Methods for Patent Portfolio Valuations
- Challenges for and Responses by Academia

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A very provocative statement...

“Most investment banks have teams of accountants, tax advisers, management consultants, and regulatory affair experts to structure their deals to a company’s greatest advantage. But one would be hard-pressed to find a major investment bank that employs even one individual with experience in evaluating patent portfolios. Doubtless this will change as corporate America and Wall Street become more attuned to the financial and strategic value of intellectual property, but as matters stand now, ”due diligence” regarding patent assets is usually more myth than reality.”


Patent portfolio valuation

The ”punchline”

Questions for this talk

• What are the theoretical and applied challenges when valuing patent portfolios?

• Optimally, how would an portfolio valuation approach look like?

• Where do we stand right now?

• Realistically speaking, what can we hope to see in the future?
The sum of all challenges

Theoretical challenges
- Definition of patent value
- Assessment of future cash-flows
- Assessment of volatility
- Synergies

Applied challenges
- Individual patent valuation
- Portfolio valuation
- Reduce individual evaluation costs

Applied issues: HOW to assess parameters CHEAP?

Data sources
- Custom-tailored expert assessments
- Patent-based bibliographic measures
Wishful thinking...

How an patent portfolio valuation algorithm would "optimally" look like ...

\[ \Pi_{Portfolio} = \int Cum(C(x)))dCdx \]

Cum: Aggregation function

x: Bibliometric indicator

C: Option value of the individual patent

Wishful thinking...

...and why we are so far away from it...

S: Current underlying share price

E: Exercise price of the option

r: Risk free interest rate

\[ C = S \cdot \Phi \left( \ln \left( \frac{S}{E} \right) + \left( r + \frac{1}{2} \cdot \sigma^2 \right) \cdot t \right) - E \cdot e^{rt} \cdot \Phi \left( \ln \left( \frac{S}{E} \right) + \left( r + \frac{1}{2} \cdot \sigma^2 \right) \cdot t \right) \]

σ: Volatility of the share price

t: Time to expiry
Empirical evidence – where we stand today

Linear aggregation and betting on "large numbers" – let’s focus on the variables instead...

\[
\Pi_{\text{Portfolio}} = \sum_{P} \sum_{I} x_{P,i} b_{i} \]

RHS: \(x_i\) = Bibliometric indicator

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Empirical evidence – where we stand today

The RHS variables (1): granting procedures

Application \rightarrow Formal Examination \rightarrow Publication of the Application and the Search Report

- Granting of the Version Approved by the Applicant
- Substantial Examination
- Request for examination
  - Yes
  - No
  - Oppostion
  - National Rights
  - Appeal
  - Withdrawal/Rejection of the Patent Application
### Empirical evidence – where we stand today

#### The RHS variables (1): granting procedures

<table>
<thead>
<tr>
<th>Application</th>
<th>Applicant and Inventor Information</th>
<th>Backward References to the Non-Patent Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Measure of Technological Quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Technological Measure</td>
</tr>
</tbody>
</table>

#### The RHS variables (2): hypothesized links

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypothesized Link to Patent Value</th>
<th>Overall Effect on Patent Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backward References to the Non-Patent Literature</td>
<td>Measure of Technological Quality</td>
<td>Non-Technological Measure</td>
</tr>
<tr>
<td>Backward References to the Patent Literature</td>
<td>Measure of Market Size</td>
<td>Non-Technological Measure</td>
</tr>
<tr>
<td>Number of Designated States (Family Size)</td>
<td>Measure of Market Size</td>
<td>Non-Technological Measure</td>
</tr>
<tr>
<td>Number of Forward Citations</td>
<td>Measure of Novelty / Inventive Step</td>
<td>Market Size</td>
</tr>
<tr>
<td>Number of Applicants / Number of inventors</td>
<td>Measure of Inventive Step</td>
<td>Market Size</td>
</tr>
<tr>
<td>Indicators Referring to the Filing Strategy (Accelerated Examination Request, PCT Indicators)</td>
<td>Measure of Market Proximity</td>
<td>Market Proximity</td>
</tr>
</tbody>
</table>

Legend: - negative / + positive / ++ highly positive / missing: no link or effect
Empirical evidence – where we stand today

Linear aggregation – and focus on the variables...

\[ \sum_{\text{Patent}=1}^{P} \sum_{i=1}^{I} x_{P,i} b_i \]

\[ \Pi_{\text{Portfolio}} \]

LHS: Value-related variable
RHS: \( x_i = \text{Bibliometric indicator} \)

The LHS variables: value-related variables

**Expert ratings**
Albert et al. (1991); Harhoff et al. (2003); Reitzig (2003)

**Residual market value**
Cockburn and Griliches (1988); Megna and Klock (1993); Conolly et al (1986); Conolly and Hirschey (1988); Bloom and van Reenen (2000); Hall et al. (2000); Bosworth and Rogers (2001); Hirschey and Richardson (2004); Ramb and Reitzig (2004)

**Value-related phenomena (e.g. validity suits and oppositions)**
Lanjouw and Lerner (2001); Harhoff and Reitzig (2004)
### Empirical evidence – where we stand today

**The RHS variables (3): an overview**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Validity</th>
<th>Availability in Time</th>
<th>Compilation Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theoretical Foundation</td>
<td>Empirical Evidence as of Today</td>
<td>(Lower bounds)</td>
</tr>
<tr>
<td>Backward Citations</td>
<td>+</td>
<td>+/- 18</td>
<td>E</td>
</tr>
<tr>
<td>Forward Citations</td>
<td>++</td>
<td>ca. 42</td>
<td>E</td>
</tr>
<tr>
<td>Family Size</td>
<td>*</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Scope</td>
<td>-</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Ownership</td>
<td>+</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Number of Claims</td>
<td>++</td>
<td>+/- 18</td>
<td>E</td>
</tr>
<tr>
<td>Patenting &quot;Strategy&quot;</td>
<td>++</td>
<td>+/- 18</td>
<td>E</td>
</tr>
<tr>
<td>Number of Applicants</td>
<td>+</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Number of Trans-Border Research Co-operations</td>
<td>*</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Key Inventors</td>
<td>+</td>
<td>18* (preliminary); ca. 42* (finally)</td>
<td>E</td>
</tr>
<tr>
<td>Legal Disputes (Opposition in Particular)</td>
<td>++</td>
<td>+/- ca. 42* (preliminary); ca. 49* (finally)</td>
<td>M, partially E</td>
</tr>
</tbody>
</table>

### Empirical evidence – today and tomorrow

**Summary**

*Explanatory power in selected cases*
- Average deviation on the order of 5% between predicted and "observed" portfolio value when estimating the value of portfolios on a dichotomous scale in the chemical industry

*Remaining caveats*
- Variance of indicators at the firm level
- Availability of indicators in time
- Structural relationships between portfolio value and indicators

*Ongoing research*
- Tackling the caveats
  - Full-text analysis
  - Early time indicators
  - Structural test of more complicated models
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