Motivations to Patent: Empirical Evidence from an International Survey[24]

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Abstract This paper investigates motivations for patenting and their impact on companies' propensity to patent. Amongst the main findings, the strong importance of exclusion motives must be emphasized. Irrespective of the country, the industry or the characteristics of the company, patenting in order to prevent imitation is the main reason for patenting, and this motivation strongly affects the propensity to patent. The patent system still performs its traditional mission to a large extent. Another major finding is the important role played by defensive patenting: companies patent in order to preserve their freedom of operation which, in turn, significantly impacts the propensity to patent. Finally, monetary motivations are found to be of particular interest to small, R&D intensive companies, especially in the biotechnology, pharmaceuticals and computers industries, but only US companies actively patent for this reason.
Key words freedom to operate, licensing, motivation, propensity to patent

1 Introduction

In the quest to understand the surge in patent filings, many scholars have chosen to look at the strategic role of patenting. Companies are reported to use patent in non-traditional ways, ranging from the building of patent fences, to patent submarines, defensive publications or to earning licensing revenues. Strategic patenting and patent filing strategies become increasingly popular and harnessing the patenting process becomes a key competence. These hot topics call for a better understanding of the motivations for patenting and of their impacts on applicants' patents portfolio.

This paper precisely investigates the importance of various motives of patenting and their effect on companies' propensity to patent. The data is collected from a large-scale international survey, and therefore allows highlighting country-specificities. In this respect, the objectives of the paper are threefold. First, it examines the characteristics of applicants according to their motivations for patenting. Second, it assesses the impact of the various motives on the size of the patent portfolio. Third, it investigates potential country specificities. Doing so, it reframes the current debate on the patent system and puts forward potential research questions.

Amongst the main findings, the strong importance of the exclusion role of patents must be emphasized. Irrespective of the country, the industry or the characteristics of the company, a majority of applicants patent for traditional exclusion motives, which strongly affects the propensity to patent. The patent system still performs its traditional mission to a large extent. Another major finding is the important role played by defensive patenting: companies patent in order to preserve their freedom of operation which, in turn, has a significant impact on the propensity to patent. Finally, monetary motivations are found to be of particular interest to small, R&D intensive companies, especially in the biotechnology, pharmaceuticals and computers industries, but only US companies actively patent for this reason.

The structure of the paper is as follows. Next section reviews the literature on motivations for patenting. Section 3 presents the data and section 4 is devoted to the empirical investigation. Last section concludes and puts forward potential research questions.

2 Literature Review

Motivations for patenting must be differentiated from the *uses* of patents. While the latter has been

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the topic of numerous investigations, the former remains mostly neglected. There is indeed a bunch of evidence that patents are now used in various ways, such as to generate licensing revenues, to prevent suits, to block competitors, to maintain one's own freedom to operate, to enhance reputation, or as bargaining chips in negotiation (see e.g. Arora et al., 2001; Cohen et al., 2000; Duguet and Kabla, 1998; Hall and Ziedonis, 2001, Levin et al, 1987).

Yet, these supplementary uses do not necessarily mean that the motivations for patenting changed. The distinction is more than anecdotic and matters for patent offices and policy makers. Let us take a practical example for illustrative purpose. If these alternative uses are incidental to the holding of patents, patent statistics may continue to reflect innovative activities and policy makers can remain confident in interpreting patent data. To the contrary, if strategic considerations are found to motivate patent filings to a large extent, then patent statistics could be misleading and loose their remaining objectivity. Another example why it is important to understand motivations is that it allows identifying potential inefficiencies in the uses of patents. In particular, that a patent is filed with the perspective of being licensed out does not necessarily mean that it will be licensed. Only looking at the uses does not provide a complete picture on strategic patenting.

Ajouter reflexion des slides: Patents have a monetary use, but do applicants intentionally file for monetary reasons? If yes, to which extent? What kind of applicants? What is the impact on the p2p?

