



Paper to be presented at

DRUID15, Rome, June 15-17, 2015

(Coorganized with LUISS)

How do characteristics of patent attorneys influence patent quality?

Christina Koller

Management Center Innsbruck (external doctoral student: University of Hohenheim)
Business & Management (Hohenheim: Economics of Innovation)
koller_christina@web.de

Bernd Ebersberger

Management Center Innsbruck
Business & Management
bernd.ebersberger@mci.edu

Abstract

Different characteristics of patent attorneys exert a significant influence on the outcome (i.e., value of the patent) of the patent application process. Even though this contribution is clearly visible their importance has only recently been recognized. As a consequence this paper focuses on one specific characteristic ? experience ? of the patent attorney in order to analyse its relationship to the value of patents, which is measured in the time it takes for the patent to be granted and forward citations.

Regression results show a non-linear relationship of experience and the value of patents.

HOW DO CHARACTERISTICS OF PATENT ATTORNEYS INFLUENCE PATENT QUALITY?

Version: April, 2015

(Please do not cite or quote without permission from the authors)

Different characteristics of patent attorneys exert a significant influence on the outcome (i.e., value of the patent) of the patent application process. Even though this contribution is clearly visible their importance has only recently been recognized. As a consequence this paper focuses on one specific characteristic – experience – of the patent attorney in order to analyse its relationship to the value of patents, which is measured in the time it takes for the patent to be granted and forward citations.

Regression results show a non-linear relationship of experience and the value of patents.

I. The Patenting Process and the Value of Patents

In order to receive a temporary monopoly right patents are applied for; in exchange the holder has to provide a detailed description of the invention. Reasons for doing so are that – by considering the notion of the resource based view – companies might only build and sustain competitive advantage if they have superior resources and manage to protect them (Grant, 1991; Knott, Bryce, & Posen, 2003). The protection of intangible assets needs to be emphasized as they are considered to be especially important when it comes to the competitiveness of firms (Fernandez, 2000; Teece, 2010)

Patents (amongst others) as innovation output are one of the measures considered most often when it comes to determining technological progress (e.g., Acs, Anselin, & Varga, 2002; Czarnitzki, Ebersberger, & Fier, 2007; Ebersberger & Becke, 2010; Ethiraj, 2007; Makri, Hitt, & Lane, 2010; Nesta & Patel, 2004). For a comprehensive picture it has to be outlined that patent based measures do not only vary due to differences in the analyzed unit's

performance but are also affected by sectoral and technological (Arundel, van de Paal, & Soete, 1995; Scherer, 1983), regional and national (de Rassenfosse & van Pottelsberghe de la Potterie, 2009), and inter-temporal (van Zeebroeck, van Pottelsberghe de la Potterie, & Guellec, 2009) differences in firms' patenting behaviour.

This outlines that there has already been conducted a number of different research based on patents. All this research can be traced back to one underlying assumption that is not spelt out explicitly: It is usually assumed that inventions are rather automatically transferred into patents or patent applications (Somaya, Williamson, & Zhang, 2007). However, by having a closer look at the patent application process it gets clearly visible that this might not be entirely true. Basically, when it comes to the application of patents, it can be distinguished between the actions that have to be set within the company and the ones that have to be set in interaction with the European Patent Office (EPO).

On the company level the notion of an IP value chain might be considered. Three main, highly specialized, and complementary functions can be identified, which are IP generation, IP protection, and IP utilization (Reitzig & Puranam, 2009; Somaya et al., 2007). In order to gain advantage from complementarities of activities between these functions generally strong coordination of the intensity and the direction of the involved activities is required (Siggelkow, 2002).

The EPO offers a harmonized application and examination path to obtain a broader protection (Harhoff & Wagner, 2009). The process encompasses a number of different steps that might give the option of the process to either be enhanced or delayed. 18 months after the date of filing the patent application is published. During that time period there is an examination of the formalities as well as the development of a search report taking place. After the application has been published applicants have six months in order to decide whether they request a substantive examination that as a best output leads to the grant of a

patent. All these steps require strong interaction between the applicant and the examiner at the EPO (EPO, 2012).

Only if these processes are run through successfully, they lead to the granting of a valuable patent. Determining the value of patents has been hugely debated and a number of different indicators have already been developed due to the fact that there are a number of different issues influencing the final result (Harhoff, Scherer, & Vopel, 2003; Reitzig, 2003).

One of the measures that gained most attention are patent citations (Meyer, 2000), whose very basic assumption is a positive relationship between the importance of a patent and how often it is cited in later patents (Hagedoorn & Cloudt, 2003). Therefore, the quality is reflected by how often a patent is cited (Guellec & van Pottelsberghe de la Potterie, 2000) – the higher the economic value of a patent the more often it is cited compared to those patents having a low value (Harhoff, Narin, Scherer, & Vopel, 1999). To summarize the importance of patent citations, Hall et al. (2005) generally speaking found out that the market value of a company would increase by 3% if on average the patents increase by one additional citation.

One additional criterion to determine the value of patents is the grant of patents, which is often taken as given by quality measures like forward citation, renewal, or family size. The grant of a patent provides its holder with the possibility to take advantage of the associated temporary monopoly right in order to counteract infringement. In addition, it enables companies to base their decision regarding the development and position of the patent portfolio on a sound basis (Harhoff & Wagner, 2009). As a consequence patents that are granted – and therefore passed the evaluation at the patent office regarding the respective criteria – are found to have higher quality compared to those patents that are refused or even rejected (Guellec & Van Pottelsberghe de la Potterie, 2002). In addition, it has to be pointed out that also the speed in which the patent is granted is a decisive criterion. Research has shown that those patents with a higher quality usually have shorter pendency times and are

granted significantly earlier, as well as the withdrawal of such patents will be delayed (Harhoff & Wagner, 2009).

