Filing strategies and patent value*

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March 2008

Abstract

This paper aims at contributing to the literature on the determinants of patent value. First, it puts forward a new potential class of value determinants in the form of filing strategies (encompassing filing routes and drafting styles). Second, it provides empirical evidence suggesting that these strategies are consistently and positively associated with patent value indicators. The empirical implementation relies on a unique dataset (about 250,000 patents granted by the EPO), which allows running large-scale sensitivity tests. The results reveal that the new determinants this paper puts forward –filing strategies – are the most stable of all. They also underline strong dependencies of several 'classical' results to the dependent variables and sampling methodologies, partly explaining several inconsistencies observed in the literature.

Keywords: Patent systems, Patent quality, Patent value, Filing strategies

JEL classification codes: O31; O34; O50

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* The views expressed in this article are purely those of the authors and may not in any circumstances be regarded as stating an official position of the EPO or ULB. We are indebted to Dietmar Harhoff for providing data on European patent citations and we gratefully acknowledge the helpful comments and suggestions received from Michele Cincera, Catherine Dehon, Christine Greenhalgh, Bronwyn Hall, Karin Hoisl, Maria-Isabella Leone, Carine Peeters, Gaetan de Rassenfosse and Reinhilde Veugelers, as well as from the participants of the 2007 IAMOT Conference in Miami in May 2007 and the Second EPIP Conference in Lund in September 2007. The authors also thank Michael Whitburn from VUB for proofreading this paper. Nicolas van Zeebroeck gratefully acknowledges financial support from Université Libre de Bruxelles and the Marie-Christine Adam Foundation.

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1. Introduction

Patent systems worldwide have been characterised by two related trends: an unprecedented boom in the number of patent applications and a parallel increase in their size. The growing number of patent filings is due to many factors (e.g., the globalization of markets, new generic technologies, the emergence of dynamic countries like South Korea or China, and the arrival of new actors like universities or small firms). One of these factors, strategic patenting, is believed to substantially affect patent systems because it simultaneously increases the number of patent applications and reduces their average quality: firms apply for more patents for a given invention or have a higher propensity to patent inventions of a lower quality. The direct consequence of these "strategic hypes" is a sharp increase in the workload – and hence backlogs – in patent offices, generating uncertainty on the markets for technology.[1]

Over the past 20 years, research scholars (e.g., Narin et al. (1987), Trajtenberg (1990), Scherer and Harhoff (2000) and Hall et al. (2001)) have developed models essentially aimed at setting an appropriate weighting scheme to count patents, or at finding the most promising patents within the ocean of codified knowledge published each year by patent offices. Different categories of determinants have been proposed in this literature to predict the potential value of patents. These categories include several characteristics of patents (e.g. citations, family sizes, renewals, opposition incidences), , characteristics of patent applicants and ownership structure (e.g. the type and size of the firm, cross-border ownership, co-application), and – in a more recent stream of research –characteristics of innovative and patenting processes, gathered directly from surveys of patentees or inventors.

The objective of this paper is to contribute to this burgeoning literature on the determinants of patent value in three ways. Firstly, it summarizes the dominant results produced by this burgeoning empirical literature to date and underlines some ambiguities. Secondly, it puts forward a new class of value determinants, related to the filing strategies adopted by applicants. Certain dimensions of the manner in which applicants draft their applications and manage the granting process have indeed never been accounted for in the literature and there is strong presumption that they may be associated with higher patent value. And thirdly, it aims at testing the robustness of the most trusted results in the literature by relying on several indicators of value as dependent variables[2] and on a wide sample of patents granted by the EPO that allows testing the results for the most important technologies and geographical areas.

Several dimensions of filing strategies have already been described and typified by Harhoff (2006) and Stevnsborg and van Pottelsberghe (2007). However, to the best of our knowledge

[1] The determinants and consequences of the boom in patent applications has been analysed by Kortum and Lerner (1999) and Jaffe and Lerner (2004) for the US patent system and by Guellec and van Pottelsberghe (2007) for the European patent system.
[2] Throughout the remainder of this paper the various measures of patent value used as dependent variables will be referred to as 'patent value indicators', though they are only used as proxies for the monetary value.

they have rarely or never been used as such as potential determinants of patent value. The paper argues that these dimensions should be correlated with patent value indicators and evaluates empirically to what extent they actually are. These filing strategies range from the structure and quality of the drafted document (the relative number of claims included in the patent, the construction of the draft by assembly or disassembly) and the filing of divisional applications to the route chosen to reach the EPO (via the PCT process or not) and the request for accelerated search.

Our set of explanatory variables is completed with different classical measures evoked here above and relating to the complexity of the inventions (patent characteristics) and the ownership of the patents. In terms of dependent variables, five patent-based indicators that the literature has found most strongly correlated with patent value and which all reveal the existence of a market for the patented technology are exploited: forward citations, European family sizes, triadic applications, renewals, and opposition incidences.[3] As these classical indicators capture different dimensions of patent value, the composite index proposed by van Zeebroeck (2007a) is also used to integrate their various degrees of orthogonality. The different features of filing strategies and the more classical determinants (patent characteristics and ownership) are then tested against each of the five classical indicators and the composite index.

The econometric estimates are run over a large dataset including all granted patents that were filed at the EPO between 1990 and 1995 (about 250,000 patents). This unique 'size' and 'breadth' of the sample, including data on the validation and renewal of European patents that is available for the first time at such a large scale, enables the third contribution of this paper to the literature: testing whether and to what extent the existing results have been affected by sampling methodologies (i.e., the geographical origin of the applicant or the technological area under investigation) or by the chosen indicator of patent value.

The paper is structured as follows: Section 2 presents an in-depth review of the empirical literature on the determinants of patent value and underlines some contradictions across studies. Section 3 introduces the different dimensions of patent filing strategies, their measures and evolutions, and discusses their expected association with patent value indicators. Section 4 is devoted to the empirical implementation, the results of which are discussed in section 5. Concluding remarks and potential policy implications induced by the results are proposed in section 6. This paper first shows that most dimensions of patent filing strategies are positively associated with more valuable patents and that they constitute the most stable determinants of all. The results further confirm the positive impact of some of the most popular determinants (such as the number of inventors), but also point to strong sensitivities to the sampling methodology (country- or industry-wise) and the patent value indicator used as dependent variable.

[3] See van Zeebroeck (2007a) for a detailed analysis of those indicators and their evolution over time for European patents.

2. The literature on patent value

The burgeoning empirical literature on patent value has been surveyed by Dixon and Greenhalgh (2002), Reitzig (2004b), Greenhalg and Rogers (2007), and Sapsalis and van Pottelsberghe (2007).[4] A particularity of the numerous contributions in this field of research is that they cannot be easily summarised, as their empirical design diverge over three dimensions: i) the measure of patent value used as dependent variable; ii) the adopted sampling strategy and iii) the number and type of explanatory variables (i.e. the potential value determinants). Most empirical implementations take the following generic form:

$$V_i = f(PC_i, PO_i, II_i) \quad (1)$$

where V_i is a measure of the value of patent *i*, PC_i is the vector of characteristics of patent *i*, PO_i is the vector defining the characteristics of patent *i*'s owner, and II_i is a vector of variables, based on information gathered directly from assignees or inventors and characterizing the underlying invention and the context in which it was made. The heterogeneity observed in the existing literature mainly comes from the various measures of *V* and from the heterogeneity in the number and type of determinants within each of the three classes included in the empirical models.

2.1. Diversity in indicators of patent value

Roughly speaking, classical measures of patent value used on the left-hand side of Equation 1 can be divided into two broad categories: those that come from outside the patent system and those that come directly from it, respectively 'market-based' and 'patent-based' measures, as summarised in Table 1. The former measures mainly consist of financial or economic indicators, the most popular being Tobin's *q* and stock market values for works at the firm level, and surveyed estimates for studies at the patent level. In the case of firm market values, the underlying assumption is that the value of a firm's patent portfolio should be somehow reflected in its market value, provided that financial markets are efficient. In the case of the surveyed monetary value of patents, the underlying rationale assumes that inventors or managers know the financial value of their patents.

The second group of measures, henceforth designated 'patent-based', are much more diverse in nature and rationale. The survey provided by van Zeebroeck (2007a) in this respect has concluded that 4 families of indicators have been consistently found to be positively correlated with patent value or firm valuation: citations, families, renewals, and oppositions. Given their relatively high degree of orthogonality and the divergences in their evolution, no one can be preferred to the other, but their metes and bounds need be defined precisely prior to being measured (see as well van Pottelsberghe and van Zeebroeck, 2008).

[4] Reitzig (2004b) discusses in particular the theoretical and conceptual meaning of various indicators and determinants.

Table 1 – Typology of patent value indicators in the literature

Group	Indicator
Market-based measures (MKT)	
Firm value	Tobin's *q* Stock Market Sales/ Benefits New firm creation Technologic Strength R&D Performance
Estimated patent value	Royalties Valuation by inventors or managers Sleeping vs. Active Buy-outs
Patent-based measures	
Technological importance (*CIT*)	Forward citations
Geographical scope (Families) (*FAM*)	Triadic Number of countries worldwide Number of EPC validation States
Length (Renewals) (*REN*)	Age at lapse
Grant decision (*GRT*)	Patent has been granted
Legal disputes (*DIS*)	Litigation incidences Opposition incidences Opposition outcomes

Table 2 proposes a typology of the empirical studies available so far on the determinants of patent value, based on the value indicator used and the sampling methodology.[5] It first clearly appears that some indicators of value are much more popular than others, namely market-based measures, citations and oppositions. Second, many indicators have never been used on a large scale, which is logically the case for market value measures over a full sample, since such measures can only be gathered manually – hence selectively – at the patent level.

2.2. Diversity in sampling strategies

The different levels of observation (aggregate, firm, or patent) and types of samples (surveyed, focused or full-scale) are represented on the vertical axis in Table 2. Sampling strategies vary widely, from a few dozen observations in studies at the aggregate level to full-scale samples with up to tens of thousands of patents. However, very few studies have relied on full samples of patents, i.e. without making any arbitrary choice on the sample selection to be made. Focused approaches – i.e., limited to one country or one sector – are clearly the most popular, with 35 studies at the patent level and 14 at the firm level. As joint data on patents and firms is difficult to obtain, focused approaches have so far been a logical solution. Obviously, samples based – even partially – on the answers to any survey are constrained by the selection inherent to any survey. One may therefore logically wonder to what extent the empirical results found in such 'focused' pieces of research can be generalised.

[5] Table A1 in the appendix provides the names of the authors of the studies depicted in Table 2.

Table 2 – Typology of the empirical literature on patent value

Sample used in estimation \ Indicator used as dependent variable	Market Value	Citations	Grants	Opposition	Opposition Outcome	Litigation	Renewals
Patent-level full-scale			GVP00 GVP02 PJW05 WPJ07				B05 D05
Patent-level focused	A93*° CC80*° CNW81* L98*° L93*° LPP98*° P03*° S05* S01*° ST04* TF94*	L94*° SVP07*° SVPN06*° S07*	S06*	CS04° GHHM02° HH02° HR04° JW03° R04a*° R04b° W04°	GHHM02° R04b°	AL98* ALMT03* C04* LS97* LS99*° LS01* L94*°	B06*° LS99*°
Patent-level survey	AANM91*° PATVAL06* G05* GHV06* HSV02* HSV03* R02 R03°	HNSV99* JTF00*					
Firm-level focused	B06*° BVR02* BR01* CHO05 GJW05* GPH86 HC03° HJT05*° HTT07 LS04* L94*° NS06*° SK97° T90*°	N04*°					
Firm-level survey	NNP87*°	BCM07*		BCM07*			DI97*
Aggregate level	ACC04*° P86* PS84 PS89* P96 S98* SP86* S94*			HH04			

**Geographical sample | °Sectoral sample | Acronyms are detailed in Table A1 in the appendix*
The term 'Focused' refers to samples limited to a few sectors and/or countries

2.3. Diversity in the determinants

Further to the selection of value indicators and the adoption of a sampling methodology, the type and number of explanatory variables vary also widely across studies. To start with, some explanatory variables that are significantly correlated with an independent value measure of proven reliability have subsequently been used as new indicators of value on their own. This has been the case, for instance, with forward citations, the most important determinant of patent value for market-based measures, which were also used as dependent variable in at least 8 studies. This has also been the case with renewals and legal disputes. In addition to these frequent measures with well supported though imperfect reliability, research scholars have identified a range of extra features of patents as potential value determinants, which can be grouped into the three different classes of variables introduced in Equation 1: various characteristics of each patent application (*PC*), the characteristics of the patent owners (*PO*), and some contextual information gathered from surveys, pertaining to the context of the invention or the patenting motives pursued by the applicant (*II*). This typology of patent value determinants is summarised in Table 3.

The class of determinants based on patent characteristics include different subsets of variables with very different rationales. The first four subsets correspond to the four groups of patent-based indicators described here above, which have been used on both sides of Equation 1: forward citation counts (and derived measures), measures of the geographical scope (patent families), measures of the length (renewals), and variables identifying legal disputes, their characteristics and outcomes. The rationale of these four subsets of variables has been reviewed in van Zeebroeck (2007a), and all of them have consistently been found to be positively associated with patent value in the literature. These four types of measures will constitute the dependent variables for the model presented in the next section and will therefore 'only' be used as value indicators (i.e. on the left-hand side of Equation 1).