Whether these uses are explicitly intended from the filing or whether they are incidental is an open question, but one may reasonably suspect that strategic considerations motivate patent filings to a large extent. As soon as new uses become common enough, one can indeed expect that the patenting decision will be influenced by the range of potential uses. In addition to this common sense argument, empirical evidences point in the same direction. For instance, Blind et al (2006) report the importance of a broad set of motives on the patenting activity of German companies. They suggest that the various reasons for patenting can be grouped into the following clusters of motives: i) *protecting motives*: protection from imitation and safeguarding of markets; ii) *blocking motives*, offensively or defensively; iii) *reputation motive*; iv) *exchange motives*: improved access to the capital market, exchange potential, licensing income and v) *incentive motives*: motivation of staff and internal performance indicator. Nothing is said, however, about the impact of these motivations on the propensity to patent. Using a sample of French manufacturing firms, Duguet and Kabla (1998) support the argument that the number of patents is affected by strategic motivations. They find that the willingness of firms to avoid trials and to reach a stronger position in technology negotiations lead to a higher patent count.

There, nevertheless, lacks an international perspective and the impact of the motivations on the size of patent portfolios remains largely misunderstood. In a nutshell, it is the very purpose of this paper to fill these gaps by presenting a comprehensive overview on the motivations to patent and on their impact in the patenting behaviour of companies.

3 The Data

The data comes from the Applicant Panel Survey carried out from June to September 2006 by the European Patent Office.[28] The main purpose of the survey is to provide information on filing intentions for the EPO's forecasting exercise for budgetary planning purposes. Besides information on filing intentions which we do not report here, a part of the survey was dedicated to the motivations to use the patent system.

We now briefly report the methodology adopted by the EPO to select applicants.[29] There were 2,098 applicants selected amongst the largest applicants and at random, covering about 31% of total applications at the EPO. Contact details were successfully established for 1,524 applicants and 772 responses were returned (leading to a response rate of 50.65% of contacted applicants, or 36.80% of the initial sample). The survey was carried out via telephone and mail interviews with the pre-established contact persons. The answers of respondents are summarized in Table 1.

[28] Note that the term "panel" is misleading, as applicants are not followed over time.
[29] We refer the interested reader to the complete description of the survey: http://www.epo.org/patents/APS.html

Table 1 Mean of answers, by motives

Question:	Variable	N	mean	[5-6]
I patent mainly to prevent imitation by competitors	Imitation	604	4.60	66%
I patent mainly to preserve my freedom of operation	Freedom	602	4.22	50%
I take more patents in areas where competition is more intense	Competition	596	4.19	51%
I use my patents for hampering my competitors' access to technology	Hampering	601	4.18	52%
I take patents in view of licensing them out	Licensing	606	3.25	25%
I take patents in order to convince investors or banks of the value of my inventions	Investors	599	2.83	20%

Note: The motivations are ranked on a 1 (totally disagree) to 6 (fully agree) Likert scale. The column [5-6] indicates the percentage of respondents that selected 5 or 6.

Patenting in order to prevent imitation by competitors (Imitation), the most traditional reason for patenting, is also the one that scored the highest. The statement related to the freedom to operate (Freedom) scored high, with a mean score of 4.22 and 50% of applicants patenting mainly to preserve their freedom of operation. This observation comforts the view that patents are commonly used as a defensive mechanism: defensive publishing is not only common practice outside the patent system (Henkel and Pangerl, 2008), but also at its very heart. Monetary reasons (Licensing and Investors) matter for one-quarter to one-fifth of applicants.

Other characteristics of applicants were also reported in the survey. In particular, the variables summarised in Table 2 will be used throughout the analysis. 'Patents in 2005' is the worldwide number of priority filings in 2005, as reported by the company. 'Persons Employed' is an ordinal variable ranging from 1 to 9, corresponding to 1 to 50,000+ employees.[30] 'FTE Researchers' is the total number of full-time researchers in 2005. 'Intl Group' is a dummy variable taking the value of 1 if the company belongs to an international group of companies. The variable 'Geographic concentration' is the Herfindahl index of geographic dispersion of second filings in 2005. The more focusee the company, the closer to one the index is. Similarly, the variable 'JC concentration' is the Herfindahl index of the dispersion, in terms of JC, of patents filed in 2005. An index close to 0 reveals thus that the company file patent in many joint clusters *i.e.* is active in several technological areas.[31]

Table 2 Summary statistics

	Full Sample				*Sample 1*		*Sample 2*	
	N	Mean	min	Max	N	mean	N	mean
Patents in 2005	721	255	0	18,160	236	145	326	148
Persons Employed (c)	638	5.52	1	9	236	5.52	326	5.49
FTE Researchers	425	713	0	47,200	236	530	326	552
Intl group (d)	618	60%	0	1	236	63%	326	61%
Geographic concentration	616	0.57	0.21	1	236	0.55	287	0.55
JC concentration	413	0.89	0.10	1	236	0.88	266	0.90
Applicants from DE (d)	772	22%	0	1	236	27%	326	26%
Applicants from the US (d)	772	23%	0	1	236	11%	326	12%
Applicants from JP (d)	772	14%	0	1	236	19%	326	18%
Applicants from GB (d)	772	6%	0	1	236	4%	326	4%
Applicants from FR (d)	772	3%	0	1	236	5%	326	5%

