Using Bibliometric Indicators from Patent Portfolio Valuation as Value Factor for Generating Smart Beta Products

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Abstract. This paper goal is to present the results of the use of patent valuation indicators as alternative data which can generate a value factor which is suitable to design financial products. Based on different patent value indicators which address the areas "assignee", "technology" and "market" an "IP portfolio index" was designed and back tested with real market data. The outperformance of the IP portfolio index is shown in the current paper.

Keywords: Patent valuation · Bibliometric data · Stock picking · IP portfolio index · Smart beta · Factor-investing · Alternative data

1 Introduction

Alternative data (proprietary datasets) in different areas like geo-location, credit card, social/sentiment or web traffic became very popular over the last years at financial institutions promising additional insights beside business data.

The financial asset management institutions like discretionary, quantitative or hedgefunds develop own indexes which should outperform in terms of absolute return on investment with low maximum drawdown (A maximum drawdown (MDD) is the maximum observed loss from a peak to a trough of a portfolio, before a new peak is attained. Maximum drawdown is an indicator of downside risk over a specified time period, Investopedia) compared to an underlying (similar) index. These so called 'smart beta products' (Smart beta defines a set of investment strategies that emphasize the use of alternative index construction rules to traditional market capitalization-based indices. Smart beta emphasizes capturing investment factors or market inefficiencies in a rules-based and transparent way, Investopedia) use alternative index construction which is rule-based and including different factors.

Patent data became very popular over the past years because of the currently high quality of the data delivered by the most national patent offices and the possibility to use patent metrics as an indicator to measure the innovation developed by companies [1–8].

In literature have been created as well some "patent indexes" based on different patent metrics. Some of them are described in the study of Michele Grimaldi and Livio Cricelli [9]. In this study an own "patent value index" is described based on different metrics.

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The main weakness of the current existing patent indexes is beside of the lack of high-quality data that the meaningfulness of the outcome and the commercial exploitation is doubtful.

2 Aim of the Study

The aim of the study is to scientifically prove that patent indicators derived from different metrics have a real market impact especially for the financial sector.

This paper shows that patent value indicators build out of bibliometric data are suitable to determine equities which will outperform on a long-term base and can be used as reliable factor to develop smart beta products based on patent related indicators.

The main theory for using patent indicators is, that the development of the patent portfolio of a company is an early trend indicator and contemporary representing the present status of a company's research- and development output.

The amount and quality of granted and applied patents are an early stage and trend indicator, because first there is a serious time lag between application and grant of a patent which depends on the patent office, the patent quality itself and the technological sector and is stated to 1–10 years [10]. Secondly patents can be found after several years of their filing in products of the applicant.

The patenting activity of a company represents as well the current status of a company in terms of revenues and profits, because filing and counter fighting needs available resources in terms of money and human power. Further the development of patents needs a high-class research and development department, which generates innovations, otherwise no patents will be granted. Last but not least, a company which is filing patents with a high quality believes in its own technology and future growth, and is not only optimizing the corporate structure for cost-savings.

These points make patent analysis for fundamental company rating so interesting. Studies have shown that there is a correlation between stock value and patent development [11–13].

The current paper endorses the basic theory, that measurement of patent quality is a suitable factor for selecting equities and generating indexes for investment purposes.

3 Data Sources

For this study different data sources have been used which are described as follows:

3.1 Business Data

The business data have been delivered from Moodys product "Orbis" which is Bureau van Dijk's flagship company database [14]. It contains information on companies across the world and focuses on private company information. It has information on around 300 million companies from all countries. The main information which was exported from the database have been:

- Company identifier (ISIN)
- Total assets
- Amount on employees
- Corporate tree with subsidiaries >51% share
- Stock quotes of the equities (closing prices)
- List of constituents for backtested index

3.2 Patent Data

The used database for patent data was "Patstat" [15] which is a global database containing bibliographical data relating to more than 100 million patent documents from industrialised and developing countries. It also includes the legal event data from more than 40 patent authorities contained in the EPO worldwide legal event data.

3.3 Economic Data

The economic data used for this study is the GDP from each country. This was downloaded from the Worldbank Open Data [16].

4 Proposed System for the Main Indicators

Based on different possible indicators, the proposed main indicators determining patent portfolio quality are:

1. Assignee impact [Ai] = ratio alive patent families/employees and total assets of the assignee
2. Technology Impact [Ti] = Number of citing patents
3. Market impact [Mi] = amount of family members and GDP of the countries where the patent family members are alive (=patent country distribution)

The indicators are determined like follows:

4.1 Assignee Impact [Ai]

The assignee itself seems to have an impact for the value of a patent because he needs high resources to get the patents in force, to block competitors and to sew infringements. One metric to determine the commercial strength of an assignee is the amount on "total assets". Further the more granted patents a research and development department is producing, the higher the quality of the patents due to standardised processes and intellectual knowledge in patenting.