Table 3 – Typology of patent value determinants

Group	Determinant
Patent characteristics (PC)	
Technological importance (*CIT*)	Forward citations (after N years)
	Forward citations by type of citation (after N years)
	Institutional origin of forward citations
Geographical scope (Families) (*FAM*)	Triadic
	Number of countries worldwide
	Number of EPC designated States
	Number of EPC validation States
Length (Renewals) (*REN*)	Age at lapse (*REN*)
Grant decision (*GRT*)	Granted (*GRT*)
Legal disputes (*DIS*)	Litigation incidences (*LIT*)
	Opposition incidences (*OPP*)
	Opposition outcomes (*OTC*)
	Multiple opponents (*MOP*)
Complexity	Number of backward patent citations (*BPC*)
	Share of Self Citations (by same applicant)
	Generality index
	Basicness/Originality index
	Number of backward non-patent citations (*NPC*)
	Number of claims (*CLM*)
	Number of IPC classes (at different levels) (*IPC*)
	Number of inventors listed (*INV*)
Filing route	PCT (Chapter I/Chapter II) vs. EP Direct (*PCT*)
	Accelerated Search Request (*ASR*)
	Accelerated Examination Request (*AEX*)
Patent Ownership (PO)	
Ownership structure	Co-Applicants (*COA*)
	Cross-border ownership (*CBO*)
Applicant profile	Portfolio size (*CUM*)
	Market size (*APS*)
	Academic (*ACA*)
	Independent (*APP*)
	Inexperience (*OCC*)
Insider information (from surveys only) (II)	
Patenting motives (*MOT*)	Offensive vs. Defensive
	Blocking vs. Protection
	Research Collaboration
Invention context (*ICH*)	Difficulty to invent around
	Inventors' profiles
	R&D Structure
	Environment

Two additional subsets of determinants in the same class have been widely tested in the literature: measures of complexity and indications on the adopted filing route. The former set includes backward patent citations (indicating the existing technological background of the invention) and derived measures,[6] non patent citations (denoting the link of the invention to

[6] Czarnitzki et al. (2005) and Hall et al. (2005) observe that self backward patent citations (i.e. made to patents owned by the same individual or firm) are more valuable than citations coming from third-party patents, while Palomeras (2003) and Sapsalis and van Pottelsberghe (2007) obtain more nuanced results.

basic research, as in Carpenter et al. (1980) or Narin et al. (1987)), the number of claims (supposedly informative on the legal breadth of the protection, cf. Tong and Frame (1994)), the number of IPC classes (a proxy for the technological scope or architectural nature of the invention (Lerner, 1994), but subject to the aggregation level chosen in the classification (van Zeebroeck et al., 2006b)), and the number of inventors listed in the application (indicating the research efforts made to design the invention).[7] All those complexity indicators are expected to be positively correlated with patent value and have proved so in some empirical studies. The latter set summarizes the path followed by each application to reach a given patent office and is considered in the present paper as fully part of its filing strategy (discussed in section 3).

The second class of determinants qualify a patent's ownership. This class first includes the structure of the ownership: the presence of multiple applicants introduced by Duguet and Iung (1997) denotes joint research efforts, and the cross-border ownership of patents (i.e. at least one inventor and one applicant residing in different countries) defined by Guellec and van Pottelsberghe (2000, 2001) indicates an international organization of research. Both measures are expected to be positively correlated with patent value. The second set of determinants in this class qualifies the applicant itself with different measures (the size of the applicant, academic applicants, occasional applicants, and of the size of the patent portfolio). The association of these measures with the value of patents is however much less clear.

First, the size of the applicant – from independent inventors to large multinational firms (Lanjouw and Schankerman, 1997; Gambardella et al., 2006) has an ambiguous relationship with patent value, for larger firms may produce higher quality research, but may also be less discriminating in choosing which inventions to patent or not. Second, academic patents are thought to relate to more basic research, which is expected to produce higher value inventions (cf. Harhoff et al. (2002) and Sapsalis et al. (2006)), but they might be of a higher scientific value although of a lower market value due for instance to the uncertainty induced by unproven concepts. Third, the inexperience of a patentee with the patent system (Allison et al., 2003) may be the sign of a highly valuable invention (valuable enough to convince a newcomer to enter the patent arena) or of a small invention that did not pass a careful screening prior to being patented. And fourth, the size of the applicant's patent portfolio (Shane, 2001) – included in many empirical models – may reflect the level of experience the applicant has with the patent system and therefore be proportional to the value of his patents, but very large portfolios may denote patentees with a very high propensity to patent, possibly inducing many applications of a lower value to be filed.

As a complement to the richness of the data available in patent databases, various dimensions of inventing and managerial processes underlying the decision to patent have been explored through inventors' surveys. These variables make the third class of value determinants, which

[7] Note, however, that Brusoni et al. (2006) found the number of inventors to be strongly correlated with the size of the applicant firm, probably indicating differences in the organisation of research activities according to the size of firms. Therefore, this variable may also capture in some way the size of the applying firm.

is in more of an embryonic state as compared to the other types of determinants. A large scale example of such surveys was conducted in Europe a few years ago under the name PatVal, whose authors gathered detailed information on about 9000 European patents and their underlying invention (Gambardella, 2005; Brusoni et al., 2006; Gambardella et al., 2006).[8]

Table 4 – Empirical evidence on value indicators so far (as of May 2007)

	Value Indicators																													
	MKT				CIT				GRT				REN				OPP				OTC				LIT					
Value Determinants	A	N	P	T	A	N	P	T	A	N	P	T	A	N	P	T	A	N	P	T	A	N	P	T	A	N	P	T	T	W
MKT				*0*			2	*2*				*0*				*0*				*0*				*0*				*0*	**2**	**2**
CIT	2		14	*15*				*0*	2		1	*3*			3	*3*	2		6	*8*		1	2	*3*			5	*5*	**38**	**34**
FAM	1		5	*5*	2			*2*	1	2		*3*	1		1	*2*	2		6	*8*	3			*3*			2	*2*	**26**	**22**
REN			13	*13*			1	*1*				*0*				*0*	1			*1*				*0*				*0*	**15**	**15**
DIS			4	*4*				*0*				*0*			1	*1*				*0*				*0*			1	*1*	**6**	**6**
MOP				*0*				*0*				*0*				*0*				*0*		1	1	*2*				*0*	**2**	**1**
BPC	1		3	*4*			3	*3*	2	1		*3*	2			*2*			5	*5*	1			*1*	3		2	*5*	**23**	**21**
NPC	1		2	*3*	2		1	*3*				*0*				*0*	4	1		*5*	1			*1*	1			*1*	**13**	**12**
CLM		1	3	*4*			2	*2*	1			*1*	1			*1*	2		5	*7*	1		1	*2*			5	*5*	**22**	**19**
IPC	1		3	*4*			1	*1*	1	2		*3*				*0*	1	1	1	*3*				*0*	2		1	*3*	**14**	**12**
INV		1		*1*	1	1		*2*				*0*				*0*	2			*2*			1	*1*				*0*	**6**	**5**
PCT				*0*				*0*	1		2	*3*				*0*	4		3	*7*	3			*3*	1			*1*	**14**	**11**
AEX				*0*				*0*				*0*				*0*			5	*5*	2		1	*3*				*0*	**8**	**5**
ASR				*0*				*0*				*0*				*0*	1	2		*3*	1	1		*2*				*0*	**5**	**3**
COA				*0*			2	*2*			1	*1*	1			*1*	2			*2*	1			*1*				*0*	**7**	**6**
CBO				*0*				*0*			2	*2*				*0*				*0*				*0*				*0*	**2**	**2**
CUM	2		2	*4*			1	*1*		2		*2*				*0*		2	1	*3*				*0*		2		*2*	**12**	**11**
APS	2	1	2	*5*			1	*1*				*0*			1	*1*	1	1	1	*3*		2		*2*	2			*2*	**14**	**12**
ACA		1		*1*				*0*				*0*				*0*	1			*1*				*0*				*0*	**2**	**2**
APP	1			*1*				*0*	1			*1*				*0*				*0*				*0*	1			*1*	**3**	**2**
OCC				*0*				*0*				*0*				*0*				*0*				*0*			1	*1*	**1**	**1**
MOT				*0*	1			*1*				*0*				*0*	1			*1*				*0*				*0*	**2**	**1**
DIA			1	*1*				*0*				*0*				*0*				*0*				*0*				*0*	**1**	**1**
ICH	3			*3*				*0*				*0*				*0*				*0*				*0*				*0*	**3**	**3**
T	**14**	**4**	**52**	***68***	**6**	**1**	**14**	***21***	**9**	**7**	**6**	***22***	**5**	**0**	**6**	***11***	**24**	**7**	**33**	***64***	**13**	**5**	**6**	***24***	**10**	**2**	**17**	***29***		
W				***39***				***8***				***5***				***4***				***9***				***2***				***7***		***67***

A: Ambiguous, N: Negative, P: Positive, T: Total, W: Distinct Works

2.4. Consistency within the existing literature

The main results obtained by most contributing papers in the field are summarised in Table 4,[9] which shows the number of empirical estimates in which each potential value determinant appeared associated with each potential indicator. At first sight, some areas appear much more crowded than others. It first confirms that the most popular indicators used as dependent variables are market value indicators with 68estimated parameters (at the patent or firm level), followed by oppositions and forward citations, with respectively 64 and 21 estimated parameters. This last variable is however the most frequently used determinant, followed by families (26), backward patent citations (23) and claim counts (22).

A closer look at the table shows that several inconsistencies have occurred in the literature. Renewals (REN) and forward citations (CIT) have almost always been positively associated

[8] Earlier examples in the US included Scherer (1965), Carpenter and Narin (1983), Narin et al. (1987), Albert et al. (1991), Cohen et all (2000), and Jaffe et al. (2000) and in Europe, Crépon et al. (1996), Duguet and Iung (1997), Harhoff et al. (1999, 2002, 2003), Scherer and Harhoff (2000), Scherer et al. (2000), Kleinknecht et al. (2002), Reitzig (2002, 2003), and Silverberg and Verspagen (2004).

[9] Detailed results found in the literature are provided in Table A2 in the appendix.

with patent value indicators, but backward patent citations (BPC) and even more so backward non-patent references (NPC), claims (CLM), and IPC classes – not to mention many less frequently tested measures – seem to have a much more ambiguous or unstable relationship with the different value indicators. This may of course be due either to the different indicators actually capturing different dimensions of patent value and hence characterised by different drivers, or to the sampling methodology. These inconsistencies across the various specifications tested in the literature call for a more comprehensive exercise conducted at the largest possible scale to investigate potential indicator, geographical or industrial patterns in what determines patent value.

3. Filing strategies

As patent systems evolve and become increasingly popular, new strategies emerge in terms of managing patenting processes and maximizing the legal protection of inventions. The empirical investigation of strategic patenting and patent thickets has recently intensified among scholars (e.g., Hall and Ziedonis, 2001; Noel and Schankerman, 2006; Harhoff et al., 2007a). In this paper, the focus is more on an upstream issue: the filing strategies adopted by firms when applying for a patent. Harhoff (2006) has developed the notion of patent constructionism,[10] illustrating how firms build patent portfolios by merging several priority filings or using divisional applications.[11] Stevnsborg and van Pottelsberghe (2007) have scrutinised the numerous options patentees use along the patenting process at the EPO and put forward a typology of four broad filing strategies based on patenting routes, drafting styles, and the behaviour adopted for interacting with EPO examiners. These typologies range from 'good will and fast track' to 'deliberate abuse of the system'. The latter covers the exploiting of every procedural possibility offered by the system to delay the granting process or to obtain the broadest possible scope of protection.[12]

The costs and additional red tape associated with most of these strategies suggest at first sight that the underlying inventions must be worth the effort involved, and that the resulting patents must be of higher value. However, patent filing strategies have never been analysed as such as potential determinants of patent value. The objective of this paper is precisely to address this question and so doing, to contribute to this literature. This objective requires the construction of several variables – described in Table 5 – to identify the filing strategies and a discussion on their expected impact on value indicators. These variables are essentially twofold: some of them relate to the path followed to reach the EPO and be granted a European patent, and the

[10] Harhoff (2006) defines patent constructionism as the "strategies and tactics used by patent applicants to construct patent portfolios by constructing overlapping, multiple filings with high similarity from smaller building blocks (claims, first filings) or by recombination of smaller building blocks."

[11] Some applicants merge several national priority filings to file a single patent application at a regional patent office, whereas others file very large patents including many pages and or claims and later divide them into smaller subsequent patents.

[12] Lazaridis and van Pottelsberghe (2007), for instance, show that two additional claims (from the median application) on average lead to an additional communication between the examiner and the applicant, and one additional communication in turn leads to one year of delay in the outcome of the examination process (see also van Zeebroeck (2007b) for a quantitative analysis of this issue).

others pertain to the way each application has been drafted. The former group of strategies has already been accounted for in different papers, but the second – to the best of our knowledge – has so far not been tested as determinants of value.

Table 5 – Summary Statistics of Filing Strategies Variables

Variable	Acronym	Obs.	Mean	St.Dev.	Min	Max
PCT Filing	PCT	248,856	0.29	0.45	0.00	1.00
Accelerated Search Requested	ACCSRC	248,856	0.02	0.13	0.00	1.00
Excess claims (compared to JC median)	CLMDEV	248,848	1.21	0.90	0.07	37.40
Excess claims (compared to JC mean)	CLMDEV_MN	248,848	0.99	0.73	0.06	28.67
# Claims lost in examination phase	CLMLS_NB	245,194	1.63	6.28	-152.00	350.00
% Claims lost (as % of granted claims)	CLMLS	245,194	0.29	1.05	-1.00	116.50
# Priorities	PRIO	248,856	1.20	0.84	0.00	49.00
# Equivalents	EQUIV	248,856	0.13	0.53	0.00	24.00
Application has divisional(s)	HASDIV	248,856	0.04	0.20	0.00	1.00
Application is a divisional	ISDIV	248,856	0.03	0.16	0.00	1.00

Source: Own calculations based on EPO data – Granted patents filed 1990-1995

3.1. Filing routes (and speed)

Applicants may follow several routes to file their applications at the EPO. They may either file a priority application directly at a national patent office or at the EPO. Since the Paris Convention (1883), applicants have one year from the date of their first (priority) filing to extend their patent application to any other country in the world, including the EPO. Until recently, most patentees used to file an application at their domestic patent office and transfer it to other offices within 12 months. Before the mid eighties this was the case for more than 90% of all applications filed at the European Patent Office (EPO). Since then, the Patent Cooperation Treaty (PCT) – signed in 1978 – has offered patent applicants a new option to delay the international extension of their priority filings to patent offices worldwide from 12 to 31 months. The PCT multiplied the number of potential routes toward the EPO, which are now entirely part of the strategic choices that any patent applicant needs to make before reaching the EPO.[13]

This longer assessment time has convinced many applicants to opt for the PCT process, so that about 53% of applications filed at the EPO in 2005 were transferred through the PCT route.[14] Over the period considered in the present analysis (1990-1995), about 30% of the granted patents were filed via the PCT option. The PCT procedure may carry applications that are clearly aimed at being widely extended worldwide and may hence be associated with a higher economic value. But it may also concern applications that were filed very early in the innovation process, at a time when the invention's market potential was still unclear (see van Zeebroeck et al., 2006a). In such a case, the patentee may have preferred to delay by an extra 18 months the time when a final decision as to whether the application is worth being extended abroad or not would have to be made, and so the application itself may be of much

[13] See Stevnsborg and van Pottelsberghe (2007) for a comprehensive overview of these routes.
[14] EPO Annual Report, 2005.

or of very little value, if any. Therefore, the overall association between the PCT option and patent value is a priori unclear.