[30] The categories are as follows: 1:1, 2:2-9, 3:10-49, 4:50-249, 5:250-999, 6:1,000-4,999, 7:5,000-9,999, 8:10,000-49,999, 9:50,000+ employees.

[31] EXPLAIN HERE WHAT JOINT CLUSTER ARE!

Note: (c) indicates a categorical variable, and (d) a dummy variable. Geographic concentration and JC concentration are not used in sample 2; it has thus no importance that the number of observations in this sample is lower than 326.

The composition of sample 1 and sample 2 is driven by data availability, but public sector applicants and individual inventors were deliberately excluded. Both samples have similar means but differ somewhat from the full sample, in particular regarding the number of patents filed and the number of researchers.

4 Empirical investigation

4.1 Motivations to patent and profile of applicants

A first insight into the data is provided by a correlation matrix of the various motives, reported in Table 3. Given that the variables are ordinal, the differences between neighbouring levels are presumably not equidistant and polychoric correlation coefficients have been estimated.

Table 3 Polychoric correlation matrix of the various statements

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Imitation	1					
(2) Freedom	0,14	1				
(3) Investors	-0,02	0,07	1			
(4) Licensing	-0,18	-0,04	0,45	1		
(5) Competition	0,29	0,22	-0,04	-0,04	1	
(6) Hampering	0,45	0,08	0,02	-0,14	0,40	1

Interestingly, the motives of Imitation, Competition and Hampering are strongly correlated with each other, such as the Investors motivation is with the Licensing one. It might therefore seem appropriate to talk about *exclusion motives*, associated with the traditional role of protecting a market against competitive pressure, and *monetary motives,* that aim at generating direct financial resources either by increasing the company's ability to raise capital or by earning licensing revenues. The motivation Freedom is relatively uncorrelated with the other motives and could constitute a group by itself, which will be called *Defensive motive*. This grouping is formally confirmed by a factor analysis and echoes Blind et al (2006) results.[32]

In order to understand where the heterogeneity in the various answers of Table 1 comes from, and to detect patterns in the characteristics of applicants, Table 4 presents the results of ordered probit analyses. The aim is to identify the potential factors that impact the score of the various motivations so as to be able to draw relevant profiles of applicants.

Table 4 Determinants of the motivations to patent

	(1) Imitation	(2) Competition	(3) Hampering	(4) Investors	(5) Licensing	(6) Freedom
Number of employees	-0.03	0.07	0.05	-0.24***	-0.24***	0.02
	[0.52]	[1.32]	[1.03]	[4.49]	[4.34]	[0.31]
FTE Researchers (000)	-0.00	0.00	-0.05	0.04	0.35***	-0.09
	[0.08]	[0.00]	[0.85]	[0.71]	[3.24]	[1.46]
International group?	0.22	0.33**	0.23	-0.13	0.12	0.18
	[1.31]	[2.06]	[1.41]	[0.81]	[0.77]	[1.12]
Geographic concentration	0.06	-0.16	-0.12	0.78***	0.54*	0.25
	[0.20]	[0.57]	[0.43]	[2.66]	[1.86]	[0.87]
JC concentration	-0.66*	-0.86**	-0.94**	0.00	-0.73*	0.62*
	[1.71]	[2.24]	[2.47]	[0.00]	[1.94]	[1.65]
Country (ref = other)						

[32] The Kaiser-Meyer-Olkin measure of sampling adequacy is 0.57.