The total assets are normalized to the maximum of 369.8 B€ on total assets for Toyota Motor Corporation [14], having as industrial, non-governmental owned, the worldwide highest total assets declared in the balance sheet.

The Assignee impact is defined to:

$$[\mathrm{Ai}] = \frac{\textit{Amount on alive patents}}{\textit{Amount on employees}} * \frac{\textit{Total assets}}{\textit{Maximum total assets}} \quad (1)$$

Both sub-indicators are equalweighted.

4.2 Technology Impact [Ti]

There are 2 different types of citation: forward and backward citations. Future citations received by a patent (forward citations) 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 in several studies as a measure of the value of an invention [5, 17, 18]. The main thesis is, that the more often a 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 [19, 20].

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.

The examiners in the Patent offices have a certain number 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 [20] and Juan Alcácer and Michelle Gittelman [21].

Further the cited documents can be also used as an indicator. Usually there are other patents or utility models cited but also NPL (Non-Patent-Literature) [22]. The main conclusion is, that the closer a patent application is to "fundamental research", as reflected by the non-patent references, the higher its technological quality. NPL is also used like backward citation to show the examiner that the state of the art has been approved before applying.

The forward citation is also a main indicator for the litigation process. In the work of Jean O. Lanjouw and Mark Schankerman [23] it is shown that there is a direct impact between citation and litigation.

The current Technology impact is defined as follows: the amount on foreign citations were divided through the amount on alive patents. The normalization was performed under the backward citation index, average per economy (country) [24].

Self-citations (even intra-corporate from subsidiaries) and references to non-patent literature have been excluded from the count. Approximately 11 percent of all citations in the sample from Jaffe and Tratenberg, 2003 are self-citations. To determine this indicator properly the corporate tree from the company must be available [25].

The technology impact [Ti] is defined to:

$$[\mathrm{Ti}] = \frac{\text{amount on foreign citations (normalized)}}{\text{amount on alive patents}} \quad (2)$$

4.3 Market Impact [Mi]

A number of authors have argued out that information on family size may be particularly well suited as an indicator of the value of patent rights. The studies by Putnam and Lanjouw et al. [26] have shown that the size of a patent family, measured as the number of jurisdictions in which a patent grant has been sought are highly correlated. To measure the potential power of a "family size", it is recommended to obtained the number of nations in which protection for a particular invention was sought from Derwent's World Patent Index (WPI) database.

The study from Adam B. Jaffe, Gáetan de Rassenfosse [27] shows, that there exists as well a bias for the priority application,

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.

There exist some studies [28] showing that triadic patents (patent family applied and/or granted in Europe, Asia and USA) having a higher value then only filed in single countries, but due own experience of the author in several valuation projects the value of a patent depends much more on the certain economy where the patent is filed.

The market impact is therefore defined to the share of the IPC class (distinct 4-digit IPC subclasses) in the certain country where the patent family is filed, expressing the importance of the technology area in the certain country. The shares for each sub-class are exemplarily shown in a study from InTraCoM [29].

The market impact is further directly correlated with the economic size of the country (expressed in GDP), the importance of the certain technology in that country (expressed in share of the IPC class in the country) and the legal status of the patent family (application, grant or utility model).

The Market impact [Mi] is defined to:

$$[\mathrm{Mi}] = \sum_{1}^{n} \frac{\textit{amount patents in the IPC class in the country}}{\textit{total amount on patnets in the IPC class}} * \frac{\textit{GPR of the country}}{\textit{Global GDP}} * Co \quad (3)$$

Co = factor for legal status of the patent family member defined to
Granted patent = 100%
Applied patent = 20%
Utility model = 10%

4.4 Composite Index

The calculation of the total patent quality [TPQ] in %, is based on the equal weighted indicators Ai, Ti, Mi, to:

$$TPQ = Ai * Ti * Mi$$

5 Data Samples

The IP portfolio index was generated and backtested based on the available indices in the market. Because the constituents (listed and delisted equities) of the index change every year, the backtest is performed static and dynamic. The static tests were designed in that way, that the current constituents have been selected and remained for the past 10 years in the patent value index, and not replaced with the new ones. This is a small failure in the direct benchmarking of the IP portfolio index with the current indices, but there is no other possibility on how to handle this issue for benchmarking on a long time period (>10 years). A second, dynamic backtest was performed too, but for a shorter period, for 4 years. The dynamic tests take into account the change of constituents and there is as well some turnover in the designed IP portfolio index.

The composition of the indexes and other related data like closing prices have been received from Orbis IP database [14].

