EMPIRICAL STUDY OF THE IMPORTANCE OF BIBLIOMETRIC INDICATORS FOR PATENT PORTFOLIO VALUATION AND PROPOSED NEW INDICATOR MODEL

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Abstract
Valuation of intangible assets becomes a key issue for companies oriented towards continuous innovation since information and knowledge represent an important dimension of the market value. In this context, patents are relevant components of the intellectual property portfolio. Various methods have been proposed by now to valuate patents in monetary units. However, none of them is enough comprehensive to cover all facets that shape intangibles. For patenting strategy and internal decision making, as well as for bookkeeping, bibliometric indicators for patent valuation is of high relevance. An empirical model based on bibliometric indicators has been formulated in this research. In order to extract the tacit knowledge and perception of IPR experts about the relevance of possible bibliometric indicators in the equation of patent valuation, a survey on 40 IPR experts was conducted in this research. Several theses have been considered and tested. The empirical study highlighted the need of refining the definition and components and revealed that citations and patent family are significant indicators in patent valuation.

Keywords:
patent valuation, bibliometric data, citation analysis.

1 INTRODUCTION

The filing of intellectual property rights, especially patents and utility models, has been rapidly grown in the last 5 years due to a high activity from Asian companies. At the European Patent Office the growth of patent filings was +5.4% in the years 2011-2012. Almost 60% of this growth was accounted to companies from China, Korea and Japan [1]. Due to the increasing of IPR data, more and more information retrieval and analysis methodologies are required.

In 2008 the complete Nortel Company was sold for $ 3.5 billion. Its patent portfolio of 6,000 patent families was sold separately for $ 4.5 billion [2]. This shows in a very impressive way intangible values of high-tech companies.

One of the biggest values at immaterial assets are intellectual property rights (IPR) like patents or trademarks. Companies have the need to balance their intangible assets at their accounting system due to different reasons:

1. Companies listed at the stock market have the opportunity, that the intangible assets which are listed in their accounting system have a direct influence on the company value (stock value)
2. Increasing the assets in the balance sheets offers the opportunity

- to get credits under better conditions
- for mergers & acquisitions transactions the value of the company can be better determined and it can be much higher than without intangible assets

Furthermore there are a lot of strategic reasons for balancing the intangible assets:

- Purchases and sales of intangible assets
- Management of IPR portfolio
- Acquisitions, mergers and sales of businesses or parts of businesses
- Management of R&D expenses
- Strategic alliances between companies: cross licensing greatly simplifies the dealing because the value of the patents is determined
- Management of budgets
- Reporting to tax authorities
- Litigation and insolvency proceedings
- Financial reporting

The best representation of intangible assets are patents because they can be evaluated much well than any other intangible asset.

In the last decades many theoretical methods have been developed for the evaluation of patents, like:

- Model of Hoffman/Barney [3]
- Portfolio model of Hofinger [4]
- Cost Approach [5]
- Income Approach or Discounted cash flow method [6]
- Incremental Cash Flow method [7]
- Licence Analogy Method [8]
- Relief-from-Royalty method [9]
- Real options method [10] etc.

Furthermore proprietary systems for the evaluation of patents combining different methods have been developed [11].

All patent valuation methods need high effort in the evaluation process in order to achieve a reliable result. Most of them are only working if the patented technology is still represented in the sold product (market approach). Many companies avoid the evaluation of their complete patent portfolio because of the high effort in time which correlates with high costs. Therefore there is a serious need to identify the “high-potential” patents which should be evaluated first.

An empirical study of InTraCoM GmbH, Stuttgart, shows the followings by evaluating 20% of the patent portfolio – according to Pareto principle – nearby 80% of the values can be identified. The evaluation of the European Patent Office comes to similar results showing that only 25% of all granted patents in Europe have a value over 1 Mio. € [12].

2 EMPIRICAL STUDY

An empirical study was performed during 2013 among 40 international experts in IP valuation. Most of the experts

operate in the industrial area, the participants' profession being characterized as follows in Table 1.

Table 1: Business area of the IP experts included in the survey

Bsuiness area	No. of experts
Technology	19
Aerospace & defence	2
Communications	2
Energy, utilities & mining	2
Engineering & construction	2
Retail & consumer	2
Chemicals	1
Government/public services	1
Healthcare	1
Industrial manufacturing	1
Metals	1
Pharmaceuticals & life sciences	1
not specified	4

In this survey, different theories for the bibliometric analysis of patents have been examined.

The first area is the "*size and country of the granted patent family members"*. Putnam (1996) [14] and subsequently a number of other authors argued that information about patent family size may be particularly adapted as value indicator for patent rights. The studies by Putnam (1996) [14] and Lanjouw et al. (1998) [uniformity in citations] have shown that the size of a patent family, measured as the number of jurisdictions (patent countries) in which a patent grant has been sought, are highly correlated.

