IMPROVEMENTS IN PATENT PORTFOLIO VALUATION WITH BIBLIOMETRIC INDICATORS

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ABSTRACT: This paper goal is to introduce substantial improvements in patent valuation by using two of the most significant bibliometric indicators: the size of the patent family and the backwards and forwards citations. The size of the patent family represents the market impact and the citations represent the technology impact of a granted patent.

The purposed indicators describe the quality of a patent related to the complete patent portfolio which is evaluated. The main purpose is the qualitative analysis of patent portfolios. The advantage of using the indicators is that large patent portfolios can be scanned in order to find the ones with the highest value. Further the portfolios can be benchmarked by using these techniques.

Key words: patent valuation, bibliometric data, citation analysis, patent family analysis

1. INTRODUCTION

The importance of intangible assets has greatly increased in the last decade from 40% in the early 1980s to over 80% at the end of the 1990s. This means that today only 20% of a company's market value is reflected in its accounting system [1]. In 2008 the complete Nortel company was sold for $ 3.5 billion, their 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[1] 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 better 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]

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 following 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

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[1] In this model we define intangible assets only as IPR-rights. Other intangible assets like customer relations, human resources, business models, etc. are not reflected.

Organisation comes to similar results showing that only 25% of all granted patents in Europe have a value over 1 Mio. € [12].

2. INDICATORS FOR PATENT VALUATION

The following indicators are proven to be the most reliable for patent valuation, in order to find the patents with the most possible highest value inside a bunch of patents in a portfolio.

The bibliographical data which will be evaluated consists of

1. the size of the Patent family [PF] [13]
2. the citation Index [CI] [14]

These two bibliometric indicators represent the most important ones which can be extracted automatically from a patent database. The size of the Patent family is representing the market impact and the citation index the technology impact.

Those indicators have the disadvantage that they can't determine an accurate value – this is only possible due to a deeply human examination of a patent. There are a lot of traps existing which can rate the value of a granted patent even down to zero. Some of them are:

1. Legal status
   If the real owner of a granted patent is not clear, there is a big uncertainty of the valuation process. Sometimes patents are an output of a common R&D project of companies and/or universities and if this project is funded with subsidies problems can occur due to the uncertain legal situation on these patents.
2. Patent Interdependencies
   Often patents are based on claims of previous patents and which are cited in the application document. Sometimes the technology which is described in the newer granted patent can only be applied if the older patent on which the newer one is based has been exploited or is in use. And if these dependent patents are belonging to different assignees the problem is clear and the value of the newer can't be appointed if there is no license agreement existing.
3. Vulnerability of a patent
   Worldwide patents are only granted if the described technology/solution in the patent is an improvement of the current state of the art. In most infringement or oppositions the defendant party is therefore trying the action of annulments by searching of older publications where the patented technology is described. Therefore there is always an uncertainty existing if the described technology in the patent has been somewhere been published before the application date.

Further bibliometric indicators which can be found in several studies are [21, 22, 23, 24]:

1. Number of applicants
2. Number of inventors
3. Accelerated Examination Request
4. Claims
   - Independent
   - Additional
   - Lenght
5. Duration of the patent examination process
6. Oppositions
7. Pages of the application

Those bibliometric indicators are very difficult to be used for valuation process due to habits in patenting practise

- in the different countries,
- of the patent attorney,
- of the assignee.

3. MAIN INDICATORS FOR PATENT VALUATION

The main advantage of the following described indicators is that the valuation process can be done automatically – without reading a patent. This makes the process less time-consuming and big data volumes can be analysed easily.

Based on the industrial need, the core of the described indicators is to pre-evaluate automatically the patents in order to identify the ones with the highest value. The only possibility for automatic evaluation is based on the bibliographical data which can be extracted from patent databases.

For the indicator 1 (Patent family size) and indicator 2 (Citation Index) several studies have been carried out in the past.

1. Patent family size

Putnam (1996) 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) 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 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 in 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. Therefore there is a need in adjusting this indicator and turning him into a particular significant indicator.