Whereas the main effect of the PCT route is a substantial delay in the patenting process, at the time the application is filed at the EPO the patentee is allowed to file a request for accelerated search and/or examination so that the file may be processed more rapidly. Table 5 shows that accelerated searches (*ACCSRC*) are requested in as little as about 2% of the cases. One particular strategy associated with this procedural option consists of filing a Euro-Direct application (i.e. non-PCT) with an accelerated search request, so that a preliminary opinion on the patentability of the invention may be obtained very quickly and a decision to pursue the granting process may be taken within a short period of time. Accelerated searches and examinations may also be used by patentees who are very confident about the patentability of their invention and just want their patent to be granted as fast as possible. Consequently, the association between accelerated search requests and patent value is also a priori ambiguous.

3.2. Drafting styles

The drafting style of patent applications is made of three main dimensions related to the number of claims, the merger or split of national priority filings (or patent constructionism) and the reliance on divisionals. These dimensions are sometimes strategically exploited by applicants in order to reinforce the legal strength of their patents, to circumvent the disclosure requirement, or to create smoke screens or uncertainty in a specific technological area.

3.2.1. Claims

Regarding the number of claims, van Zeebroeck et al. (2006a) have shown that the severe inflation in the size of patent applications at the EPO was notably due to a progressive harmonization of drafting styles toward American drafting modes, themselves largely influenced by legal changes in the US patent system. The literature on patent value has frequently used the number of claims as a proxy for the breadth or complexity of patents (Tong and Frame, 1994), suggesting – and empirically demonstrating – a positive correlation with patent value.

This complexity may induce uncertainty at the patent office and among competitors on the market, possibly to the benefits of the applicant. However, raw counts of claims depend heavily on technology specific practices and their evolution over time (cf. Archontopoulos et al.,2007). Therefore, the number of claims as such may not provide a fair indication of the strategic behaviour of a patentee in drafting an application. Rather, the deviation of a patent's number of claims relative to the median number of claims contained in applications from the same technological area and filed in the same year provides a measure of the relative oversize of an application, potentially denoting a strategic behaviour. This deviation, the '*CLMDEV*' variable, is computed according to Equation 2.

$$CLMDEV_i = \frac{C_i}{median_{S_i,Y_i} C_j} \quad (2)$$

C_i is the number of claims contained in application *i*, (S_i, Y_i) is the set of applications filed in the same technology joint cluster (S_i) and year (Y_i) as application *i*. Note that two parameters have to be set in the construction of this variable: the level of aggregation and the measure to compare with. In the present case, the deviation in claims will be computed with respect to the median number of claims in the same EPO Joint Cluster and the same year of filing.[15] Table 5 shows that the average *CLMDEV* is 121% (99% when using the mean instead of the median), which means that the deviation is on average positive, denoting a highly skewed distribution of claims across patents. However, the extrema ranging from 6% to 3740% suggest the presence of large outliers and a high level of skewness in the distribution. To deal with this severe skewness, the variable will be taken in logarithm within the estimated equations. Given the cost incurred by excess claims (the EPO charges additional fees for claims in excess of 10), and because excess claims may represent more robust or larger patents (including more fall-back positions or encapsulating a larger scope of protection), this variable is expected to be positively associated with value.

As a complement, the claims abandoned in the course of the examination proceedings may be a good indicator of potentially abusive drafting strategies. It should be recalled here that the examination process often takes the form of an interactive process between the examiner and the patent agent, which ends in a final set of claims that would be allowed for grant by the examiner. In this respect, the number of claims abandoned as a percentage of the number of claims remaining in a granted patent (*CLMLS*) is informative of the scope of protection that has been refused by the examiner and is therefore expected to have a detrimental effect on indicators of patent value. The average number of claims lost is about 1.6, and the record case had a loss of 350 claims.[16]

3.2.2. Constructionism

The progressive shift from patent strategies to patent portfolio strategies has led patentees to no longer rely on a single patent to protect an invention, but rather to build a set of intellectual property rights. The size and strength of the patent portfolio therefore matters more than the quality of each individual patent. This change in reliance on and use of the patent system contributed to the well known surge in patent filings around the world (Kortum and Lerner,

[15] An alternative measure could rely on the average number of claims (the econometric models have been run under this option, but exhibit no major difference). In terms of aggregation levels, different options were tested, based on the IPC classes (at 3 or 4 digits). However, the large number of classes at such aggregation levels induces a large proportion of them with a very small number of applications filed in any given year, so that the median or average number of claims does not make much sense (for a discussion on these issues, see van Zeebroeck et al., 2006b).

[16] Note, however, that this figure may sometimes be negative, denoting an increase in the raw number of claims during the examination process. Such an increase would in most circumstances be due to the split of certain claims into smaller ones. This may be dictated by the examiner when he thinks the claims are too complex or broad. It is legally forbidden to add extra substance within a given application once filed, and hence a negative value of CLMLS should normally never denote an expansion in the scope of protection.

1999) and has given rise to new schemes in constructing patent filings (Harhoff, 2006). In particular, applicants increasingly split national priority filings into a set of applications with a common root that they file or extend to the EPO (cf. Harhoff's Type I construction), and conversely merge several national priority filings to form one single EPO application (cf. Harhoff's Type III construction).[17] The average number of EP equivalents (EP filings having at least one priority in common) or *EQUIV* is about 0.13, but ranging from 0 (no EP equivalents) to 24 (extreme case of Type I construction), and the average number of priorities per EPO application (*PRIO*) is just over 1 (about 1.2), but actually ranges from 0 (EPO first filings) to 49 (extreme case of Type III construction).[18] Such EP equivalents may potentially contribute to the creation of a patent thicket, "*a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize a new technology*", according to Shapiro (2001)'s definition, though the identification of patent thickets is a very complex issue that goes beyond the scope of this paper.[19]

At first sight, the drafting and procedural costs associated with such strategies suggest that only higher value inventions would justify them, and the corresponding variables should be associated with more valuable patents as a result. However, should a given scope of protection be split into different filings, one could hardly foresee the way the value of the underlying invention would spread across these filings. Assuming that most value could remain concentrated in one application in the case of a Type I construction, such a strategy would generate one highly valuable filing and several filings of much less value. Hence, the expected sign of the association between construction strategies and patent value is uncertain.

3.2.3. Divisional filings

An additional feature that is intensively debated on both sides of the Atlantic is the possibility to split one European application into several divisional filings that will follow their own track in the examination process, while keeping the same filing date and priority number as the parent application from which they originate. This option is mostly used when the original application is said to lack unity and would hence be refused as such by the examiner. In this scenario, the applicant may isolate different subsets of the initial claims and encapsulate them into different divisionals, while the now smaller original filing follows its initial path up to grant, usually carrying the core of the claims. Therefore, divisional filings frequently reveal excessively large or unfocused applications, sometimes resulting from the premature patenting of an invention or from a deliberate willingness to deceive competitors and examiners by hiding the true invention in numerous claims, or to maintain a case pending for as long as possible.

[17] Harhoff's Type II construction referring to the possibility for applicants to file independent priority filings covering a same invention and extend them to the EPO as such is much more difficult to identify because such applications are not related by a common priority number.

[18] Note that the computation of the *EQUIV* variable excluded from recognised equivalents those applications that were in fact divisionals of the original filing, see below.

[19] See e.g. Harhoff et al. (2007a) for an empirical investigation of patent thickets.

Divisional filings sometimes emerge as a new form of *de facto* submarine patents (see Graham and Mowery, 2004; van Zeebroeck et al., 2006a; and Stevnsborg and van Pottelsberghe, 2007). Indeed, although Article 76(1) of the European Patent Convention provides that divisionals "*may be filed only in respect of subject-matter which does not extend beyond the content of the earlier application as filed*", some applicants file divisional applications beyond this requirement to amend them later, during prosecution. Some even file divisionals of divisionals that they amend even later in the process. This has led to concerns that divisionals can be abused, thereby inducing legal uncertainty for third parties.[20]

Nonetheless, the administrative burden induced by the filing of divisionals suggests that such strategies would only be used when the root application is unusually valuable. Hence parents of divisionals are expected to be strongly associated with patent value. The sign of the association with divisional filings is much less clear, as no one could predict which part of the subject matter from the original filing (the core of the invention or some accessory features) will be encapsulated into each divisional. Should the two effects materialize (divisionals concern more valuable patents, but most value remains within the original filing), the association would be ambiguous. From Table 5, one may notice that about 4% of all granted patents filed at the EPO in the period considered have given rise to divisional filings (*HASDIV*) and 3% only were divisionals themselves (*ISDIV*). Since by definition each parent has given rise to at least one divisional application, this difference readily suggests that divisional filings are less likely to be granted than their parents.[21]

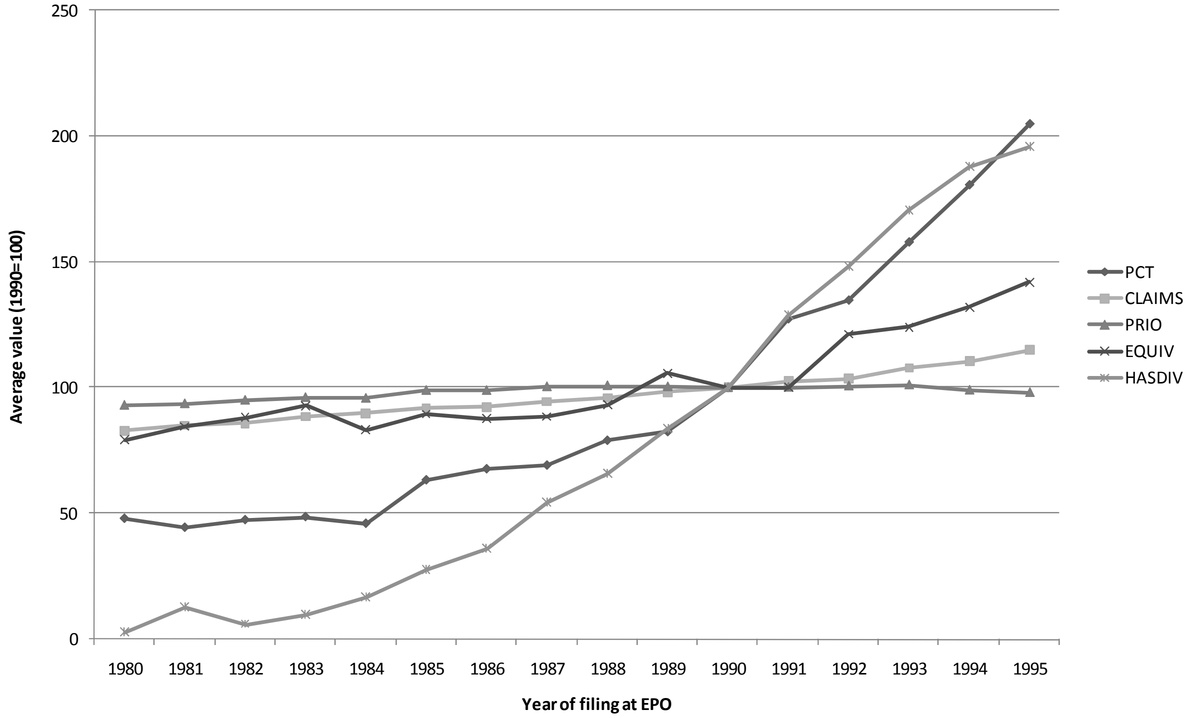
Figure 1 depicts the evolution of the different dimensions of patent filing strategies for the period 1980-1995. It shows that all these strategies have become increasingly frequent over the period considered. The most striking evolutions are the share of applications filed through the PCT route and the share of applications that were followed by one or more divisional applications (*HASDIV*). With a less pronounced evolution, the average number of claims and of EP equivalents have also experienced a continuous increase over the entire period, whereas the average number of priorities has remained remarkably stable around 1 priority, suggesting that the construction by assembly, though more frequent today than before, remains largely exceptional.

Whereas most patent value indicators have decreased or remained mitigated over the same period (see van Zeebroeck, 2007a), all strategic filing indicators exhibit an upward trend. These opposite evolutions could actually suggest a negative impact of filing strategies on patent value, against the common sense intuition evoked earlier in this section. This further emphasizes the need for an empirical investigation of this relationship.

[20] Nurton, J., "EPO Enlarged Board rules on divisionals", in MIP Weekly News July 4, 2007.

[21] Divisionals are identified in our dataset from two sources. One variable extracted from an EPO internal database indicates the number of divisional filings each application gave rise to (enabling the identification of parent filings), and the second source is provided by the "Continuation" table in PatStat (identifying children).

Figure 1 – Evolution of Patent Filing Strategies at the EPO (1980-1995)



Sample: All applications filed to the EPO in the period 1980-1995

4. Empirical implementation

To measure the potential association between filing strategies and patent value and to test the robustness of some classical variables as determinants of patent value, a specific dataset needed to be constructed from different sources: OECD (2004), PATSTAT (EPO, 2006), OECD (2006) and different internal EPO databases. This dataset is composed of all applications that were filed to the EPO between 1990 and 1995 and were granted by the Office no later than in January 2006, which represents a total of about 250,000 patents. Indeed, since the measurability horizon of most value indicators is about 10 years, including post 1995-filings would induce right censoring on the data on most value indicators. In addition, some variables (e.g. claims abandoned) were not available for pre-1990 patents.[22]

The model to be estimated is an extension of the classical model represented by Equation 1:

$$V_i = f(FS_i, PC_i, PO_i, CV_i) \qquad (3)$$

where FS_i is the vector of new variables characterizing the filing strategy adopted by patent *i*'s applicant and CV_i is a vector of control variables composed of technological, geographical and time dummies. The indicators and determinants included in the model are described in the two following sub-sections.

[22] Note that since our dataset only comprises granted patents, the following results may not hold for pending, withdrawn and refused applications.