JP	0.14	0.41*	-0.31	0.12	0.06	0.64***
	[0.58]	[1.76]	[1.34]	[0.53]	[0.27]	[2.70]
US	0.22	-0.10	-0.84***	0.17	-0.04	-0.00
	[0.88]	[0.42]	[3.42]	[0.71]	[0.15]	[0.00]
GB	-0.08	-0.17	-0.15	0.22	0.18	0.16
	[0.23]	[0.47]	[0.42]	[0.62]	[0.49]	[0.44]
DE	0.33*	0.15	0.45**	-0.16	-0.12	-0.07
	[1.70]	[0.79]	[2.35]	[0.85]	[0.63]	[0.39]
FR	-0.09	0.36	0.58	-0.04	0.40	0.81**
	[0.27]	[1.01]	[1.59]	[0.12]	[1.12]	[2.16]
Pseudo R2	0.03	0.05	0.06	0.10	0.07	0.05
Observations	236	236	236	236	236	236

Dependent variables are the likert-scaled variables on agreement towards motivations to patent. The econometric method used is ordered probit, and the regressions are performed on Sample 1 Absolute value of z-statistics reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% probability threshold, respectively. Industry dummies were included in the regressions.

Interesting conclusions emerge from Table 4. Companies that are not active in several technological areas (hence having a high JC concentration index) will tend to disagree with the statements related to the exclusion motives, in columns (1) to (3). Put differently, companies active in several industries have a more dynamic and more aggressive patenting behaviour. A potential explanation might be that the learning of intense patenting strategies in sectors with high propensity to patent may translate to other sectors traditionally less patent intensive.

International group will tend to take more patents were competition is more intense. It is known that firms take more patents on foreign markets than on their own, as they have other means for controlling their home market (*e.g.* brand name, infrastructure or human capital assets). It could apply to multinational firms, which circulate their inventions internationally, at least among their various affiliates.

As far as monetary motives are concerned (columns (4) and (5)), applicant's size clearly matters: small companies active in one specific geographic market will be more likely to agree on the corresponding statements. Large firms have more equity and easier access to banks and they do not need patents to raise capital, as opposed to small companies that are financed, for example, by venture capital. This interpretation is reinforced by the positive industry dummies in Audio, Video and Media (JC1), Biotechnology (JC2), Semiconductor (JC5), Medical Products (JC9) and Pharmaceuticals (JC12). These sectors typically have high-tech start-ups, funded by venture capitals that require patents. Licensing is also known to be more important for small firms, which do not have the same diversification in manufacturing as large firms do. Small R&D intensive companies cannot implement all the inventions they produce and will, therefore, seek to license out.

4.2 Impact of motivations on the size of patents portfolio

One might suspect that the various motivations explain the propensity to patent to different extents. In order to assess the impact of each motive on the size of patents portfolio, a traditional patent production function will be estimated (Hausman et al., 1984). The conditional expected number of patents filed by company *i* is given by an exponential mean parameterization function:

$$E[p_i \mid X_i] = \mu_i = \exp(X_i'\beta + \varepsilon_i), \qquad (1)$$

where X is the vector of covariates (most importantly the number of FTE researchers and the groups of motives), β is the vector of parameters and ε_i is the error term. The parameters of equation (1) will be estimated with a Poisson quasimaximum likelihood regression. This estimation method is particularly suited since the number of patents is a count variable and the variable realistically follows a Poisson distribution (few large patent portfolios but a lot of small portfolios). In addition, the Poisson distribution is of the linear exponential family, which ensures efficient estimates if the model is misspecified (Gourieroux et al., 1984).

The main determinant of the number of patents is the number of FTE researchers, as a measure of the innovation potential of the company. The objects of interest are the various motivations, more precisely their impact on the size of the patents portfolio. Since the motives are somewhat correlated

with each other (see Table 3), the score on each axis of the factorial grouping are used. The scores on axes 1 to 3 represent the importance of the exclusion, monetary and defensive motives, respectively.

The regression must naturally control for the industry as well as for the country of the applicant. For example, it is frequently found in the literature that Japanese companies and companies in the semiconductor industry use to have a higher propensity to patent (*i.e.* a larger number of patents per unit of research input), hence the necessity to account for these specificities through country and industry dummies.

An important remark must be made regarding the relationship between patents and research efforts implicitly assumed throughout this empirical investigation. As a matter of fact, the R&D-patent relationship is characterised by two components: a *productivity* effect and a *propensity* effect. More productive research efforts will lead to a greater number of inventions per unit of research input (productivity), and the propensity to patent will determine how many patents will be applied for given the total number of patentable inventions. de Rassenfosse and van Pottelsberghe (2008) show that both components do matter and should therefore be taken into account. It is nevertheless difficult to collect data empirically and this is probably the reason why most papers do not distinguish between the two. This article is no exception and assumes a productivity of research efforts constant across companies.