Some data samples are given in the following tables in order to give an impression about the patent indicators, the sectors and equities used. Table 1 shows data samples are for the STOXX600 index (Table 2):

Table 1. Data samples of patent metrics for a sample set of companies from STOXX600

No.	Company name	1	2	3	4	5	6	7
1.	BP PLC	GB	10.264	25.144	81	90	100	51
2.	SIEMENS AG	DE	208.112	297.635	95	87	100	99
3.	HENNES & MAURITZ AB	SE	7	2	31	36	0	56
4.	ASTRAZENECA	GB	42.525	34.160	81	95	100	48
5.	SODEXO	FR	23	19	39	60	0	58
6.	TELEFONAKTIEBOLAGET	SE	134.219	81.995	91	88	100	85
7.	CREDIT AGRICOLE S.A.	FR	78	84	51	100	54	0
8.	HENKEL AG & CO. KGAA	DE	32.265	28.764	83	94	100	55
9.	WM MORRISON SUPERMARKETS	GB	5	4	44	63	13	55
10.	ALLIANZ SE	DE	86	80	79	91	100	48

1 Country code
2 Number of live publications
3 Number of granted publications
4 Total patent quality in %
5 Technical impact
6 Market impact
7 Assignee impact

Table 2. Data samples of financial metrics for a sample set of companies from STOXX600

No.	Company name	1	2	3	4	5	6	7
1.	BP PLC	GB	GB0007980591	7	5	5	70	262
2.	DAIMLER AG	DE	DE0007100000	76	45	46	298	302
3.	TOTAL S.A.	FR	FR0000120271	57	43	46	107	243
4.	FIAT CHRYSLER AUTOMOBILES N.V.	NL	NL0010877643	22	12	13	191	98
5.	BAYERISCHE MOTOREN WERKE AKTIENGESELLSCHAFT	DE	DE0005190003	98	69	71	133	228
6.	NESTLE S.A.	CH	CH0038863350	77	65	71	291	117
7.	SIEMENS AG	DE	DE0007236101	126	100	110	385	150
8.	DEUTSCHE TELEKOM AG	DE	DE0005557508	16	13	15	210	170
9.	ENEL SPA	IT	IT0003128367	5	4	5	69	165
10.	TESCO PLC	GB	GB0008847096	3	2	3	464	57

1 Country code
2 ISIN number
3 Market price - high, EUR, year 2018
4 Market price - low, EUR, year 2018
5 Market price - year end, EUR, year 2018
6 Number of employees in 1,000
7 Total assets, b€

The Stoxx600 Index contains in general 20 sectors. The sectors considered for the IP portfolio index are:

1. Automobiles & Parts
2. Basic Resources Services (Basic resources)
3. Chemicals
4. Construction Materials
5. Food & Beverages
6. Industrial Goods
7. Media
8. Medical Engineering (Healthcare)
9. Oil Services, Green Energy (Oil&Gas)
10. Personal & Household Goods
11. Retail
12. Technology
13. Travel & Leisure

The sectors not considered (due low IP activity and importance) are:

1. Banks
2. Basic Resources (producers)
3. Financial Services
4. Healthcare (producers)
5. Insurance

6. Oil & Gas (producers)
7. Real Estate
8. Real Estate Cap
9. Telecommunications
10. Utilities

In the Stoxx600 232 companies were identified having a reasonable amount on patents (Fig. 1):

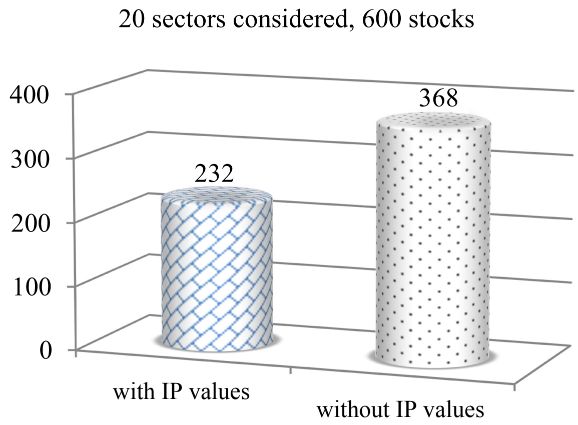


Fig. 1. Amount on equities with high quality patents in Stoxx 600 index

In these sectors the equities with highest IP relevance were selected (Fig. 2):

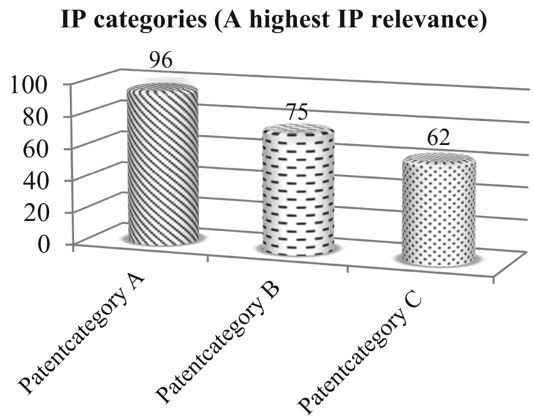


Fig. 2. Categories within the IP value index

The selected equities in the Patentcategory A in the IP portfolio listed in Table 3.