4.1. Dependent variables (value indicators)

Since the objective of the present paper is to perform an econometric analysis at the patent level and on a full-scale basis, the dataset is limited to the information that can be found within patent databases, therefore excluding any market value indicator as dependent variable. However, in order to obtain results that would be less dependent on the chosen indicator, a multi-indicator approach is preferred, in which the same model is to be estimated with different indicators as dependent variables (*V*). Building on van Zeebroeck (2007a), five variables are used in order to approximate patent value on the left-hand side of the models, which represent the four most classical types of patent-based value indicators discussed in section 2, and which all strongly suggest the existence of a market for the patented technology: the number of forward citations received by each application within 5 years from its publication date (*CITE5*),[23] the number of EPC Contracting States in which the patent has been validated after grant (*EPCFM*),[24] whether the patent was still enforced in France, Germany and the UK 10 years after it had been filed (*SRV10*), whether the patent is a member of a triadic patent family (i.e. has been applied for or granted at the USPTO and JPO as well)[25] (*TRIAD*), and whether the granted patent has been opposed at the EPO (*OPPOS*).[26] Note that the two former indicators are discrete variables and the three latter are binary variables. In addition, to integrate these different dimensions of patent value, a sixth indicator (*COMPO*) is made of the composite value index ranging from 0 to 20 defined in van Zeebroeck (2007a), as in Equation 4:

$$COMPO_i = r\left\{\ln(1+CITE5_i)+10\left(0.8\frac{\max\left\{SY_i-20;0\right\}}{80}+(1-0.8)TRIAD_i\right)+5\Big(0.4(OPPOS_i-REV_i)+(1-0.4)REJ_i\Big)\right\} \quad (4)$$

where $COMPO_i$ is the composite value of application *i*, *r(x)* is a function that rounds its given parameter to the closest integer, SY_i is the Scope-Year Index (the composite measure of the geographical scope and term of maintenance defined in van Pottelsberghe and van Zeebroeck, 2008), REJ_i is equal to 1 if the opposition was rejected or closed, and REV_i takes the value of 1 if the application was revoked as a result of the opposition procedure. By definition, this indicator may be expected to provide a synthetic view of the aggregate effect of each explanatory variable in the model, should these effects differ from one indicator to the other.

Summary statistics of these six dependent variables are provided in Table 6. It shows that about 66% of patents in the sample belong to a triadic family (*TRIAD*), 50% were still in force in Germany, France and the UK 10 years after their filing date (*SRV10*), and 6% have been opposed (*OPPOS*). The average number of citations received within 5 years (*CITE5*) is about 0.5 with a minimum of 0 and a maximum of 46, the number of EPC Contracting States in

[23] See Webb et al. (2005) for a detailed overview of the main issues with patent citations data. Following Harhoff et al. (2007c), we only include X and Y (i.e. particularly relevant) citations received.
[24] Using EPO databases for renewals, validation records with a lapse within the first year from the date of grant are discarded as they denote in fact lapses '*ab initio*' (see van Pottelsberghe and van Zeebroeck, 2008).
[25] See Dernis et al. (2001), Dernis and Khan (2003) and Webster et al. (2007)
[26] See Priest and Klein (1984) for a theoretical model underlying this choice.

which patents in the sample were validated (*EPCFM*) ranges from 1 to 16 with an average of over 5 countries,[27] and the average composite value in the sample is about 3.54.

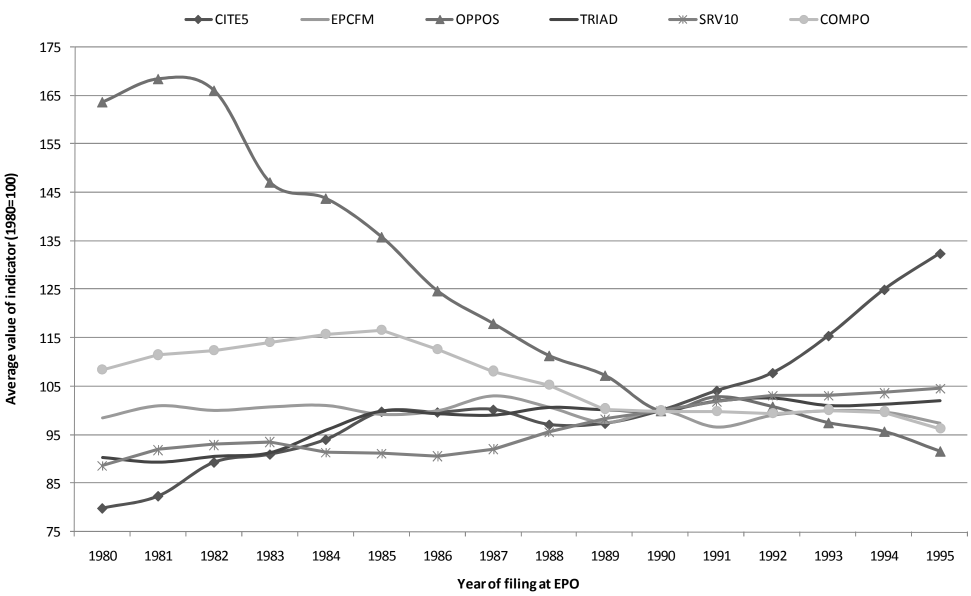
Table 6 – Summary Statistics of Value Indicators (dependent variables)

Variable	Acronym	Obs.	Mean	St.Dev.	Min	Max	Model
Patent is triadic	TRIAD	248856	0.66	0.47	0	1	Probit
Patent survived 10 years in DE,FR and GB	SRV10	243894	0.50	0.50	0	1	Probit
Patent has been opposed	OPPOS	248856	0.06	0.24	0	1	Probit
Number of X and Y citations received	CITE5	248856	0.56	1.19	0	46	Neg. Bin.
Geographical scope of validation (in EPC10)	EPCFM	243886	5.38	3.51	1	16	Neg. Bin.
Composite Index (van Zeebroeck, 2007a)	COMPO	248856	3.54	2.79	0	18	Neg. Bin.

Source: Own calculations based on EPO data – Granted patents filed 1990-1995

The evolution of these six indicators over time is depicted in Figure 2. As observed in van Zeebroeck (2007a), most of the indicators witness some decrease in value between 1990 and 1995, with the exception of the number of citations, which has increased, and the rate of 10-year survival in the three largest countries (Germany, France and the UK) which increased before declining back to its 1990 level at the end of the period. Hall et al. (2001) nevertheless observe that the increase in the number of forward citations is probably influenced by systemic factors, which may not be associated with any increase in value (essentially relating to changes in the nature and creation of citations or to the increasing number of claims included in patent filings), and we argued in van Pottelsberghe and van Zeebroeck (2008) that the increase in the rate of 10-years survival is tempered by a contraction in the geographical scope of protection and an expansion of the grant lag.[28]

Figure 2 – Evolution of Patent Value Indicators 1990-1995



1990 = 100 - Sample: All granted patents filed at EPO in the period 1980-1995

[27] Note that data on validations and renewals at the Italian Patent Office are excluded due to data unavailability.
[28] The Examination Guidelines of the EPO mention that the search for prior art and the substantive examination should be made on the basis of the claims. Therefore, an increasing number of claims should lead to an increasing number of references in the search reports drafted by the examiners.

The model described in Equation 3 is to be estimated with each of the 6 value indicators, using probit estimators for dummy variables and maximum likelihood for discrete ones, with a negative binomial specification given the suspected overdispersion in the distributions.[29]

4.2. Explanatory variables (value determinants)

The present model (cf. Equation 3) extends the classical models insofar as it adds to Equation 1 the indicators of filing strategies introduced in section 2, which represent filing routes and drafting styles. However, as compared with Equation 1, the present model excludes any insider information (*II*) because of the size of the dataset, and uses the first four sets of patent characteristics only on the left-hand side of the equation as indicators of patent value. This leaves only measures of complexity from the class of patent characteristics, and different measures of patent ownership (structure and profile). Three sets of control variables will allow potential technological, country and time effects to be accounted for. Descriptive statistics for the complexity, ownership, and control variables are provided in Table A4 in the appendix.[30] A Spearman rank correlation matrix of all explanatory variables included in the model is presented in Table A5 in the appendix.

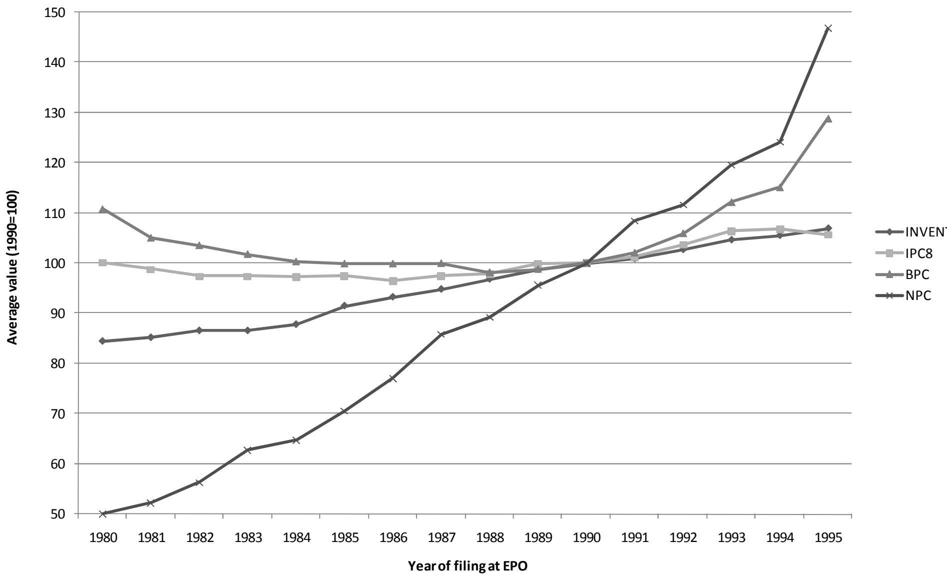
The complexity measures (*PC*) include four variables: the number of inventors listed in the application (*INVENT*), ranging from 1 to 32 with an average of 2.4 inventors; the number of IPC classes at 8 digits associated with the patent (*IPC8*), ranging from 1 to 43 with an average of about 2 classes per patent; the number of references made by each patent to earlier patent documents (*BPC*), ranging from 0 to 99 with about 4.5 backward citations on average, and the number of references made by each patent to non patent documents such as scientific papers (*NPC*), which has a maximum of 61 and an average of about 1 non patent citation per patent.

The evolution of these four complexity measures is depicted in Figure 3. It shows that most complexity indicators have increased in the period 1980-1995, especially the number of backward patent and non patent references to the prior art. This may reveal that inventions are becoming more incremental or architectural – an intuition which is supported by the concomitant but slower increase in the number of IPC classes and inventors –, but may also be driven by systemic factors such as better electronic documentation and search techniques allowing examiners to more easily find relevant pieces of the prior art. As reviewed in section 2, the theoretical foundations of these four variables suggest that they should be positively associated with patent value, but the numerous empirical models found in the literature have produced many ambiguous results (cf. Table 5). The present implementation, conducted over a large sample and with 6 different value indicators will allow sensitivity tests to be performed on the chosen value indicators and samples.

[29] NEGBIN II in Cameron and Trivedi (1984)'s presentation.

[30] Note that in order to reduce the potential impact of the outliers present in most discrete variables included, the latter will be taken in natural logarithm in the econometric estimates.

Figure 3 – Evolution of the complexity of patent applications



Sample: All applications filed to the EPO in the period 1980-1995

The ownership characteristics (*PO*) include: the total number of applications filed at the EPO by the same applicant in the same year and five previous years (minus the application under consideration) (*CUMUL*), which provides an overview of the cumulative portfolio size of the applicant (see van Zeebroeck et al., 2006a). This represents on average about 410 EPO applications with a maximum of 4832. *OCCAS* is a dummy variable taking value 1 if the cumulative portfolio size (*CUMUL*) is 0 (in which case the application being considered is the first one applied by the same applicant over the previous 5 years), and 0 otherwise. This variable therefore identifies filings made by very inexperienced patentees, which represented about 21% of the patents in the sample. *ACAD* is a dummy variable identifying patent applications originating from academic institutions and public research centres, which represents about 2% of all patents in the sample.[31] Finally, *CBOWN* is a dummy variable identifying patents with at least one applicant residing in another country than the country of one inventor, also known as cross-border ownership (Guellec and van Pottelsberghe, 2000; 2001). This is the case for about 1 patent in 10 in the sample and should be related with higher value patents as they denote an international organization of research activities.

To complete the model and account for potential industry, country, or time effects, three sets of dummy variables have been constructed as control variables (*CV*): 14 dummy variables represent the 14 Joint Clusters representing different technological areas at the EPO (see Archontopoulos et al., 2007), 19 country dummies identify the country of residence of the applicants, and 6 year dummies represent the year of filing of each patent at the EPO (ranging from 1990 to 1995). The three sectors with the largest number of patents granted from the sample are 'handling and processing', 'organic chemistry' and 'industrial chemistry', with 14,

[31] This variable was created based on the presence of the stems of the words "*University*", "*Institute*" and "*Centre*" in the name of the applicant. It is therefore imperfect and should be interpreted with care. In addition, not all academic patents are applied for by universities, as shown by Saragossi and van Pottelsberghe (2003) and Sapsalis and van Pottelsberghe (2007).

13 and 12% of the patents respectively, and the 3 largest countries of residence of applicants represent about 70% of the sample (the US, 26%; Japan, 22%; and Germany, 20%). The sample is well balanced over the period considered as 16% to 17% of the patents had been filed in each of the 6 years in the period.

The correlation matrix of all explanatory variables (see Table A5 in the appendix) shows some interesting results. For instance, the variable *HASDIV* is relatively highly correlated with the claim size variables. This would have been expected as these patents are generally purposefully large, and later split into several divisional applications. The number of backward patent citations is also highly correlated with the claim deviation variable, suggesting that patents with a large targeted scope (in terms of the number of claims) are subject to a larger knowledge base, or prior art. The number of backward citations to the scientific literature is positively correlated with the number of inventors, the academic patentees and the biotech joint cluster. In other words, biotech inventions are performed by large teams that rely heavily on the scientific literature and include a relatively high share of academic researchers.

5. Empirical results

The results of the consecutive estimations with the six alternative indicators of value are reported in Table 7 with robust standard errors.[32] The first observation to be made is that most parameters associated with filing strategies are significant and positive, evidencing that such strategies are positively correlated with patent value. The log-deviation in claims (*CLMDEV*), the number of priorities (*PRIO*), the parents of divisionals (*HASDIV*), and the PCT route (*PCT*) are generally associated with the most significant parameters of all potential determinants of patent value.[33]

5.1. Filing strategies

According to most existing studies, the number of claims is positively associated with patent value, although it has been reported as non significant or at least ambiguous in a few papers and even negative in one.[34] The log-deviation in claims is associated with a significant and positive parameter for the six value indicators, which is consistent with the literature, and is systematically one of the 2 or 3 most significant parameters of the model. It sounds logical, therefore, that the share of claims abandoned in the course of the examination has a detrimental effect on patent value, except that it does not in any way reduce the likelihood to

[32] The estimated parameters of the control variables are available upon request. Various robustness estimates were performed and are available upon request as well. These tests include different model specifications, Iteratively Reweighted Least Squares estimates, instrumental variables for the claims variables, dropping variables, varying samples, clustered regressions by type of applicant, country and industry, and within-sample prediction.