Finally, it is worth noting that a company facing a patenting decision will have to decide whether to patent the invention or not and if it chooses so, to decide how many patents are needed. The variables may impact one or both of the dimensions. Since the data are collected at the company-level, it is impossible to disentangle both effects. This issue is of minor interest here, as the propensity to patent encompasses both aspects.

Table 5 Determinants of the propensity to patent

	(1)	(2)	(3)	(4)	(5)	(6)
Characteristics of the company						
log(FTE Researchers)	0.20***	0.16***	0.21***	0.20***	0.21***	0.21***
	[20.51]	[11.17]	[20.30]	[20.16]	[20.26]	[20.43]
Number of employees		0.06***				
		[3.24]				
International group?		-0.01				
		[0.14]				
Motivations (factors)						
Exclusion	0.04**	0.04*				
	[2.03]	[1.79]				
Monetary	-0.01	0.01				
	[0.45]	[0.46]				
Defensive	0.13***	0.12**				
	[2.72]	[2.40]				
Motivations (statements)						
Imitation			0.00			
			[0.27]			
Competition				0.03**		
				[2.37]		
Hampering					0.01	
					[0.54]	
Freedom						0.04***
						[2.88]
Country (ref = other)						
JP	0.35***	0.36***	0.38***	0.37***	0.38***	0.35***
	[6.88]	[7.15]	[7.81]	[7.54]	[7.89]	[7.00]
US	0.14**	0.12**	0.13**	0.13**	0.13**	0.13**
	[2.21]	[2.05]	[2.01]	[2.10]	[2.07]	[2.22]
UK	-0.24*	-0.23*	-0.26*	-0.24*	-0.26*	-0.27**

	[1.86]	[1.79]	[1.95]	[1.87]	[1.96]	[1.98]
DE	0.12**	0.11**	0.12**	0.13**	0.12**	0.12**
	[2.28]	[2.23]	[2.38]	[2.44]	[2.27]	[2.21]
FR	-0.10	-0.09	-0.08	-0.09	-0.09	-0.11
	[0.78]	[0.72]	[0.64]	[0.65]	[0.69]	[0.87]
Constant	-0.16	-0.36**	-0.00	-0.12	-0.02	-0.17*
Observations	326	326	326	326	326	326

Dependent variable is the number of priority filings in 2005 taken to the log. The econometric method used is pseudo maximum likelihood (Poisson density) and the regressions are performed on Sample 2. Robusts z-statistics reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% probability threshold, respectively. Industry dummies were included in the regressions.

It appears from Table 5 that applicants valuing exclusion motives exhibit a higher-than-average propensity to patent. This result supports the view that the patent system still performs its original mission. Exclusion motives scored the highest (cfr. Table 1) and significantly impact the demand for patents. Even though the patent system currently faces many critics, one must reckon that applicants still patent for 'traditional' exclusion reasons.

Not surprisingly, companies that patent for monetary reasons will not patent more than the norm. These companies often have few resources and will presumably be selective in their decision to patent. In addition, they will probably base their business transactions on their patents and will be scrutinised by business partners. They therefore need high quality patents. It reminds that the 'quality' policy of patent offices is key to support the development of technology markets and high tech start-ups.

Firms that are motivated by defensive motives patent more than the average. Not only do applicants apply for defensive reasons (cfr Table 1), but those that patent in that view will exhibit a higher-than-average propensity to patent and therefore actively use the patent system.

It is also worth mentioning that Japanese companies have the highest propensity to patent. This result is in line with earlier findings and can be explained by the much narrower scope of Japanese patents (de Rassenfosse and van Pottelsberghe (2007)). US and DE applicants have similar propensity to patent and UK applicants seems to patent less than the average.

The various components of the exclusion motive are tested separately in column (3) to (5). It appears that only the statement Competition is significant: the more competitive the market, the more patents will be applied for. This behavior may actually drive the results presented in column (1) and (2).

The regressions are controlled for industry specificities but were not reported. Positive impacts were found for JC4 (computers) and JC8 (medical products) and a negative effect was observed for JC2 (biotechnology). Biotech companies tend to take less patents per dollar of R&D, but probably more solid ones. Since patent protection is known to be key in these sectors, the results exemplify the trade-off between the quantity and the quality of patents.