Table 3. Top equities with highest patent portfolio quality in Stoxx600 index

1. ABB Ltd.	41. Hexagon AB	81. STMicroelectronics NV
2. Actelion Ltd.	42. Infineon	82. SUEZ SA
3. Air Liquide SA	43. International Consolidated Airlines	83. Swatch Group Ltd. Bearer
4. Akzo Nobel N.V.	44. Investor AB	84. Syngenta AG
5. Alcatel-Lucent SA	45. Johnson Matthey	85. Tate & Lyle PLC
6. Alstom SA	46. Kone Oyj	86. Technip SA
7. Arkema SA	47. LANXESS AG	87. Telecom Italia
8. ARM Holdings plc	48. Legrand SA	88. Telia Company AB
9. ASML Holding NV	49. LM Ericsson Telefon AB	89. UCB S.A.
10. ASSA ABLOY AB	50. Lonza Group AG	90. Umicore
11. Associated British Foods plc	51. L'Oreal SA	91. Unilever NV Cert. of shs
12. Atlas Copco AB	52. Metso Oyj	92. Unilever PLC
13. BASF SE	53. Nestle S.A.	93. Veolia Environnement SA
14. Bayer AG	54. Nokia Oyj	94. Vestas Wind Systems A/S
15. Beiersdorf AG	55. Novo Nordisk A/S	95. Vivendi SA
16. BT Group plc	56. Novozymes A/S	96. Wartsila Oyj Abp
17. Carlsberg A/S	57. Orange SA	
18. CGG	58. Outotec Oyj	
19. Clariant AG	59. Petroleum Geo-Services ASA	
20. Compagnie de Saint-Gobain SA	60. Porsche Automobil Holding SE Pref	
21. Michelin SCA	61. Prysmian S.p.A.	
22. Continental AG	62. Reckitt Benckiser Group plc	
23. Daimler AG	63. Rolls-Royce Holdings plc	
24. Danone SA	64. Royal DSM NV	
25. Deutsche Lufthansa	65. Royal KPN NV	
26. Diageo plc	66. Royal Philips NV	
27. Electrolux AB	67. Safran SA	
28. Elekta AB	68. Salzgitter AG	
29. Essilor International	69. Sandvik AB	
30. FLSmidth & Co.	70. SAP SE	
31. Fortum Oyj	71. SBM Offshore NV	
32. Fresenius Medical	72. Schneider Electric	
33. Fresenius SE & Co.	73. SES SA FDR	
34. GEA Group	74. Siemens AG	
35. Gemalto N.V.	75. SKF AB	
36. Getinge AB	76. Sky plc	
37. Givaudan SA	77. Smith & Nephew	
38. GKN plc	78. Smiths Group Plc	
39. Grifols, S.A.	79. Solvay SA	
40. Henkel AG & Co.	80. Sonova Holding AG	

6 Results

6.1 Backtests on STOXX600

The performance of the IP portfolio Index containing the selected 232 equities with high IP quality shows a significant outperformance in opposition to the equal-weighted Stoxx 600 Index, and to the index of No IP Stoxx 600 (Fig. 3):

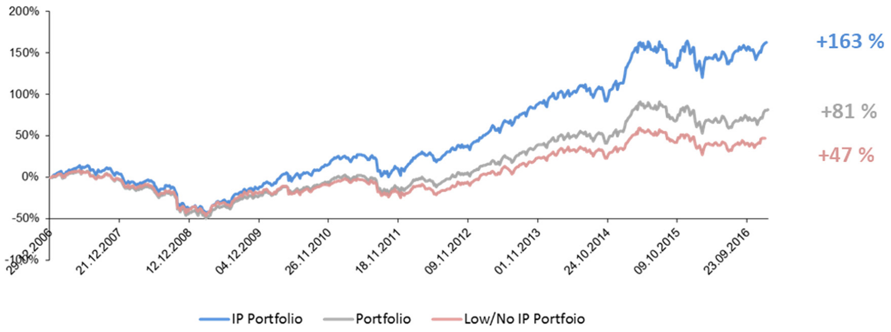


Fig. 3. Performance of the static IP portfolio Index for Stoxx600

Portfolio Construction. The Stoxx Europe 600 Index is separated in IP and Low/No IP stocks per 30.06.2016. Static, equal weighted portfolios of 232 IP stocks ("IP Stoxx Europe 600") vs 368 Low/No IP stocks ("Low/No IP Stoxx Europe 600") with yearly adjustment per 31.07; Benchmark is equal weighted Stoxx Europe 600 Portfolio ("Stoxx Europe 600"; 600 stocks); degree of investment = 100%; no risk management; no fees; ex dividend; all stock prices are calculated in EUR.