[33] The results from OLS regressions of the different sets of determinants on the composite index (available upon request) reveal that – apart from the technological control variables (joint clusters) – filing strategies make the most significant contribution (an extra 4%) to the R-squared of the model, followed by the technical complexity, then patent ownership characteristics.

[34] Lanjouw and Schankerman (1999), Graham et al. (2002), Schneider (2006), Calderini and Scellato (2004) and Wagner (2004) obtain ambiguous coefficients, and Palomeras (2003) a negative one.

be opposed. In other words, the number of claims seems strongly related with patent value. Patents with excess claims are associated with more citations (arguably because the scope of the patent is then larger and hence increases the probability that future applications rely on it as prior art), tend to be applied for in more countries within and outside the EPC, and tend to live longer. However, claims have a much smaller effect on the probability to be opposed. This result may arguably be regarded as surprising since the main objective of oppositions is to reduce or destroy the legal scope of protection provided by a patent, which is made of the claims. In a nutshell, this result suggests that opponents target the substance defined by the independent claims rather than the subtleties such as fall back positions (mostly made up of dependent claims) of a patent.

The two constructionism variables differ in significance but not in sign across the six value indicators. Their correlation with patent value is positive in most cases but insignificant in some respects. The number of priorities is associated with a particularly strong positive coefficient for citations, triadicness and composite value, but – consistently with the claims – has no effect on oppositions. A patent linked to a larger number of priorities is an aggregate of several domestic priority filings. If one assumes that its scope is larger than the standard application, this might explain why they tend to receive more citations from subsequent applications. This extra substance embedded into the patent may also explain why it tends to be validated in more countries in and outside Europe and why it seems more likely to be still active after 10 years.

The dummy variables identifying divisional strategies provide very interesting results as well. The *HASDIV* variable – identifying the parents of divisional filings – is one of the very few variables associated with a highly significant and positive parameter for all 6 value indicators. That is, parents of divisional filings are significantly associated with more important patents, no matter how value is measured: they are more likely to receive citations, to be validated in more countries, to be applied in the trilateral offices, to be maintained for at least 10 years and to be opposed.

However, the *ISDIV* variable, identifying divisional filings themselves, presents similar results though with smaller significance levels on oppositions and families and a negative impact on the number of forward patent citations received. That they tend to survive longer may be a mere consequence of a longer application and examination process. It is in the very nature of divisionals to be associated with longer pendency times as discussed here above; hence the likelihood for them to be still active at the end of their tenth year from filing is systematically higher, and more significantly so than their parents. Similarly, if the parents are triadic, then the children will necessarily be considered triadic as well since triadic families are built on priority numbers. But the fact that they are less significantly associated with large EPC families and high opposition rates than their parents, and more importantly their negative

Table 7 – Econometric estimates for the 6 indicators of patent value

	5yrs Citations *Neg. Bin. II*			EPC Family *Neg. Bin. II*			Triadic *Probit*			Survived 10yrs *Probit*			Opposed *Probit*			Composite *Neg. Bin. II*		
Variables	**Coef.**	**ε (1)**	**z**	**Coef.**	**ε (1)**	**z**	**Coef.**	**ε (1)**	**z**	**Coef.**	**ε (1)**	**z**	**Coef.**	**ε (1)**	**z**	**Coef.**	**ε (1)**	**z**
Patent Filing Strategies (FS)																		
(a) ln(CLMDEV)	0.30	0.14	44.43 (**)	0.03	0.16	16,16 (**)	0,12	0,04	23,83 (**)	0,08	0,03	18,38 (**)	0,02	0,00	2,91 (**)	0,10	0,34	41,27 (**)
(b) ln(1+CLMLS)	-0.14	-0.06	-13.21 (**)	-0.06	-0.31	-19,58 (**)	-0,09	-0,03	-11,65 (**)	-0,03	-0,01	-4,54 (**)	0,02	0,00	1,89	-0,08	-0,26	-20,61 (**)
(c) ln(1+PRIO)	0.36	0.17	22.99 (**)	0.05	0.24	9,98 (**)	0,62	0,21	41,60 (**)	0,06	0,03	5,88 (**)	0,03	0,00	1,71	0,17	0,57	29,33 (**)
(d) ln(1+EQUIV)	0.02	0.01	1.42	0.01	0.04	1,66	0,19	0,07	14,25 (**)	0,07	0,03	5,72 (**)	0,08	0,01	4,54 (**)	0,05	0,16	8,32 (**)
(e) HASDIV	0.25	0.13	13.90 (**)	0.13	0.70	22,42 (**)	0,21	0,07	11,92 (**)	0,34	0,13	23,95 (**)	0,30	0,04	16,08 (**)	0,21	0,79	34,55 (**)
(f) ISDIV	-0.27	-0.11	-9.09 (**)	0.03	0.13	3,19 (**)	0,47	0,14	19,89 (**)	0,45	0,17	24,27 (**)	0,10	0,01	3,42 (**)	0,11	0,38	11,83 (**)
(g) PCT	0.09	0.04	9.13 (**)	0.09	0.46	30,36 (**)	0,29	0,10	40,11 (**)	0,08	0,03	12,02 (**)	0,00	0,00	-0,42	0,13	0,46	36,57 (**)
(h) ACCSRC	0.07	0.03	2.50 (*)	0.03	0.18	3,82 (**)	0,10	0,03	3,82 (**)	0,17	0,07	8,29 (**)	0,11	0,01	3,38 (**)	0,06	0,21	5,85 (**)
Technical Complexity (PC)																		
(i) ln(INVENT)	0.18	0.08	26.55 (**)	0.02	0.12	11,73 (**)	0,11	0,04	20,50 (**)	0,07	0,03	14,66 (**)	0,07	0,01	8,82 (**)	0,08	0,27	31,10 (**)
(j) ln(IPC8)	0.31	0.14	41.46 (**)	0.03	0.16	14,12 (**)	0,06	0,02	10,61 (**)	0,03	0,01	6,55 (**)	-0,01	0,00	-0,85	0,09	0,29	30,85 (**)
(k) ln(1+BPC)	0.21	0.10	25.41 (**)	-0.01	-0.06	-4,88 (**)	-0,07	-0,03	-11,27 (**)	0,02	0,01	4,30 (**)	0,25	0,03	26,11 (**)	0,03	0,10	10,14 (**)
(l) ln(1+NPC)	0.06	0.03	9.62 (**)	-0.01	-0.04	-3,54 (**)	0,08	0,03	14,91 (**)	0,08	0,03	16,66 (**)	0,09	0,01	11,18 (**)	0,03	0,10	12,20 (**)
Applicant Profiles (PO)																		
(m) ln(1+CUMUL)	0.01	0.01	6.62 (**)	-0.03	-0.14	-44,01 (**)	0,10	0,03	58,45 (**)	0,02	0,01	11,85 (**)	-0,05	-0,01	-21,15 (**)	-0,01	-0,02	-7,93 (**)
(n) OCCAS	0.00	0.00	0.18	-0.03	-0.17	-8,68 (**)	-0,10	-0,04	-11,42 (**)	-0,07	-0,03	-8,53 (**)	-0,05	0,00	-3,54 (**)	-0,07	-0,24	-14,30 (**)
(o) ACAD	0.09	0.04	3.52 (**)	0.00	-0.02	-0,48	-0,09	-0,03	-4,02 (**)	-0,04	-0,02	-1,85	-0,11	-0,01	-3,46 (**)	-0,02	-0,06	-1,78
(p) CBOWN	0.06	0.03	4.21 (**)	0.04	0.20	9,35 (**)	-0,08	-0,03	-7,88 (**)	0,01	0,00	0,73	0,11	0,01	7,86 (**)	0,03	0,11	6,21 (**)
Model																		
# Observations	242048			239528			242048			239536			242048			242048		
Pseudo R^2	0.05			0.06			0.21			0.05			0.04			0.04		
Log likelihood	-229208			-566606			-122987			-157502			-52296			-539243		
LR chi² (P>chi²)	25308.79 (0.00)			111635.71 (0.00)			47.755 (0.00)			16.288 (0.00)			4.252 (0.00)			57101.86 (0.00)		
LR Test of alpha=0 (P>chibar²)	42000 (0.00)			35000 (0.00)												51000 (0.00)		

Granted Patents filed 1990-1995 - Robust Standard Errors - Coefficients significant at the 5% probability level (*) or at the 1% probability level (**)

(°) Marginal elasticities (dy/dx) computed for a hypothetic patent characterised by all explanatory variables equal to their average value. Elasticity to dummy variable X is defined as dy when X changes from 0 to 1. | 18 Technology dummies, 14 country dummies and 6 Time dummies included in the regression (results available upon request)

(a) Deviation in claims, (b) Claims dropped (as % of granted claims), (c) # Priorities, (d) # Equivalents, (e) Has divisionals, (f) Is a divisional, (g) PCT Filing, (h) Accelerated Search Requested, (i) # Inventors, (j) # IPC-8 Classes, (k) # Backward Patent Citations, (l) # Non patent citations, (m) 5-yr Cumulative filings, (n) Inexperienced patentee, (o) Academic patentee, (p) Cross-border ownership

coefficient for citations received, suggest that most value of divisional applications remains within the original application. This could explain why the parents are more likely to be cited, opposed, and validated in more countries. In other words, it is likely that applicants making use of divisionals tend to keep the core or essence of their invention defined in the root application and spread surrounding inventions or secure fall back positions into divisionals.

Contrary to what could have been expected, but in line with some evidence produced in the literature, the PCT route is also generally associated with higher value. The *PCT* variable performs particularly well in predicting the size of the family or the likelihood to be triadic, which in these particular cases is consistent with the very objective of the Patent Cooperation Treaty to simplify the extension of domestic patents abroad. It is therefore no surprise that patent applications filed in the three major offices (JPO, USPTO and EPO) or extended in many European countries, given their international promise, were filed through the PCT route. PCT filings being also associated with more forward citations and a higher likelihood to be maintained for ten years confirms earlier evidence that the PCT route witnesses more valuable patent applications (Guellec and van Pottelsberghe, 2000, 2002; Graham et al., 2002; Reitzig, 2004a). Nonetheless, the PCT dummy is associated with a coefficient 2 to 3 times smaller than the coefficient of divisionals' parents with forward citations, survival rates and the composite, suggesting that this strategy option is less associated with value than the parents of divisionals. The *PCT* variable has no effect on the likelihood to receive an opposition, which is consistent with Harhoff and Hall (2002), Harhoff and Reitzig (2004), Reitzig (2004b) and Wagner (2004).

Finally, the request for accelerated search is associated with a positive and significant coefficient for all 6 indicators. This result is in contradiction with earlier empirical evidence (Graham et al., 2002; Jerak and Wagner, 2003; Reitzig, 2004a), though the *ACCSRC* variable had only been tested as a determinant of oppositions. However, the same authors as well as Harhoff and Hall (2002) found positive and significant coefficients for accelerated *examination* requests. Our results support the idea that the strategy consisting of getting the patent granted faster is also associated with patents of higher value, and that this effect prevails.

5.2. Complexity

The set of variables expressing the technical complexity of patents is also associated with many significant parameters, most of them being consistent with the literature. The number of inventors has a strong positive impact on all indicators (in line with Reitzig, 2004b), as is the case for non patent references (in line with Carpenter et al. (1980) and Narin et al. (1987), but in contradiction with Reitzig (2004b), who obtained a negative coefficient, and Allison and Lemley (1998), Harhoff and Hall (2002), Harhoff et al. (2002), Harhoff and Reitzig (2004), and Wagner (2004), who all obtained a non-significant impact).

The number of IPC classes (a measure of the technological scope according to Lerner, 1994) also has positive effects. The same variable was associated with a negative coefficient in

Guellec and van Pottelsberghe (2000, 2002) as well as in Harhoff and Reitzig (2004), and a non significant or ambiguous parameter in Lanjouw and Schankerman (1997, 2001), Harhoff et al. (2002), Reitzig (2004a) and Schneider (2006). One of the most frequently tested determinant, backward patent citations has been found positively correlated in 13 distinct empirical analyses listed in Table A1 in the appendix and 9 times non significant, but negative in only one case. In the present estimates, backward patent citations counts are associated with more citations and a higher likelihood to be maintained 10 years or opposed, but also with smaller EP families and a smaller likelihood to be triadic, making it one of the most unstable variables across indicators.

5.3. Patent ownership

The three variables identifying different types of applicants shed some additional light on these results. Two preliminary observations may be made when looking at the *CUMUL* and *OCCAS* variables, expressing the experience or lack of experience of applicants in terms of their cumulative portfolio of patent applications at the EPO: first, that the sign of their coefficient varies widely across value indicators; and second, that they are usually in opposition with each other: the coefficient of these two variables (*CUMUL* and *OCCAS* respectively) is non-significant vs. negative on citations, negative vs. positive on EPC family size and opposition likelihood, then positive vs. negative on likelihood to be triadic and maintained for 10 years. These puzzling results – in line with the literature – may be interpreted as follows. As compared to large applicants, inexperienced patentees are less likely to have their patents cited, to build triadic patent families and to maintain their patents for 10 years or more; but they tend to validate their patents in more European countries and are more likely to see their patents opposed. On the contrary, academic patents are associated with more forward citations, but slightly lower probabilities to be triadic, maintained for 10 years or being opposed. Finally, the dummy variable identifying cross-border applications (*CBOWN*) is associated with more citations, larger EPC families and more frequent oppositions, but also with a smaller likelihood to be triadic and no particular survival rates.

It is worth noticing that the effect of patent filing strategies on patent value is only slightly affected by the type of applicant implementing each strategy, as suggested by the inclusion of interaction terms between filing strategy and applicant profile variables into the model as well as by clustered regressions by type of applicant (i.e. occasional patentees only, academic patentees only, and all the others). These results reinforce the idea that similar filing strategies may be adopted by different types of applicants.

5.4. Technology and country effects

There are very significant geographical and industrial effects with each value indicator – even more so for countries than for technological areas. The most significant parameters are to be found for the chemical and biotechnology clusters. Organic chemistry and biotechs, in particular, are associated with the most significant variables of the model to explain the size of the European family; in other words, patent families seem significantly larger in these clusters than in others. The reason for this is probably to be found in market structures, competitive processes and the importance of the patent system in these sectors.