To measure the strength and intensity of the "family size" indicator, it is recommended to verify the number of countries in which protection for a particular invention was sought.

The size of a patent family is an indicator for the market impact that the technology described in the patent may have. The assumption is, that the higher the applicants willingness to pay for a large territory protection, the higher the patents value.

On the other hand, some authors claim that the assumption that patent value increases with its family size is sometimes wrong, because a large number of countries may reflect a lack of maturity of the applicant. Further, the larger a potential market for a patent, the higher the likelihood of the focal patent being an incremental contribution and therefore low technology quality [15]. The main conclusion of several empirical studies is, that the size of a patent family does not reflect the value of patents in a linear way [16].

In addition to that the patent family, a company has very often the same designated states. This occurs from the specific technology in the specific countries a company is active, but one influence factor is also the force of habit in the IPR department.

The following hypotheses were examined in the current study:

a) the larger the family, the higher the market impact
b) a granted US Patent is always more valuable than any other
c) a Triade Patent family (US, EP, JP) always has the highest value
d) size and country of the granted patent family members influence the patent rank

The results of the answers are shown in Figure 1.

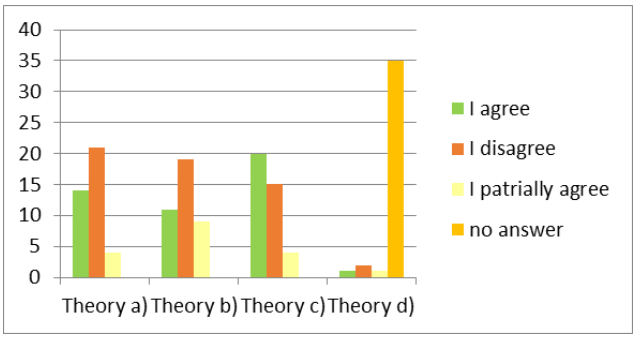

Figure 1: Results of the survey on the four theses related to the first indicator

The answers of the experts reflect clear opposing opinions about the impact of a patent family. Therefore there is a need in adjusting this indicator and turning it into a particular significant indicator by interpreting the technology described in the patent family and connecting it with the GDP of the specific country.

The second area examined at the study are the "*citations"* in a patent. There are two different types of citations: forward and backward citations. Forward citations are future citations received by a patent and are more important than the backward citations, because in the case of forward citation the main indication is that an innovation has contributed to the development of subsequent inventions. For this reason, citations have been used as a measure of the value of an invention. The main thesis is that the more often a focal patent is quoted as prior art during examinations of subsequent patent examinations, the more fundamental its technological contribution to the field, thus the higher the quality [17].

Backward citations are used to determine the inventory step of the innovation and because this is connected with the patent applying process of the attorney it can't be used as a proper indicator. Some attorneys are using a huge amount of backward citations with the aim to show the examiner that the applied patent is very innovative, other attorneys do not use this very intensively. Also the application process in different countries leads to different amounts of backward citations. International patent attorneys claim from their experience that the citation usual ratio is 1:7:20 (Germany: Japan: US) – this means that in US they cite 20 times more than in Germany. Further, Michel and Bettels [18] found that while 90% citations in USPTO patents are related to other USPTO patents, in EPO patents they contain a wide range of patent offices: 23.3% EPO, 30.9% USPTO, 16.3% WIPO, 13.1% Germany, 6.2% British, 5.2% Japanese, and 5% others. Further, examiners in the patent offices have a certain amount of patents they always use for citations (because of time reduction for the examination process).

The following theories were examined in the current study:

e) the more backward citations found in a patent, the better the state of the art described
f) the self- citations of an assignee do not count when calculating the citation index
g) the more foreign forward citations, the higher the technology impact of the patent
h) citations are correlated with patent age (e.g. a young patent can't have forward citations).

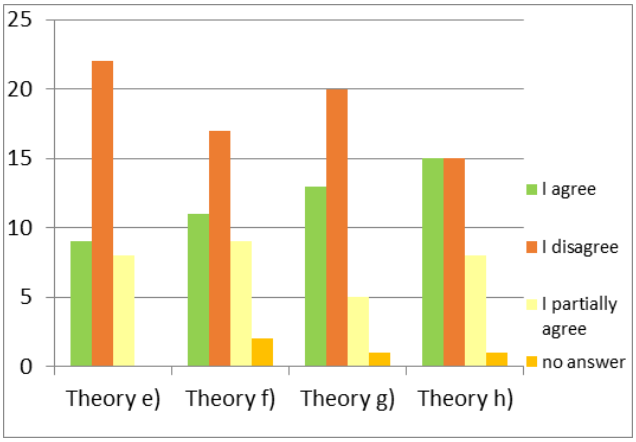

Figure 2: Resukts of the survey on the four theses related to the second indicator

Results are shown in Figure 2. The answers of the experts reflect clear opposing opinions with a negative trend for this indicator. Therefore, there is a need for improving this indicator and to take different factors like the increasing numbers of citations in the last years, the citations of the examiners etc. into consideration.