2. Citation index

There are two different types of citation: forward and backward citations. Forward and backward citation are Future citations received by a patent (forward citations) 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 patent a focal patent is quoted as prior art during examinations of subsequent patent examinations, the more fundamental its technological contribution to the field, 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 good 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 ratio is Germany : Japan : US is 1:7:20 – this means that in US they cite 20 times more than in Germany. Further Michel and Bettels[18] found that, while 90% citations ins USPTO patents are to other USPTO patents, in EPO patents 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 the examiners in the Patent offices have a certain amount of Patents they always use for Citations (because of time reduction for the examination process) – this behaviour from the practical point of view can have influences. This topic was examined by Criscuolo and Verspagen[19].

The forward citation is also a main indicator for the litigation process. In the work of Jean O. Lanjouw, and Mark Schankerman [20] it is shown that there is a direct impact between citation and litigation.

The amount of citations is also depending from the technological field in which the patent has been classified. Crisuolo, Bart Verspagen [19] claim that the share of inventors is also related to the technological field as follows:
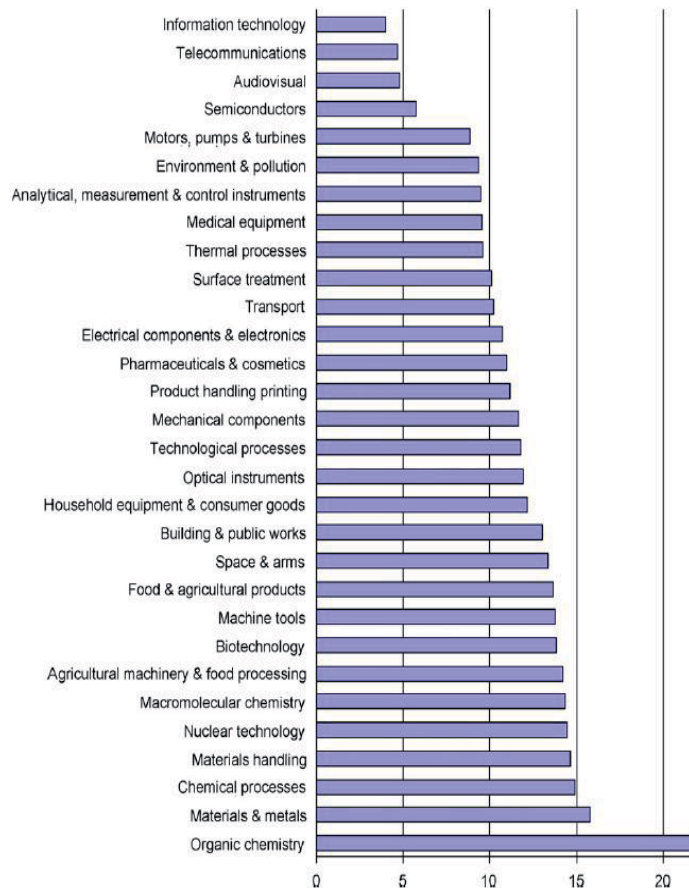

Figure 1. Share of inventor citations by technological field

4. IMPROVEMENT OF THE MAIN INDICATOR

The main indicators used for the market and technology impact are:

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

Technology Impact $[Ti] = f$ (citations)

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

The importance of the countries correlates with the dynamic 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 the **improved indicator** is proposed which is

Mi_{new} = number **and** quality of the applicant countries in the patent family

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 at the applied country.

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

Thesis 2: 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. Therefore a **new indicator** for the forward citations is proposed as follows:

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

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 3: 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 the **improved indicator** for the backward citations is proposed as follows:

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

The indicator for the Technology impact is therefore:

$$Ti_{new} = CI_f + CI_b$$

5. FURTHER RESEARCHES

These improved indicators have to be examined in a representative empirical work. Further research in this area could be done by implementing more bibliographic data like:

- claims (number & quality)
- inventors
- oppositions and anticipations /references

6. CONCLUSIONS

This paper has surveyed the literature related to the most important indicators built from bibliometric data for patent valuation. Further this paper shows the improvement of the indicators in order to obtain a more precise and reliable proposition.

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