Four sectors seem to be characterised by more forward citations on average: organic chemistry, polymers, biotechnologies and telecommunications, which may be due to inventions being more frequently incremental in these areas (hence patent applications are more frequently or more intensively relying on the state of the art), or to the state of the art being more easily identifiable in these fields, possibly thanks to a higher degree of codification and standardization in the description of inventions. Triadic families and oppositions also look more frequent in pretty much the same areas. The industries experiencing the longest survival rates are biotechnologies, multimedia and telecommunications. At the lower end of the ranking, handling and processing, automotive, civil engineering, electricity and measuring optics sectors are associated with significant negative coefficients for almost all indicators, especially citations, triadic and survival rates. In particular, the measuring optics cluster is associated with the smallest family sizes and lowest opposition rates. These results are confirmed by regressions performed at the joint cluster level, summarized in Table A6 of the appendix.

Large discrepancies are also observable across countries of applicants, and indicator to indicator variations are even more perceptible. The most remarkable countries are also the largest patent filers at the EPO: the United States, Japan and Germany, all with very striking fluctuations across indicators. Japanese and US patents are logically the most triadic ones (two-thirds of the way to a triadic family is covered when a Japanese or US patent is filed at the EPO) along with patents from Nordic European countries. US and Japanese patents are also the most frequently cited (along with British patents) and experience the highest survival rates. But they are associated with the smallest EPC families and the lowest opposition rates. This might suggest that patents from Japan or the US extended to and granted by the EPO are of higher value on average, but that patentees from these two countries are more selective in choosing the states where they would like their inventions to be protected (supposedly they target the most relevant European countries for their business, usually the three largest according to van Pottelsberghe and van Zeebroeck, 2008) and produce patents that are less likely to be opposed. This might be an indication of lower value, but it may also very well be that having successfully passed the granting process in one or two major triadic offices and having crossed at least one ocean to reach the EPO, these patents are more robust and less likely to be successfully challenged in oppositions. Conversely, German patents are characterised on average by the largest EPC families (along with their Austrian and Swiss counterparts) and exposed to the highest risk of being opposed (together with Danish and Dutch patents), but they are the least likely to be triadic and among the least cited. These patterns are confirmed by the country-level regressions summarized in Table A7 in appendix.

It is very likely that these discrepancies across countries are to a large extent related with a home disadvantage biases. Being a European applicant, one is more likely to file a patent at the EPO as this is the first natural step for any European patentee willing to seek protection beyond domestic borders.[35] But since a European applicant could be less selective in which patents to extend to the EPO, the average value of his EPO filings might be lower than that of Japanese or US applicants who had to make a more difficult decision to cross the ocean or not and were therefore more selective.

5.5. Trends in patent value indicators

The coefficients associated with time dummies confirm the apparent negative trend with most indicators (hereby suggesting a significant decline in patent value over the period 1990-1995) except for the number of forward citations received, which seems to have continuously increased over the same period. This is consistent with conjectures on a declining trend in patent quality made by Jaffe and Lerner (2004) and Guellec and van Pottelsberghe (2007), as well as with statistical evidence reported in the van Zeebroeck (2007a).

Overall, the results presented here clearly bring a positive answer to the question raised in the beginning of the paper: patent filing strategies are positively associated with more valuable patents. As a complement, these results empirically confirm the observed decline in most patent value indicators (except citations), although the sources and correct interpretation of this trend remain to be explored in the future.

5.6. On the consistency of the results

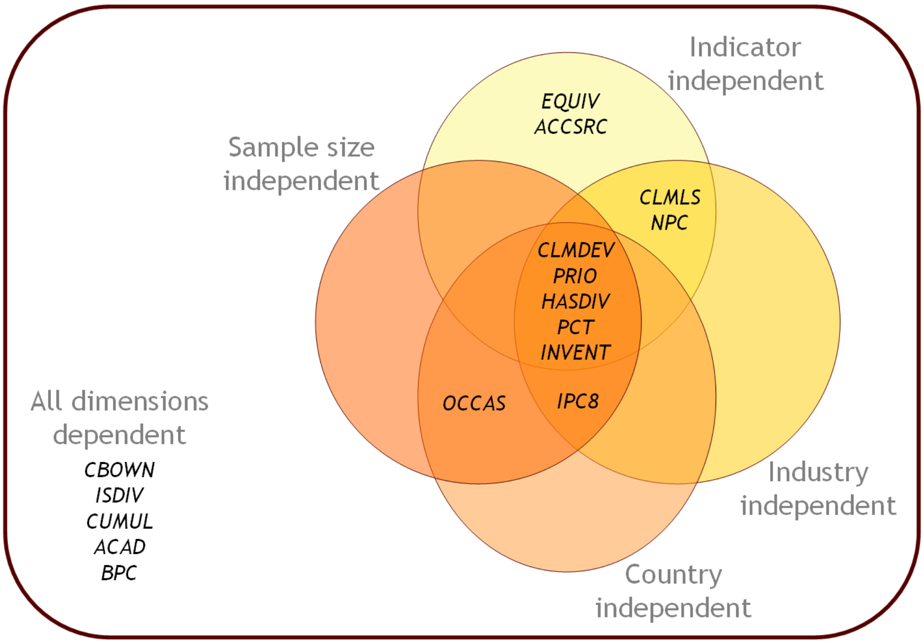
The survey of the empirical literature (cf. section 2) has highlighted a number of ambiguities from the existing results. The size of our dataset enables a large scale sensitivity test to be performed to investigate the extent to which such results (and ours in particular) may be sensitive to the sample used in the regressions or whether they can be generalized. To do so, the main model presented in Table 7 was run for each of the six value indicators on 14 industry samples, 18 country samples, and 32 random samples representing 3% of the dataset each. For each indicator, the number of times each explanatory variable got a positive (+), a negative (-), or a non-significant (/) estimated coefficient was computed and reported in Table A6 for the 14 industry regressions, in Table A7 for the 18 country regressions and in Table A8 for the 32 random sample regressions. The three tables are in appendix A6 to A8.

By looking at each indicator in isolation (in Tables A6, A7 and A8), the stability of the explanatory power of each variable on the value indicator considered can easily be assessed. In particular, all filing strategy variables – except divisional filings (*ISDIV*) – are consistently positively associated with patent value, for all value indicators. However, these tables mostly confirm the sensitivity of many results to the indicator used. All classical determinants – except the number of references to the scientific literature (*NPC*) and the number of inventors (*INVENT*) – vary in sign or significance from one indicator to another. This is probably due to these different indicators capturing different dimensions of value and hence potentially driven by different factors.

[35] This is the classical argument of the well-known home advantage bias (van Zeebroeck et al., 2006b).

Many fluctuations in the results also appear across industries and countries. Most complexity indicators and filing strategies are insensitive to the industry, but all applicant profiles variables have impacts that vary across industries. Three of them (portfolio sizes (*CUMUL*), academic patentees (*ACAD*) and cross-border ownership (*CBOWN*)) are even unstable across all dimensions.[36] In terms of country dependencies, only four dimensions of filing strategies remain stable (claims (*CLMDEV*), priorities (*PRIO*), parents of divisional (*HASDIV*) and the PCT route (*PCT*)), two complexity indicators (inventors (*INVENT*) and IPC classes (*IPC8*)), and the variable identifying inexperienced patentees (*OCCAS*). All other variables have associations with patent value that depend on the country of residence of the applicant.

Figure 4 – Stability or instability of explanatory variables



In a nutshell, the results highlight a number of country, industry and sample size dependencies in the correlation between filing strategies and technical characteristics of patents and the six value indicators. These sensibilities are summarised in Figure 4.[37] It appears that only 5 variables would pass the ‘stability test, most of them being the filing strategy variables put forward in this paper. Indeed, four out of the five variables measuring filing strategies turn out to be amongst the most stable or regular determinants of value (claim deviations, the number of priorities, divisional applications and the PCT route). On the other hand, five variables are

[36] This, however, may be due to the construction of these variables relying on uncleaned applicant names (possibly leading to an underestimation of the actual portfolio size and an incomplete identification of academic patentees).
[37] In order to dichotomise the robustness or sensitivity of each variable with respect to the indicator, country or industry used, we propose the following thresholds: a variable is considered robust (independent) with respect to one dimension if its coefficient keeps the same sign in all regressions across this dimension and remains significant at the 5% probability level in at least two thirds of the regressions. This means a maximum of 2 non-significant parameters in the six indicators regressions (from Table 7), maximum 4 in industry regressions on the composite indicator (from the sixth column in Table A6), 6 in country regressions on the composite indicator (from the sixth column in Table A7), and 11 in random sample regressions on the composite indicator (from the sixth column in Table A8).

highly sensitive to the three dimensions: cross-border ownership, divisionals, applicant's portfolio size, academic patentees and the number of backward patent references. These instabilities are probably rooted in the nature of the different value indicators and in the specificities of the patenting practices and inventions across technologies and countries.

6. Concluding remarks

We started this paper by suggesting that one class of potential patent value determinants had been largely ignored in the existing literature: the strategies adopted by the applicants in drafting, filing and managing their patent applications. Whereas a few of these filing strategies (the raw number of claims, the PCT route, the requests for accelerated search or examination) have been accounted for in different papers, a substantial number of characteristics relating to the structure and quality of the drafts (the amount of excess claims filed, the share of claims lost in the examination, the construction of the drafts by assembly or disassembly, and the filing of divisionals) had so far barely been heard of. The objective of this paper was to test whether these strategies are consistently and positively associated with patent value indicators.

The literature on patent value has proposed many potential determinants. The latter may be grouped into three classes: patent characteristics, ownership characteristics, and 'insider' information obtained from field surveys or interviews. Two shortcomings were identified in the prior art on patent value determinants. First, the impact of some variables varies a lot across studies, probably being sensitive to various sampling strategies or to the chosen value indicator. Second, filing strategies had barely been accounted for

Our empirical implementation relied on a unique dataset made up of about 250,000 EPO patent grants and on six different indicators of value as dependent variables. The explanatory variables included the filing strategy indicators proposed in this paper, completed with more established determinants: complexity measures and ownership characteristics.

The results of this paper first show that most dimensions of filing strategies are positively associated with more valuable patents, and that they constitute the most stable determinants of all. This is particularly the case with the amount of excess claims filed, the drafting by assembly, the choice of the PCT route, and the parents of divisional applications. The results further confirm the positive impact of some popular determinants (such as the number of inventors), but also underline strong sensitivities to the sampling methodology (country- or industry-wise) and the patent value indicator used as dependent variable. In particular, well established determinants of patent value such as backward patent citations and the applicant's patent portfolio size appear to have a very ambiguous relationship with patent value, which heavily depends upon the country from which patents originate, the technology area they are related to, and the value indicator chosen. In other words, much care is prescribed before generalising results obtained with a single value indicator or a restricted sample of patents, which is a characteristic that applies to most existing papers

The strikingly strong relationship between filing strategies and patent value raises several policy issues. The recent surge in the size of patent applications witnesses an exploitation of all procedural possibilities offered by patent systems to build the most suitable filing strategy (see van Zeebroeck et al. (2006a) as well as Stevnsborg and van Pottelsberghe (2007)). The present paper empirically establishes that these filing strategies consisting in drafting excessively long patents – often by assembly or disassembly – and in particular the filing of divisional applications, are indicative of more important patents.

The benefits of such divisional or drafting strategies to patent holders can easily be guessed: they may induce complexity and uncertainty on the market, not to mention a larger field of exclusive exploitation for the patent owner. A common denominator of these strategies is that they may also induce considerable delays in the granting process. This possibility is more carefully investigated in van Zeebroeck (2007b).

Although the factual or empirical evidence in this matter is very scarce, there is a distinct danger that such strategies could derive to real abuses of the patent system, possibly to the benefits of the owner and to the expense of consumers (see Stevnsborg and van Pottelsberghe, 2007). For instance, by re-filing the same subject-matter over and over again by means of divisionals over several generations, a patentee could unduly keep some subject-matter alive from a parent application that had been refused for grant by the Office. By filing divisionals of the application and then divisionals of divisionals, and so on for up to twenty years, such a strategy could provide the applicant with a provisional protection as provided by Article 67 EPC[38] over some subject-matter which had already been judged unpatentable by the Office. In a recent ruling,[39] the EPO Enlarged Board of Appeal confirmed that this strategy is a legitimate exploitation of the procedural possibilities afforded by the EPC as it is, although some consider it "*an abuse in relation to the law as they think it ought to be [...]*." The Board nonetheless found it "*unsatisfactory that sequences of divisional applications each containing the same broad disclosures of the original patent application* [i.e. with the same description] *should be pending for up to twenty years*." But the Board decided that "*it would be for the legislator to consider where there are abuses and what the remedy could be*."[40]

The results of this paper reinforces Harhoff (2006)'s assertion that such strategies may well be an endogenous response to value, suggesting that applicants simply need more time and flexibility in the patenting process when the perceived value of their future patents is higher.[41] This statement is further investigated in van Zeebroeck (2007b). Distinguishing between this legitimate quest for flexibility and abusive behaviours may be a very delicate task – which should be achieved in view of social or economic optima – in order to determine whether the

[38] According to Article 67 EPC, a pending application provisionally confers upon the applicant the same rights in all designated States as if the patent were granted (see van Zeebroeck, 2007).

[39] Cases G0001/05 and G0001/06, decided on June 28th, 2007. The full transcription of the decision is available on the EPOLINE website.

[40] EPO EBA Decision in case G0001/05 rendered on June 28, 2007, pp. 44-45.

[41] Should this assertion be correct, the results presented in this chapter should be taken with care as simultaneity issues may slightly bias the results of our estimations.

legal framework, or the examination practice, should be adapted to better control these strategies.

In any case, this paper confirms that developments in patent filing strategies are something policy makers and all stakeholders of the patent system at large should care about for they signal more important patents that will become unavoidable in the state of the art (they are more frequently cited), remain active for longer in more countries (they have higher survival rates and larger family sizes), and tend to be more frequently opposed (clearly witnessing economic value on the market). These developments are also something the economic literature on the determinants of patent value should consider as this paper shows they provide the most stable determinants available so far.