Some performance indicators for the IP portfolio index is shown at following table (Table 4):

Table 4. Key performance indicators of static IP portfolio Index Stoxx600

	Sharpe ratio	Sortino ratio	Avg 1 Y return	Avg 1 Y volatility	MAX DD
Patent portfolio index Stoxx600	0.54	0.87	10.2%	14.4%	−43.3%
Stoxx 600	0.42	0.39	6.1%	14.2%	−44.9%
No IP Stoxx 600	0.32	0.18	4.0%	14.6%	−42.3%

The Sharpe Ratio is used to help investors understand the return of an investment compared to its risk. Generally, the greater the value of the Sharpe ratio, the more attractive the risk-adjusted return. The sharpe ratio is calculated to:

$$\text{Sharpe Ratio} = \frac{Rp - Rf}{\sigma p} \quad (4)$$

Where:

Rp = return of the portfolio
Rf = risk-free rate
σp = standard deviation of the portfolio's excess return

The Sortino ratio is a variation of the Sharpe ratio that differentiates harmful volatility from total overall volatility by using the asset's standard deviation of negative portfolio returns, called downside deviation, instead of the total standard deviation of portfolio returns (Investopedia). The Sortino ratio is a useful way for investors to evaluate an investment's return for a given level of bad risk and is defined to:

$$\text{Sortino Ratio} = \frac{Rp - Rf}{\sigma d} \quad (5)$$

Where:

Rp = actual or expected return of the portfolio
rf = risk-free rate
σd = standard deviation of the portfolio's downside

All key performance indicators show a better quality of the IP portfolio index. Especially the correlation of significantly increasing the return with a very slight change of maximum drawdown (Max DD) and volatility makes the IP portfolio index very attractive. The downside risk (Sortino ratio) is as well much better than the index.

This backtest was performed with a static portfolio of selected equities. This means, that the constituents of the IP portfolio index did not change, which does not meet the reality. Therefore, a dynamic index was backtested too, where every year the new composed Stoxx 600 was analysed. The performance is shown in the Fig. 4.

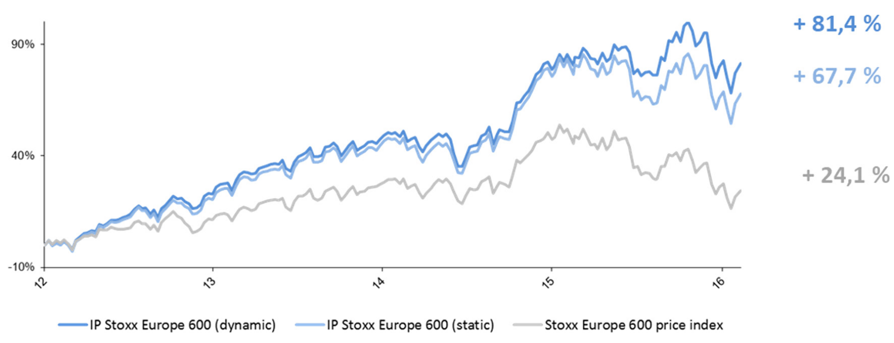


Fig. 4. Performance of the dynamic IP portfolio Index for Stoxx600

Portfolio Construction. Stoxx Europe 600 Index Portfolio is separated in IP and Low/No IP stocks per 30.06.2016. Static, equal weighted portfolios of 232 IP stocks ("IP Portfolio") vs. 368 Low/No IP stocks ("Low/No IP Portfolio") with yearly adjustment per 31.07; Benchmark is equal weighted Stoxx Europe 600 Portfolio ("Portfolio"; 600 stocks); degree of investment = 100%; no risk management; no fees; ex dividend; all stock prices are calculated in EUR.

Sector Performance. The selected sectors for designing the IP Stoxx index intended to show the market neutrality of the composed index. This means that the index should provide positive returns completely independent of the market conditions. Compared to the STOXX Europe 600 Index the main performance driver are the Sectors Industrial Goods, Healthcare, Food & Beverages, Chemicals, Pers. & HH Goods and Technology (Fig. 5).

