreciation rate and $z$ is drawn from an exponential distribution (represents learning).

- Learning opportunities decrease with application’s maturity (drawing higher $z$ 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

\[ r_t^{Appl} = q \, r_t^{Pat} \quad \text{with} \quad 0 < q < 1 \]
Model

Optimal decision rule:
In each period choose the strategy with the highest expected value!

- **(W)**ithdrawal: \( V_t^W = 0 \)
- **(D)**eferment: \( V_t^D = qr_t^{Pat} - c_t + OptionValue_t^{Def} \)
- **(E)**xamination: \( V_t^E = qr_t^{Pat} - c_t - K_t^{Exam} + OptionValue_t^{Exam} \)

\[
\begin{align*}
W_t & = 0 \\
D_t & = qr_t^{Pat} - c_t + OptionValue_t^{Def} \\
E_t & = qr_t^{Pat} - c_t - K_t^{Exam} + OptionValue_t^{Exam}
\end{align*}
\]
Model

Examination Stage (Canada)
- Examination length is 4 years for all applications
- Obsolescence with probability $\theta$
- Grant probability $\pi = 79\%$
- 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 $1 - \delta^{Pat}$ such that: $r_t^{Pat} = \delta^{Pat} r_{t-1}^{Pat}$
- Since renewal fees are non-decreasing with $t$, (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
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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

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

| Mean Value | 25,743           | 50,954                | 50.38%       | 4,547                    |
| (s.e.)     | (1,536)          | (2,961)               | (0.43%)      | (393)                    |

**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!

<table>
<thead>
<tr>
<th>Age</th>
<th>L = 5</th>
<th>L = 6</th>
<th>L = 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>58,914 (262)†</td>
<td>58,091 (250)</td>
<td>57,460 (240)</td>
</tr>
<tr>
<td>2</td>
<td>14,226 (199)</td>
<td>14,007 (201)</td>
<td>13,846 (202)</td>
</tr>
<tr>
<td>3</td>
<td>11,383 (116)</td>
<td>11,142 (128)</td>
<td>10,986 (128)</td>
</tr>
<tr>
<td>4</td>
<td>9,464 (89)</td>
<td>9,095 (99)</td>
<td>8,872 (115)</td>
</tr>
<tr>
<td>5</td>
<td>8,361 (88)</td>
<td>7,835 (94)</td>
<td>7,562 (108)</td>
</tr>
<tr>
<td>6</td>
<td>76,998 (292)</td>
<td>7,096 (96)</td>
<td>6,715 (102)</td>
</tr>
<tr>
<td>7</td>
<td>64,959 (276)</td>
<td>6,055 (97)</td>
<td>5,4267 (270)</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>∑</td>
<td>179,346 (352)</td>
<td>172,225 (338)</td>
<td>165,763 (340)</td>
</tr>
</tbody>
</table>

†Standard errors in parenthesis.

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

⇒ Incentive to act strategically!

Table 3.4: Examination Requests

Table 3.5: Option Value of Deferment
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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
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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimates</th>
<th>(s.e.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$ (fixed)</td>
<td>0.9500</td>
<td>-</td>
</tr>
<tr>
<td>$\theta$ (fixed)</td>
<td>0.9535</td>
<td>-</td>
</tr>
<tr>
<td>$\mu_{IR}$</td>
<td>5.9015</td>
<td>(0.0491)</td>
</tr>
<tr>
<td>$\sigma_{IR}$</td>
<td>1.8865</td>
<td>(0.0222)</td>
</tr>
<tr>
<td>$q$</td>
<td>0.7307</td>
<td>(0.0032)</td>
</tr>
<tr>
<td>$\phi^A$</td>
<td>0.9659</td>
<td>(0.0011)</td>
</tr>
<tr>
<td>$\sigma^A$</td>
<td>1.4090</td>
<td>(0.0238)</td>
</tr>
<tr>
<td>$\delta^A$</td>
<td>0.8400</td>
<td>(0.0101)</td>
</tr>
<tr>
<td>$\delta^G$</td>
<td>0.9363</td>
<td>(0.0026)</td>
</tr>
</tbody>
</table>

| Age-Cohort Cells | 212 |
| Size of Sample | 137,427 |
| Size of Simulation | 412,281 |
| $\text{Var}_{All}(h_N)$ | 0.117316 |
| $\text{MSE}_{All} \dagger$ | 0.000855 |
| $1 - \frac{\text{MSE}_{All}}{\text{Var}_{All}(h_N)}$ | 99.27% |
| $\text{Var}_{E}(h_N)$ | 0.050834 |
| $\text{MSE}_{E}$ | 0.000115 |
| $\text{Var}_{D}(h_N)$ | 0.002848 |
| $\text{MSE}_{D}$ | 0.000154 |
| $\text{Var}_{X}(h_N)$ | 0.000586 |
| $\text{MSE}_{X}$ | 0.000619 |

$\dagger$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