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Appendixes

Table A1 – Codes used to refer to the state of the art on patent value in the tables

Code	Short Reference
AANM91	Albert et al. (1991)
AL98	Allison and Lemley (1998)
ALMT03	Allison et al. (2003)
ACC04	Arora et al. (2004)
A93	Austin (1993)
B06	Bessen (2006)
B05	Betran (2005)
BCM07	Blind et al. (2007)
BVR02	Bloom and van Reenen (2002)
BR01	Bosworth and Rogers (2001)
PATVAL06	Brusoni et al. (2006)
CS04	Calderini and Scellato (2004)
CN79	Campbell and Nieves (1979)
CN83	Carpenter and Narin (1983)
CC80	Carpenter et al. (1980)
CNW81	Carpenter et al. (1981)
CG88	Cockburn and Griliches (1988)
CS99	Cornelli and Schankerman (1999)
C04	Cremers (2004)
CDK96	Crépon et al. (1996)
CHO05	Czarnitzki et al. (2005)
D05	Deng (2005)
DG61	Dernburg and Gharrity (1961)
DI97	Duguet and Iung (1997)
G92	Gallini(1992)
G05	Gambardella (2005)
GHV06	Gambardella et al. (2006)
GS90	Gilbert and Shapiro (1990)
GHHM02	Graham et al. (2002)
GS95	Greene and Scotchmer (1995)
GR06	Greenhalgh and Rogers (2006)
GR07	Greenhalgh and Rogers (2007)
GJW05	Griffiths et al. (2005)
G81	Griliches (1981)
G89	Griliches (1989)
GPH86	Griliches et al. (1986)
GVP00	Guellec and van Pottelsberghe (2000)
GVP02	Guellec and van Pottelsberghe (2002)
HC03	Hagedoorn and Cloodt (2003)
H99	Hall (1999)
HH04	Hall and Harhoff (2004)
HMG06	Hall and MacGarvie (2006)
HJT01	Hall et al. (2001)
HGHM03	Hall et al. (2003)
HJT05	Hall et al. (2005)
HTT07	Hall et al. (2007)
HH02	Harhoff and Hall (2002)
HR04	Harhoff and Reitzig (2004)
HNSV99	Harhoff et al. (1999)
HSV02	Harhoff et al. (2002)
HSV03	Harhoff et al. (2003)
HWW05	Hunter et al. (2005)
JTF00	Jaffe et al. (2000)
JW03	Jerak and Wagner (2003)
KT86	Kamien and Tauman (1986)
KVMB02	Kleinknecht et al. (2002)
K90	Klemperer (1990)
KL99	Kortum and Lerner (1999)
K98	Kremer (1998)
L93	Lanjouw (1993)
L98	Lanjouw (1998)
LS97	Lanjouw and Schankerman (1997)
LS99	Lanjouw and Schankerman (1999)
LS01	Lanjouw and Schankerman (2001)
LS04	Lanjouw and Schankerman (2004)
LPP98	Lanjouw et al. (1998)
L94	Lerner (1994)
MN90	Merges and Nelson (1990)
MT05	Meyer and Tang (2005)
N04	Nagaoka (2004)
NNP87	Narin et al. (1987)
NS06	Noel and Schankerman (2006)
ODST98	O'Donoghue et al. (1998)
P86	Pakes (1986)
PS84	Pakes and Schankerman (1984)
PS89	Pakes and Simpson (1989)
PJW05	Palangkaraya et al. (2005)
P03	Palomeras (2003)
P96	Putnam (1996)
R02	Reitzig (2002)
R03	Reitzig (2003)
R04a	Reitzig (2004a)
R04b	Reitzig (2004b)
SVP07	Sapsalis and van Pottelsberghe (2007)
SVPN06	Sapsalis et al. (2006)
S98	Schankerman (1998)
SP86	Schankerman and Pakes (1986)
S65	Scherer (1965)
SH00	Scherer and Harhoff (2000)
SHK00	Scherer et al. (2000)
S06	Schneider (2006)
S07	Schneider (2007)
S99	Scotchmer (1999)
SG90	Scotchmer and Green (1990)
S05	Serrano (2005)
S01	Shane (2001)
SK97	Shane and Klock (1997)
ST04	Sherry and Teece (2004)
SV04	Silverberg and Verspagen (2004)
S94	Sullivan (1994)
T86	Teece (1986)
T06	Teece (2006)
TF94	Tong and Frame (1994)
T90	Trajtenberg (1990)
VBVZ08	van Pottelsberghe and van Zeebroeck (2008)
VZ07	van Zeebroeck (2007)
W04	Wagner (2004)
WPJ07	Webster et al. (2007)

Table A2 – Empirical evidence on patent value determinants in the literature

		Determinants (Independent variables)																													
Paper	**INDICATOR**	**MKT**	**DIS**	**FAM**	**CIT**	**REN**	**INV**	**IPC**	**BPC**	**NPC**	**CBO**	**PCT**	**ASR**	**AEX**	**CLM**	**CUM**	**OCC**	**ACA**	**SPR**	**SOB**	**SDB**	**SCL**	**MOP**	**COA**	**DIA**	**IAP**	**APS**	**APP**	**GAP**	**LEP**	**ICH**
A93	FV							+																					+	+	
AANM91	TST				+																										
ACC04	R&D																										+				
AL98	LIT								/	/																					
ALMT03	LIT				+				+						+	-	+														
B05	LIT				+																										
B06	FV					+																									
B06	LIT		+		+				a																		+				
BCM07	CIT															+			+	/	/	/									
BCM07	OPP				+											+			/	+	/	-									
BVR02	FV				+																										
C04	LIT		+	+	+							/			+	-												/			
CC80	PV									+																					
CHO05	FV				+																										
CNW81	TST				+																										
CS04	OPP			/	/	/									/	-											-				
DI97	LIT			/																				/							
G05	PV																										-				
GHHM02	OPP			+	+							+	-	+	+												/				
GHHM02	ORV			/	-							/	-	/	a								+				-				
GHHM02	OAM			/	+							/	/	+	+								-				-				
GHV06	PV			+	+				+						+	/		-									/	a			a
GJW05	FV															+															
GPH86	FV					+																									
GVP00	GRT			-				-			+	+																			
GVP02	GRT			-				-			+	+																			
HC03	FV				+																										
HH02	OPP			+	+				+	/		/		+	+			/									+				
HJT05	FV				+																										
HNSV99	CIT	+				+																									
HR04	OPP			+	+			-	+	/		/			+	-															
HSV02	PV		+	+	+			/	+	a																					
HSV03	PV																														a
HTT07	FV			+	a																										
JTF00	CIT	+													+																
JW03	OPP			+	+							+	-	+	+																
L93	PV		+			+																									
L94	CIT							+																							
L94	LIT							+																							

		Determinants (Independent variables)																													
Paper	**INDICATOR**	**MKT**	**DIS**	**FAM**	**CIT**	**REN**	**INV**	**IPC**	**BPC**	**NPC**	**CBO**	**PCT**	**ASR**	**AEX**	**CLM**	**CUM**	**OCC**	**ACA**	**SPR**	**SOB**	**SDB**	**SCL**	**MOP**	**COA**	**DIA**	**IAP**	**APS**	**APP**	**GAP**	**LEP**	**ICH**
L94	FV							+																							
L98	PV		+			+																									
LPP98	PV			+		+																									
LS01	LIT				+			a	/						+												/				
LS04	FV			a	+				a						+																
LS97	LIT				+			a	/						+												/				
LS99	LIT			+	+				+						+																
LS99	LIT			+	+				/						/																
N04	CIT									+																					
NNP87	FV				+					+																					
P03	NSL				/		-		+						-	+															
P86	PV					+																									
P96	FV			+		+																									
PJW05	GRT				a				a							-															
PS84	PV					+																									
PS89	PV					+																									
R02	PV																										/				
R03	PV																								+	+					a
R04a	OPP			+			/	/	+	/		+	/	+	+									/							
R04b	OPP			+	+		a		+	-		/		+										/							
R04b	ORJ			/	+		+		/	/		/		/										/							
S01	SC				+			+								/											+				
S05	TSF				+	+																									
S06	GRT			a	+			/	-			a			/									+				a			
S07	CIT								+						+												+				
S94	PV					+																									
S98	PV					+																									
SK97	FV				+																										
SP86	PV					+																									
ST04	PV		+																												
SVP07	CIT			a			-		+	a														+							
SVPN06	CIT			/			a		+	a														+							
T90	FV				+																										
TF94	R&D														+																
W04	OPP			a	/			+	+	/		/			/																
WPJ07	GRT				a				a							-															

Table A3 – Acronyms used in the appendix tables

Code	Indicator	Code	Indicator
ACA	Academic/Public research centres	LEP	Link with end product
AEX	Request for accelerated examination	LIT	Litigation
APP	Applicant Profile	MKT	Market value
APS	Applicant Size	MOP	Multiple opponents
ASR	Request for accelerated search	MOT	Patenting motives
BPC	Backward patent citations	NPC	Backward non-patent citations
CBO	Cross-border ownership	NSL	Activity (patent non sleeping)
CIT	Forward citations	OAM	Patent amended in opposition
CLM	Number of claims	OCC	Inexperienced patentees
CLS	Share of claims lost in examination	OPP	Opposition
COA	Multiple applicants	ORJ	Opposition rejected (patent maintained)
CUM	Cumulative portfolio size of applicant	ORV	Patent revoked in opposition
DIA	Difficulty to invent around	PV	Patent value (usually according to surveys)
DIS	Legal disputes	PCT	PCT filing
EQV	Number of EP filings with common priority	PRI	Number of priorities
FAM	Family size	R&D	R&D Performance
FV	Firm market value	REN	Renewals
GAP	Grant announced in press	SC	Start-up Creation
GRT	Granted	SCL	Collaborative patenting strategy
HSD	Parent of divisionals	SDB	Defensing blocking patenting strategy
IAP	Importance in applicant's patent portfolio	SOB	Offensive blocking patenting strategy
ICH	Invention context and characteristics	SPR	Knowledge protection patenting strategy
INV	Number of inventors	TSF	Patent transferred
IPC	Number of IPC classes (Scope)	TST	Firm technological strength
ISD	Divisional filings		

Table A4 – Summary Statistics of classical determinants and control variables

Variable	Obs.	Mean	St. Dev.	Min	Max
Technological complexity (PC)					
INVENT	248856	2,40	1,71	1	32
IPC8	248532	1,93	1,29	1	43
BPC	245961	4,48	2,88	0	99
NPC	245963	0,99	1,79	0	61
Applicant Profiles (PO)					
CUMUL (/1000)	248856	0,41	0,88	0,00	4,83
OCCAS	248856	0,21	0,41	0	1
ACAD	248855	0,02	0,13	0	1
CBOWN	248856	0,10	0,29	0	1
EPO Joint Clusters					
JC-01 - Industrial Chemistry	248856	0,12	0,33	0	1
JC-02 - Organic Chemistry	248856	0,13	0,34	0	1
JC-03 - Polymers	248856	0,11	0,31	0	1
JC-04 - Biotechnology	248856	0,10	0,30	0	1
JC-05 - Telecommunications	248856	0,03	0,18	0	1
JC-06 - Audio/Video/Media	248856	0,05	0,22	0	1
JC-07 - Electronics	248856	0,08	0,27	0	1
JC-08 - Electricity & Elec. Machines	248856	0,11	0,32	0	1
JC-09 - Computers	248856	0,03	0,18	0	1
JC-10 - Measuring Optics	248856	0,09	0,29	0	1
JC-11 - Handling & Processing	248856	0,14	0,35	0	1
JC-12 - Vehicles & Gen. Technology	248856	0,10	0,30	0	1
JC-13 - Civil Engineering / Thermodynamics	248856	0,09	0,29	0	1
JC-14 - Human Necessities	248856	0,11	0,31	0	1
Country of residence of applicant					
AT Applicant	248856	0,01	0,10	0	1
AU Applicant	248856	0,00	0,07	0	1
BE Applicant	248856	0,01	0,10	0	1
CA Applicant	248856	0,01	0,09	0	1
CH Applicant	248856	0,04	0,19	0	1
DE Applicant	248856	0,20	0,40	0	1
DK Applicant	248856	0,01	0,08	0	1
ES Applicant	248856	0,00	0,06	0	1
FI Applicant	248856	0,01	0,09	0	1
FR Applicant	248856	0,09	0,28	0	1
GB Applicant	248856	0,05	0,22	0	1
IL Applicant	248856	0,00	0,05	0	1
IT Applicant	248856	0,03	0,18	0	1
JP Applicant	248856	0,22	0,41	0	1
KR Applicant	248856	0,00	0,06	0	1
NL Applicant	248856	0,04	0,19	0	1
SE Applicant	248856	0,02	0,14	0	1
US Applicant	248856	0,26	0,44	0	1
Applicant from the ROW	248856	0,02	0,13	0	1
Year of filing					
1990	248856	0,17	0,37	0	1
1991	248856	0,16	0,37	0	1
1992	248856	0,16	0,37	0	1
1993	248856	0,17	0,37	0	1
1994	248856	0,17	0,38	0	1
1995	248856	0,17	0,38	0	1

Table A5 – Spearman rank correlation matrix of explanatory variables

		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
00	**CLMDEV_MED**	1,000																
01	**ln(CLMDEV_MEAN)**	0,996	1,000															
02	**CLMLS**	0,242	0,243	1,000														
03	**PRIO**	0,147	0,145	0,073	1,000													
04	**EQUIV**	0,128	0,124	0,042	0,050	1,000												
05	**HASDIV**	0,143	0,140	0,147	0,128	0,114	1,000											
06	**ISDIV**	-0,064	-0,065	-0,019	0,123	-0,055	-0,035	1,000										
07	**PCT**	0,123	0,119	-0,044	0,005	0,098	0,046	-0,105	1,000									
08	**ACCSRC**	0,034	0,032	0,020	0,027	0,008	0,026	0,046	-0,047	1,000								
09	**CUMUL/1000**	-0,054	-0,065	0,008	0,065	0,027	0,006	-0,010	-0,177	0,011	1,000							
10	**OCCAS**	0,040	0,046	0,007	-0,055	-0,014	-0,001	0,013	0,146	0,009	-0,680	1,000						
11	**INVENT**	0,086	0,076	0,017	0,182	0,034	0,079	0,064	-0,003	0,011	0,232	-0,209	1,000					
12	**IPC8**	0,109	0,110	0,007	0,061	0,047	0,072	0,026	0,091	0,003	-0,016	0,005	0,096	1,000				
13	**BPC**	0,138	0,142	0,116	0,056	0,020	0,062	0,009	0,078	0,016	-0,113	0,085	-0,005	0,081	1,000			
14	**NPC**	0,051	0,038	0,063	0,085	0,024	0,067	0,015	0,024	0,033	0,140	-0,087	0,144	0,055	-0,024	1,000		
15	**CBOWN**	0,025	0,024	-0,014	-0,046	0,008	-0,002	-0,005	0,038	-0,009	0,036	-0,031	-0,008	0,010	-0,007	-0,013	1,000	
16	**ACAD**	0,056	0,055	-0,002	0,011	0,037	0,035	0,001	0,101	0,002	-0,056	0,004	0,056	0,048	-0,033	0,091	-0,010	1,000