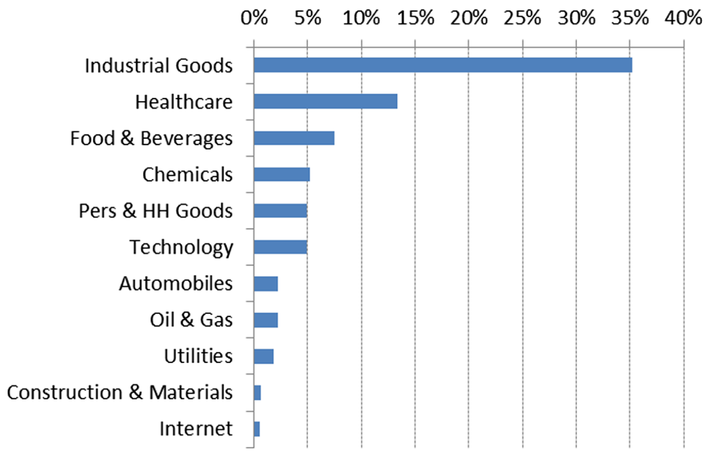


Fig. 5. Sector performance of the Stoxx600 Index

Compared with equal sector weightings to STOXX Europe 600 Index the main performance driver are the Sectors Industrial Goods, Healthcare, Technology, Pers. & HH. Goods, Food & Beverages, Chemicals, Oil & Gas and Telecommunications. In these sectors the influence of the IP Relevance on outperformance is very high (Fig. 6).

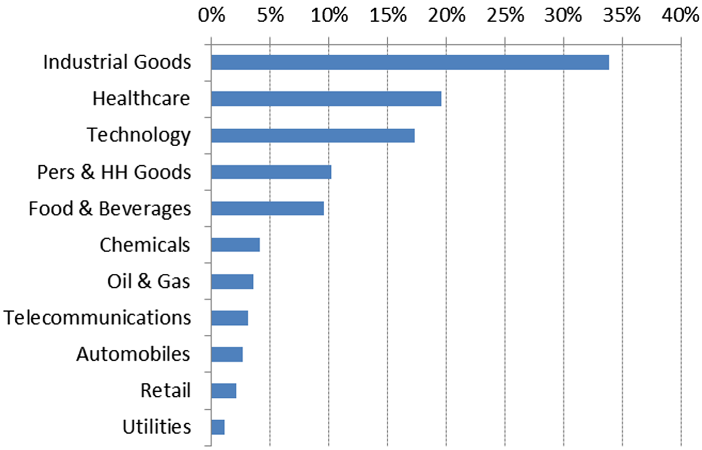


Fig. 6. Sector performance of the IP portfolio STOXX600 vs. Stoxx600 Index

Different other indices were backtested, under same conditions like the Stoxx600 which is showed more detailed in this paper. The results for the other indices are the following:

6.2 Backtests on S&P500

Backtests on S&P500 show similar results to the STOXX600 index (Fig. 7).

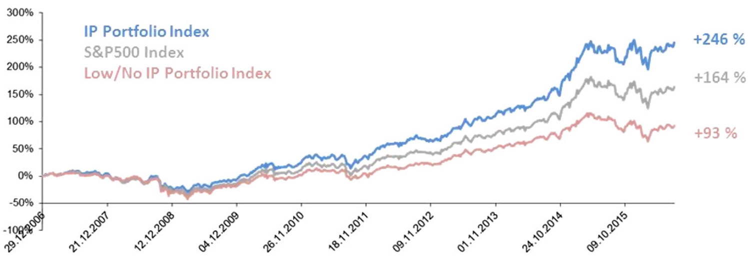


Fig. 7. Performance of the static IP portfolio Index for S&P 500

Static, equal weighted portfolios of 238 IP stocks ("IP Portfolio") vs. 248 Low/No IP stocks ("Low/No IP Portfolio") with yearly adjustment per 31.07. All stock prices are calculated in local currency (Table 5) (Fig. 8).

Table 5. key performance indicators of static IP portfolio Index S&P500

	Sharpe ratio	Sortino ratio	Return	Avg 1 Y volatility	MAX DD
IP Portfolio Index S&P 500	**0.77**	**1.28**	**14.4%**	**12.8%**	**−30.7%**
S&P 500	0.66	1.24	11.2%	12.6%	−33.8%
Low/No IP S&P 500	0.48	0.68	7.5%	12.7%	−41.9%

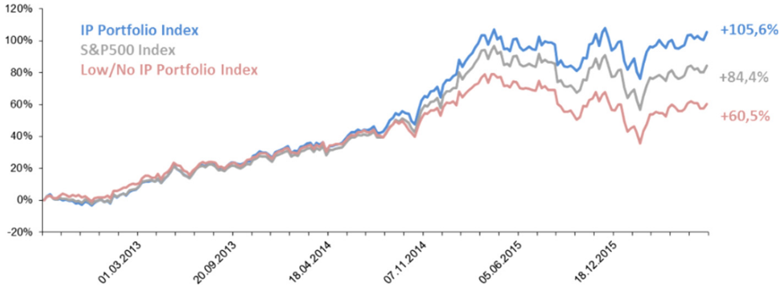


Fig. 8. Performance of the dynamic IP portfolio Index for S&P 500

For the IP portfolio S&P index the main improvement is the return. The other factors like MaxDD, Sortino- or Sharpe ratio remain similar but much better than the equities with no or low IP.