The third area examined in this study is related to different other theses:

i) Number of applicants, optimum 1
j) Number of inventors, optimum at 3-7
k) Accelerated examination request
l) Number of independent claims (the more the better)
m) Length of claims (the shorter the better)
n) Patent age – optimally around 11 years

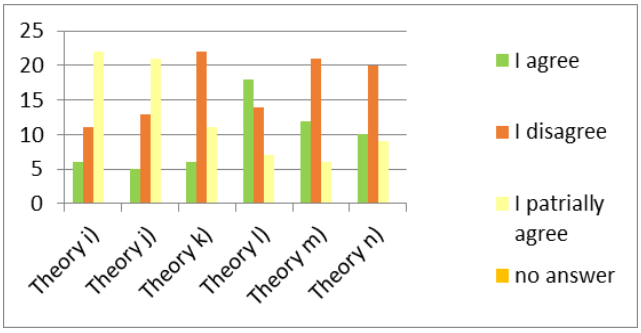

Figure 3: Results for other examined theses

Answers are illustrated in Figure 3. The answers of the experts reflect in this area opposing opinions as well, but some theories are more mainstream.

3 PROPOSED MODEL FOR THE MAIN INDICATORS

Based on different possible indicators, the proposed main indicators determining the market and technology impact of patents are basically:

Market Impact [*Mi*] = *f* (size of the patent family) (1)

Technology Impact [*Ti*] = *f* (citations) (2)

The proof of principle relying on the use of patent families as substantive market indicator is supported by following thesis.

Thesis: The larger a strict patent family (count of equivalents), the higher the patent value because more markets are protected by monopole) and the more economically important the countries of patent application in the family are (from a market perspective) the higher the patent value.

This thesis is as well confirmed from the survey, as it is shown by “Theory c)”.

The importance of the countries correlates with the dynamic of IPC deployment. This means, that e.g. a patent assigned for US is more important than a patent assigned for a third world country. But, there is the possibility that patented technologies address newly industrialized countries or developing countries, e.g. mining- or oil-drilling-technologies. Therefore an improved indicator is proposed.

Mi_{new} = number & quality of the applicant countries in the patent family (3)

This indicator was not understood in the survey, therefore “Theory d” had low response.

The quality of a family is described as “the share of GDP in the applied country correlated with share of applied country at the same IPC (main) class”. This new indicator is describing more precise the value of the patent family because each patent family is analysed specific to the market importance of the technology in the country of application.

The main thesis behind the use of citations as a strong technology indicator is:

Thesis: The more often one granted patent is cited in other (newer) patents, the higher will be its value.

The challenge on the citation index is that it does not only depend on the quality of a patent but also on the remaining life of the patent: e.g. if a patent is newly published it cannot have any citations, if a patent is quite old, the possibilities are growing.

This thesis is also well confirmed from the survey, as it is shown by “Theory h)”.

Therefore a new indicator for the forward citations is proposed as follows:

CI_f = *f* (total number of citations & rate of citations per year & remaining life of the patent) (4)

Concerning the number of citations, the citations of the assignee must be removed. The reason is that companies often cite their own patents in order to show technological diversity and therefore to protect a broader area.

Thesis: The higher the amount of cited patents the higher the technology impact.

Because of the different citation behaviour in different countries, there has to be an adjustment of the number of citations. Further there has to be constructed a ratio between the citations of the inventor and the citations of the examiner.

Based on the research of Michel, J., Bettels, B [18] the citations have also to be correlated as well with the different technology areas, represented by the IPC class. Therefore an improved indicator for the backward citations is proposed as follows:

CI_b = *f* (amount of cited patents & citation rate in the designated states & citation rate at the (main) IPC class). (5)

The indicator for the technology impact is therefore:

$$Ti_{new} = CI_f + CI_b \quad (6)$$

Thus, the two new indicators Mi_{new} and Ti_{new} are proposed by the authors of this research to be considered in patent valuation procedures.

4 CONCLUSIONS

The results of the empirical study show that most of the indicators which are explored in past studies there is a claimed distrust in them. This is caused by potential wrong interpretation and/or wrong basics and assumptions on which they are built.

Therefore the improvement of the indicators in order to obtain a more precise and reliable proposition is necessary to be done.

The proposed system of the main indicators can lead to a better understanding of the value indicators in patents, because important basic rules from patenting behaviour have been taken into consideration.

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