Table A6 – Industry dependencies in the main model

	5yrs Citations			EPC Family			Triadic			Survived 10yr			Opposed			Composite			Total			
Variable	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**TOT**
ln(CLMDEV)	0	0	14	2	0	12	0	0	14	1	0	13	8	1	5	0	0	14	**11**	**1**	**72**	**84**
ln(1+CLMLS)	1	13	0	1	13	0	3	11	0	7	7	0	9	2	3	1	13	0	**22**	**59**	**3**	**84**
ln(1+PRIO)	0	0	14	5	0	9	0	0	14	8	0	6	10	2	2	0	0	14	**23**	**2**	**59**	**84**
ln(1+EQUIV)	12	0	2	10	0	4	0	0	14	8	0	6	10	0	4	3	0	11	**43**	**0**	**41**	**84**
HASDIV	1	0	13	0	0	14	3	0	11	0	0	14	2	0	12	0	0	14	**6**	**0**	**78**	**84**
ISDIV	5	9	0	6	1	7	0	0	14	1	0	13	10	0	4	5	0	9	**27**	**10**	**47**	**84**
PCT	4	0	10	0	0	14	0	0	14	4	1	9	11	2	1	1	0	13	**20**	**3**	**61**	**84**
ACCSRC	9	1	4	10	1	3	12	0	2	8	0	6	11	0	3	9	0	5	**59**	**2**	**23**	**84**
ln(1+CUMUL)	6	1	7	1	13	0	0	0	14	1	3	10	2	12	0	4	9	1	**14**	**38**	**32**	**84**
OCCAS	9	2	3	2	8	4	3	11	0	6	8	0	13	1	0	4	9	1	**37**	**39**	**8**	**84**
ACAD	9	0	5	8	4	2	11	3	0	8	5	1	11	3	0	11	2	1	**58**	**17**	**9**	**84**
ln(INVENT)	0	0	14	5	1	8	3	0	11	2	0	12	5	0	9	1	0	13	**16**	**1**	**67**	**84**
ln(IPC8)	0	0	14	3	1	10	6	0	8	8	0	6	10	2	2	0	0	14	**27**	**3**	**54**	**84**
ln(1+BPC)	1	0	13	8	4	2	3	10	1	6	1	7	0	0	14	4	2	8	**22**	**17**	**45**	**84**
ln(1+NPC)	2	1	11	3	7	4	2	0	12	3	0	11	4	1	9	3	2	9	**17**	**11**	**56**	**84**
CBOWN	11	0	3	2	3	9	6	8	0	7	3	4	8	0	6	5	2	7	**39**	**16**	**29**	**84**
APP_AT	11	1	2	4	3	7	5	9	0	6	3	5	12	0	2	6	2	6	**44**	**18**	**22**	**84**
APP_AU	12	0	2	7	6	1	7	1	6	3	0	11	9	4	0	6	4	4	**44**	**15**	**24**	**83**
APP_BE	13	0	1	6	2	6	7	1	6	4	0	10	9	2	2	4	2	8	**43**	**7**	**33**	**83**
APP_CA	9	0	5	4	10	0	5	0	9	4	0	10	11	3	0	11	2	1	**44**	**15**	**25**	**84**
APP_CH	9	1	4	1	1	12	4	0	10	2	0	12	11	1	2	2	0	12	**29**	**3**	**52**	**84**
APP_DE	7	4	3	0	4	10	1	13	0	3	0	11	6	0	8	2	4	8	**19**	**25**	**40**	**84**
APP_DK	11	0	3	10	1	3	9	4	1	3	0	11	9	0	5	8	1	5	**50**	**6**	**28**	**84**
APP_ES	12	2	0	9	0	5	12	2	0	7	0	7	12	1	0	12	2	0	**64**	**7**	**12**	**83**
APP_FI	10	0	4	9	3	2	8	2	4	2	0	12	12	0	1	5	1	8	**46**	**6**	**31**	**83**
APP_GB	9	0	5	2	12	0	5	0	9	4	0	10	13	1	0	8	4	2	**41**	**17**	**26**	**84**
APP_IL	6	0	8	9	4	1	9	0	5	8	0	6	12	0	1	12	0	2	**56**	**4**	**23**	**83**
APP_IT	12	2	0	5	3	6	5	7	2	0	0	14	9	4	1	8	5	1	**39**	**21**	**24**	**84**
APP_JP	4	2	8	0	14	0	0	0	14	1	0	13	3	11	0	5	6	3	**13**	**33**	**38**	**84**
APP_KR	13	0	1	0	14	0	2	0	12	6	0	8	13	0	0	6	8	0	**40**	**22**	**21**	**83**
APP_NL	10	1	3	3	5	6	5	3	6	0	0	14	7	2	5	3	1	10	**28**	**12**	**44**	**84**
APP_SE	10	0	4	3	5	6	0	0	14	1	0	13	10	0	3	0	0	14	**24**	**5**	**54**	**83**
APP_US	0	0	14	0	14	0	0	0	14	0	0	14	6	8	0	6	2	6	**12**	**24**	**48**	**84**
APP_OT	13	0	1	6	4	4	6	1	7	5	1	8	7	7	0	6	3	5	**43**	**16**	**25**	**84**
FY_1991	12	0	2	1	13	0	12	2	0	11	1	2	13	0	1	5	9	0	**54**	**25**	**5**	**84**
FY_1992	5	0	9	4	8	2	10	2	2	9	0	5	12	1	1	1	13	0	**41**	**24**	**19**	**84**
FY_1993	1	0	13	1	11	2	8	6	0	11	1	2	9	5	0	1	13	0	**31**	**36**	**17**	**84**
FY_1994	0	0	14	2	10	2	6	7	1	7	3	4	6	7	1	0	14	0	**21**	**41**	**22**	**84**
FY_1995	0	0	14	1	12	1	8	5	1	10	3	1	7	7	0	0	14	0	**26**	**41**	**17**	**84**

Number of positive (+), negative (-) and non significant (/) parameters obtained from 14 industry-specific regressions per value indicator – Patents filed 1990-1995

Table A7 – Country dependencies in the main model

	5yrs Citations			EPC Family			Triadic			Survived 10yr			Opposed			Composite			Total			
Variable	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**TOT**
ln(CLMDEV)	2	0	16	5	1	12	4	0	14	9	0	9	13	2	3	3	0	15	**36**	**3**	**69**	**108**
ln(1+CLMLS)	8	10	0	5	13	0	9	9	0	15	3	0	13	1	4	7	11	0	**57**	**47**	**4**	**108**
ln(1+PRIO)	7	0	11	8	0	10	3	0	15	15	0	3	14	0	4	2	0	16	**49**	**0**	**59**	**108**
ln(1+EQUIV)	16	0	2	11	1	6	5	0	13	14	0	4	7	1	8	7	0	11	**60**	**2**	**44**	**106**
HASDIV	7	0	11	3	0	15	8	0	10	5	0	13	5	0	12	4	0	14	**32**	**0**	**75**	**107**
ISDIV	15	3	0	9	2	7	5	0	13	8	0	10	13	1	2	9	1	8	**59**	**7**	**40**	**106**
PCT	11	1	6	4	1	13	1	1	16	9	2	7	15	2	1	5	0	13	**45**	**7**	**56**	**108**
ACCSRC	16	0	2	11	1	6	16	0	2	15	0	3	12	0	4	14	0	4	**84**	**1**	**21**	**106**
ln(1+CUMUL)	11	1	6	4	11	3	3	0	15	10	3	5	9	9	0	9	7	2	**46**	**31**	**31**	**108**
OCCAS	16	1	1	8	9	1	12	6	0	9	8	1	15	3	0	5	12	1	**65**	**39**	**4**	**108**
ACAD	15	1	2	12	4	2	13	5	0	11	3	3	12	2	0	15	1	2	**78**	**16**	**9**	**103**
ln(INVENT)	5	0	13	6	0	12	7	0	11	7	0	11	13	0	5	4	0	14	**42**	**0**	**66**	**108**
ln(IPC8)	3	0	15	7	0	11	12	0	6	13	1	4	15	3	0	5	0	13	**55**	**4**	**49**	**108**
ln(1+BPC)	4	0	14	11	6	1	10	8	0	13	0	5	4	0	14	12	0	6	**54**	**14**	**40**	**108**
ln(1+NPC)	6	1	11	7	4	7	11	1	6	9	0	9	8	0	10	9	0	9	**50**	**6**	**52**	**108**
CBOWN	12	0	6	6	4	8	12	4	2	8	4	6	15	1	2	11	2	5	**64**	**15**	**29**	**108**
JC_02	8	0	10	0	0	18	9	1	8	5	0	13	14	1	3	1	0	17	**37**	**2**	**69**	**108**
JC_03	7	0	11	6	3	9	9	1	8	11	1	6	8	0	10	9	0	9	**50**	**5**	**53**	**108**
JC_04	3	0	15	2	0	16	8	1	9	2	0	16	13	3	2	3	0	15	**31**	**4**	**73**	**108**
JC_05	6	0	12	8	6	4	10	5	3	7	0	11	12	5	0	10	0	8	**53**	**16**	**38**	**107**
JC_06	10	0	8	8	10	0	10	1	7	9	0	9	8	6	1	11	5	2	**56**	**22**	**27**	**105**
JC_07	14	3	1	6	12	0	12	1	5	11	0	7	13	4	0	11	6	1	**67**	**26**	**14**	**107**
JC_08	12	6	0	5	12	1	9	7	2	10	6	2	12	6	0	9	9	0	**57**	**46**	**5**	**108**
JC_09	12	1	5	9	8	1	15	2	1	9	1	8	13	5	0	14	3	1	**72**	**20**	**16**	**108**
JC_10	11	7	0	1	16	1	14	1	3	13	4	1	7	10	0	6	12	0	**52**	**50**	**5**	**107**
JC_11	7	11	0	9	6	3	10	7	1	12	6	0	13	0	5	7	8	3	**58**	**38**	**12**	**108**
JC_12	8	10	0	3	15	0	6	11	1	14	4	0	12	5	0	4	14	0	**47**	**59**	**1**	**107**
JC_13	7	11	0	6	12	0	6	12	0	8	10	0	14	4	0	6	12	0	**47**	**61**	**0**	**108**
JC_14	11	1	6	9	7	2	14	4	0	9	7	2	14	2	2	9	6	3	**66**	**27**	**15**	**108**
FY_1991	17	0	1	10	8	0	14	2	2	14	2	2	15	2	1	13	5	0	**83**	**19**	**6**	**108**
FY_1992	11	1	6	11	6	1	12	3	3	14	0	4	15	3	0	12	6	0	**75**	**19**	**14**	**108**
FY_1993	11	0	7	9	6	3	10	6	2	12	2	4	15	3	0	8	10	0	**65**	**27**	**16**	**108**
FY_1994	9	1	8	11	6	1	12	5	1	14	2	2	10	7	1	7	11	0	**63**	**32**	**13**	**108**
FY_1995	9	2	7	9	9	0	10	5	3	13	3	2	11	7	0	6	12	0	**58**	**38**	**12**	**108**

Number of positive (+), negative (-) and non significant (/) parameters obtained from 18 country-specific regressions per value indicator – Patents filed 1990-1995

Table A8 – Sample size dependencies in the model

	5yrs Citations			EPC Family			Triadic			Survived 10yr			Opposed			Composite			Total			
Variable	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**/**	**-**	**+**	**TOT**
ln(CLMDEV_MED)	0	0	32	4	0	28	0	0	32	3	0	29	30	0	2	0	0	32	**37**	**0**	**155**	**192**
ln(1+CLMLS)	4	28	0	1	31	0	14	18	0	29	3	0	32	0	0	2	30	0	**82**	**110**	**0**	**192**
ln(1+PRIO)	0	0	32	15	0	17	0	0	32	25	1	6	29	0	3	0	0	32	**69**	**1**	**122**	**192**
ln(1+EQUIV)	30	0	2	27	1	4	6	0	26	22	0	10	29	0	3	21	0	11	**135**	**1**	**56**	**192**
HASDIV	13	0	19	0	0	32	13	0	19	0	0	32	10	0	22	0	0	32	**36**	**0**	**156**	**192**
ISDIV	20	12	0	26	1	5	0	0	32	0	0	32	26	1	5	18	0	14	**90**	**14**	**88**	**192**
PCT	22	0	10	0	0	32	0	0	32	18	0	14	29	1	2	0	0	32	**69**	**1**	**122**	**192**
ACCSRC	27	0	5	28	0	4	29	1	2	23	0	9	27	0	5	28	0	4	**162**	**1**	**29**	**192**
ln(1+CUMUL)	26	0	6	0	32	0	0	0	32	14	0	18	0	32	0	25	7	0	**65**	**71**	**56**	**192**
OCCAS	31	1	0	13	19	0	18	14	0	22	10	0	30	2	0	9	23	0	**123**	**69**	**0**	**192**
ACAD	29	0	3	27	3	2	27	5	0	28	3	1	30	2	0	29	1	2	**170**	**14**	**8**	**192**
CBOWN	30	1	1	15	0	17	26	6	0	31	0	1	22	0	10	27	0	5	**151**	**7**	**34**	**192**
ln(INVENT)	0	0	32	9	0	23	2	0	30	10	0	22	28	0	4	0	0	32	**49**	**0**	**143**	**192**
ln(IPC8)	0	0	32	8	0	24	16	0	16	24	0	8	32	0	0	0	0	32	**80**	**0**	**112**	**192**
ln(1+BPC)	0	0	32	26	5	1	21	11	0	24	0	8	0	0	32	18	0	14	**89**	**16**	**87**	**192**
ln(1+NPC)	24	0	8	25	6	1	9	0	23	7	0	25	16	0	16	18	0	14	**99**	**6**	**87**	**192**

Number of positive (+), negative (-) and non significant (/) parameters obtained from 32 random sample (3%) regressions per value indicator - Patents filed 1990-1995