6.3 Backtests on Nikkei 225

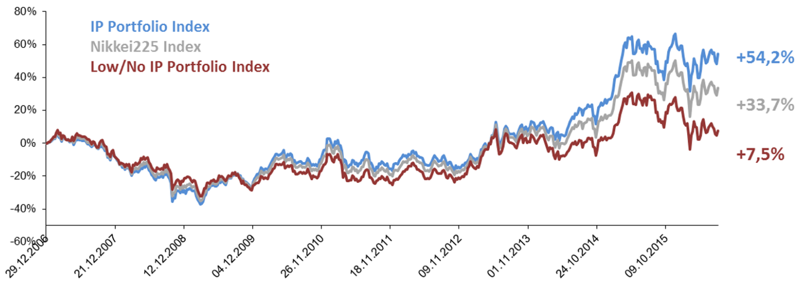


Fig. 9. Performance of the static IP portfolio Index for Nickei225

Static, equal weighted portfolios of 132 IP stocks ("IP Portfolio") vs 93 Low/No IP stocks ("Low/No IP Portfolio") with yearly adjustment per 31.07. All stock prices are calculated in local currency (Table 6) (Figs. 9 and 10).

Table 6. Key performance indicators of static IP portfolio Index Nikkei225

	Avg. return (9Y)	Avg volatility (9Y)	Sharpe ratio	Sortino ratio
IP Nikkei 225 Index	5.3%	14.9%	0.46	0.17
Nikkei 225 Index	4.0%	14.9%	0.42	0.10
Low/No IP Nikkei 225 Index	2.2%	15.3%	0.30	0.01

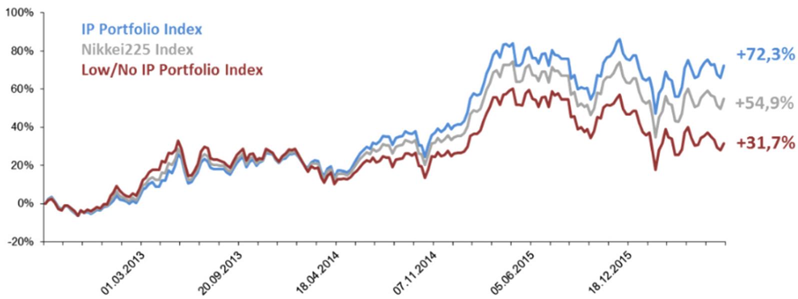


Fig. 10. Performance of the dynamic IP portfolio Index for Nickei225

6.4 Backtests on CSI300

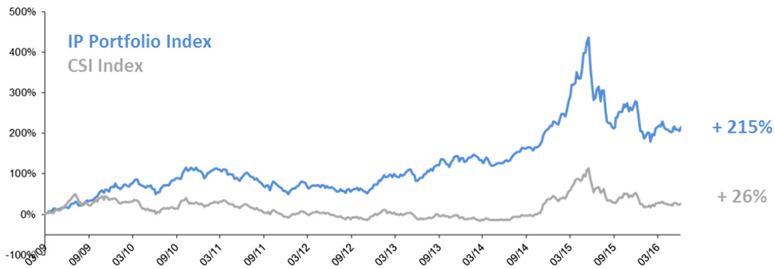


Fig. 11. Performance of the static IP portfolio Index for CSI300

Static, equal weighted portfolio of 40 IP stocks with half-yearly adjustment ("IP CSI 300 Portfolio") vs. 260 Low/No IP stocks in CSI 300 Index per 30/06/2016. All stock prices are calculated in local currency (Fig. 11).

For the Nikkei index the findings are the same like for the S&P index (Table 7) (Fig. 12).

Table 7. Key performance indicators of static IP portfolio Index CSI 300

	Sharpe ratio	Sortino ratio	Avg. return (6Y)	Avg. 1 Y volatility (6Y)	MAX DD
IP Portfolio Index	0.75	7.0	14.7%	18.6%	−47.9%
CSI 300 Index	0.16	0.85	1.6%	24.8%	−44.8%

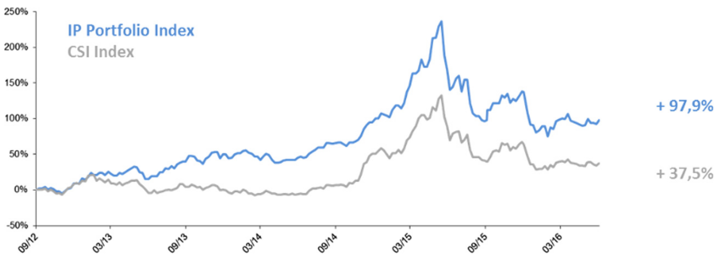


Fig. 12. Performance of the dynamic IP portfolio Index for CSI300

For the IP portfolio CSI index the main improvement is the massive increase of return and much better Sortino ratio. The max DD increased slightly.