4.3 Country-specific impact of motivations

This section deals with country specificities. The aim is to test whether the impact of motivations depends on the country of the applicant. The model specification is essentially the same as equation (1), but the motivations are this time interacted with the country dummies. The results should therefore be interpreted as the local impacts of the motivations: a significant interaction with country C dummy means that applicants from C valuing the selected motive exhibit a larger-than-average propensity to patent.

Contrary to Table 5, the score of each motive is computed as the average score of the related motivations.[33] Since each motive is tested separately, one does not need to correct for autocorrelation between motives and 'raw' (*i.e.* more informative) data can be used.

[33] Exclusion = (Imitation + Competition + Hampering)/3; Monetary = (Licensing + Investors)/2; Defensive = Freedom

Table 6 Determinants of the propensity patents, interaction terms

	(1)	(2)	(3)
Interaction term I =	Exclusion	Monetary	Defensive
log(FTE Researchers)	0.21***	0.21***	0.21***
	[20.11]	[20.46]	[20.68]
Motivation (I)	0.02	0.00	0.04
	[0.71]	[0.15]	[1.63]
Country (ref = other)			
JP	0.50**	0.49***	0.37**
	[2.38]	[4.36]	[2.22]
US	0.37	-0.24	-0.12
	[1.11]	[1.54]	[0.60]
GB	-1.23*	-0.19	-0.21
	[1.91]	[0.57]	[0.37]
DE	-0.13	0.32***	0.10
	[0.51]	[2.89]	[0.49]
FR	-0.68	0.59**	0.03
	[0.74]	[2.46]	[0.06]
Interaction terms			
JP * I	-0.03	-0.04	-0.00
	[0.57]	[0.93]	[0.10]
US * I	-0.06	0.12**	0.06
	[0.77]	[2.54]	[1.34]
GB * I	0.23	-0.02	-0.01
	[1.60]	[0.23]	[0.11]
DE * I	0.05	-0.08**	0.00
	[0.98]	[1.98]	[0.11]
FR * I	0.12	-0.21**	-0.03
	[0.69]	[2.29]	[0.31]
Constant	0.02	0.01	0.01
Observations	326	326	326

Dependent variable is the number of priority filings in 2005 taken to the log. The econometric method used is pseudo maximum likelihood (Poisson density) and the regressions are performed on Sample 2. Robusts z-statistics reported in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% probability threshold, respectively. Industry dummies were included in the regressions. Positive (negative) effects were found for JC4 and JC8 (JC2)

Table 6 presents interesting results on the local impact of monetary motivations. US applicants that apply for monetary reasons will exhibit a higher propensity to patent than their fellow-countrymen, as opposed to German and French applicants. These country specificities confirm the common wisdom that markets for technology are more developed in the US as compared to Germany and France. Whether these results are a consequence or a cause of the level of development of market for technology remains an open question.

The regressions are controlled for industry specificities but were not reported. Again, positive impacts were found for computers and medical products and a negative effect was observed for biotechnology.

5 Concluding remarks

Main conclusions from empirical investigations:

- back to basics: the patent system still performs is mission to a large extent; BUT: we use only companies that patent (and we know that not that many companies actually patent), and use EPO results, where the patent system is still seen as a high quality one
- important role played by defensive patenting
- Monetary negative in DE and FR (policies should encourage markets for technology; quality issue of the patent system)

Consequences of those new uses on the patent system and policy implications

Limitation of the dataset: is EPO well positioned to gather such data? Yes: high response rate and we may be confident in the quality of answers: results from Table 4 are in line with known facts. →

Seem to have been broadly honest in their motivations.

Raise potential research questions:

* defensive publishing & monetary need more research

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Appendices

Description of joint clusters

Code	Short name	Full name
JC1	Media	Audio, Video and Media
JC2	Biotechnology	Biotechnology
JC3	Civil Engineering	Civil Engineering; Thermodynamics (incl. engines and pumps)
JC4	Computers	Computers
JC5	Electricity and Semiconductor	Electricity and Semiconductor Technology
JC6	Electronics	Electronics
JC7	Handling and Processing	Handling and Processing
JC8	Human Necessities	Human Necessities (incl. agriculture, medical products, printing)
JC9	Industrial Chemistry	Industrial Chemistry
JC10	Measuring and Optics	Measuring and Optics
JC11	Polymers	Polymers
JC12	Organic Chemistry	Pure and Applied Organic Chemistry (incl. pharmaceuticals)
JC13	Telecommunications	Telecommunications
JC14	General Technology	Vehicles; General technology (incl. transporting mechanisms, lighting)