Summary of the most important key performance indicators (Table 8):

Table 8. Summary of most important key performance indicators of the IP portfolio index

Index	1	2	3	4	5	6	7
Stoxx600	232	368	39%	11	7	4.5	157%
CSI300	40	260	13%	14.7	1.6	–	919%
Nickei225	132	93	59%	5.3	4	2.2	133%
S&P500	238	248	49%	14.4	11.2	7.5	129%

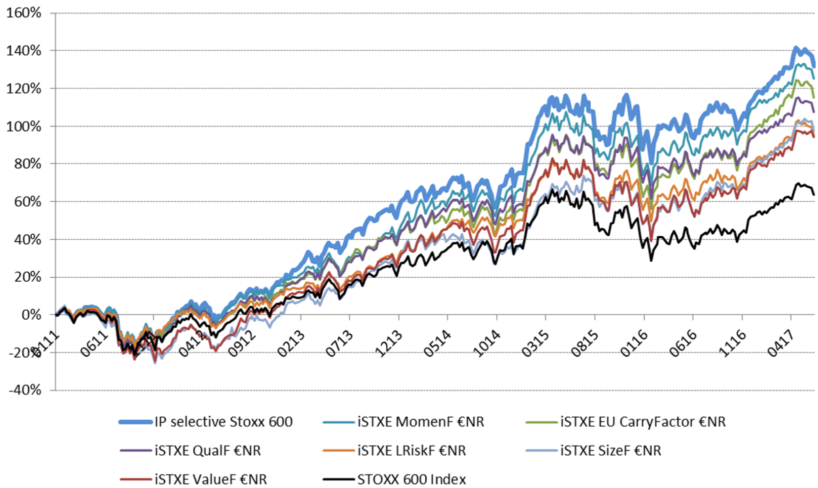
1 Amount on patent equities in index
2 Amount on No or Low patent equities in index
3 Share of IP equities
4 Average return of the IP portfolio
5 Average return of the equal weighted index
6 Average return of the no IP portfolio
7 Outperformance IP portfolio

6.5 Correlations and Sector Bias

A main question which occurs when a new factor is designed and applied to indices is if the factor has a certain attribute bias? Attribute bias describes the fact that equities that are chosen using one predictive model or technique tend to have similar fundamental characteristics. For the patent factor it is obvious that there could be a bias in technology equities, because those are having the most patents. The current analysis showed that different other sectors like “household” or “food and beverages”, which are not classified as “hightech” are outperforming as well.

A look-ahead-bias does not exist because the data were produced at point of time.

The next important question is if the factor correlates with any other existing factor? Backtests on the factors value, momentum and others are not correlated like the Fig. 13 shows.



Code	Factor	Description
IP selective Stoxx Europe 600	IP factor	stocks that have high IP Relevance
iSTXE MomenF €NR	Momentum	stocks with exceptional historical price movements
iSTXE EU CarryFactor €NR	Carry	stocks with high carry based on earnings and dividends
iSTXE QualF €NR	Quality	stocks with solid financial background based on debt coverage, earnings and other
iSTXE LRiskF €NR	Low Risk	stocks with risk / vola levels below average
iSTXE SizeF €NR	Size	stocks with low market capitalization / enterprise value
iSTXE ValueF €NR	Value	stocks that are cheap based on cash flow and earnings per share

Fig. 13. Comparison of factors Stoxx 600 versus IP portfolio Index

One could also guess that the amount on patents or research-and development expenditure is correlated. This was analysed in older studies and can be denied [30, 31].

7 Conclusions

The current work shows that using patent metrics for defining and applying indicators for stock picking is an appropriate method to develop a new factor which can generate alpha in a designed index. The main requirement to use the IP portfolio Index factor for improving financial products is, that in the selection must be a reasonable amount on equities which operate in a technology field. The backtests do not show correlations for an optimum of the share of IP equities in an index neither focus on a certain world-region or a technology sector.

The basic theory that equities with a high qualitative patent portfolio perform better than those without is proved in the current study because the main global indices like Stoxx600, S&P, Nikkei and CSI showed an outperformance in a backtest period of 10 years.

Further research in this area will be done in the area of o higher granulation of the patent quality in defining more than 3 indicators. The basic selection for the equities was to identify equities with good patent portfolio, the possibility of identifying exit signals was not evaluated in this work. Other research topics are to develop real trading models with mixing up different other quantitative factors or hedging strategies like long-short strategies.

One other research area is in the field of corporate bonds, in order to develop smart beta products.

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