II. The Role of Patent Attorneys

In order to obtain valuable patents the previously described processes have to be successfully completed. This amongst others includes to file and prosecute patent applications and to administer and to maintain interaction between the different actors (e.g., different company functions, patent examiner). The knowledge and capabilities for these actions lie in the expertise and education of patent attorneys (Macdonald, 2004; Somaya et al., 2007). With regards to that patent attorneys might be considered to be intermediaries (Howells, 2006) that take a key position in the patent application process. The following elaborations intend to further underpin the importance of the patent attorney regarding their ability to shape the patenting process:

Their importance is increasing due to the growing relevance of strategic decisions related to patenting activities (Blind, Edler, Frietsch, & Schmoch 2006; Lang, 2001; Macdonald, 2004; Macdonald & Lefang, 1997, 1998; Hufker & Alpert, 1994). It might, for example, be considered to postpone the grant of a patent because of strategic reasons (Harhoff et al., 2003) or to prolong the grant of patent to avoid costs that are bound to the grant of a patent (Harhoff & Wagner, 2009). Furthermore, mistakes in the complex and costly patenting process may have devastating effects on the protection of intellectual assets and on the corporate image of a firm (Dodgson, Gann, & Salter, 2008; Lipscomb, 1986; Vecht et al., 2009).

Finally, the patenting process can be interpreted as a negotiation process. This is mainly the case as patent applications are very often based on incremental progress, which further fosters negotiations with the patent examiner in order to prove the novelty and inventive step of the underlying invention (Cockburn, Kortum, & Stern, 2002; Harhoff &

Reitzig, 2001; Harhoff & Wagner, 2009; Quillen & Webster, 2001; Quillen, Webster, & Eichmann, 2002).

As a consequence it can be concluded that the decision regarding the appropriate patent attorney is essential for firms (Rothchild, 1987) in order to optimize their patenting process and obtain the best possible output.

As outlined above the application for and granting of a patent can be interpreted as a communication and negotiation process (Cockburn et al., 2002; Harhoff & Reitzig, 2001; Harhoff & Wagner, 2009; Quillen & Webster, 2001). Even though it must be realized that negotiations usually involve a number of different actors, the inner experience of each individual influences the negotiation process and outcome (and vice-versa; Thompson, Wang, & Gunia, 2010). It is obvious that most excellent negotiators haven an extensive history in negotiation experience, which leads to the conclusion that good negotiators are not simply born by nature (Steinel, Abele, & De Dreu, 2007). Research has shown that the experience of the communication and negotiation partners affect the quality of the outcome of the negotiation process (e.g., Barry & Friedman, 1998; Moran & Ritov, 2007; Murnighan, Babcock, Thompson, & Pillutla, 1993; O'Connor, Arnold, & Burris, 2005; Thompson, 1990; Thompson et al., 2010). This also holds true for the sharing of information. It is suggested that there is a strong correlation between the effective use of information and the experience of the negotiator (Murnighan et al., 1999). Hence, it can be assumed that the experience of the patent attorney as a key actor in the patent application process affects the value of the outcome (i.e., the patent).

As a result this research will focus on the analysis of the following two hypotheses:

- 1) *There is a relationship between the experience of the patent attorney and the grant (lag) of a patent.*

- 2) *There is a relationship between the experience of the patent attorney and the number of forward citations.*

II. Data and Method

Overall we base our empirical analysis on data of about 6,700 patent attorneys accredited with the EPO (exam between 1979 and 2010). The analysis bases on the EPO (European Patent Office) patent applications extracted from the OECD REGPAT database (July 2014). We supplement this data source with information about patent attorneys extracted from Espace Bulletin, from the EPO register of representatives, and from the EPO register of successful candidates. Additionally, the OECD patent quality indicators database (July 2014) completes the overall dataset. Our analysis focuses on those patent attorneys who have not more than 200 patent applications filed a year in order to account for the fact that discussions with patent attorneys have revealed that there are patent attorneys hiring anonymous subcontractors in order to generate and write their applications.

Dependent variable: Grant lag

As a dependent variable we will consider the time it takes for the patent to be granted. The grant lag is given in days from the application. In addition, it is also accounted for whether the patent is granted at all or not.

Furthermore, we will consider forward citations (up to five years after publication) in our analysis.

Independent variables: experience of the patent attorney

In this paper experience is captured in two ways:

- By the cumulative number of patent applications for each patent attorney.
- By the number of years between filing of the patent and exam year of the attorneys.

Additionally, we include a number of control variables like the technology field of the patent, the country of the patent attorney, gender of the patent attorney, the filing year of the patent, whether the patent attorney has taken the EPO exam, patent scope, and backward citations.

An overview on the variables used in the analysis is given in Table 1 and Table 2.

Table 1. Descriptive statistics (experience in cumulative number of patents)

	All patents (N=902,386)				Granted patents (N=410,782)			
	mean	sd	min	max	mean	sd	min	max
Grant lag					1901.72	857.46	84	7999
Grant	0.46	0.50	0	1				
Experience	299.81	411.33	0.50	4627.50	245.19	341.75	0.50	4627.50
Gender	0.15	0.36	0	1	0.14	0.34	0	1
Exam	0.72	0.45	0	1	0.69	0.46	0	1
Patent Scope	1.93	1.21	1	20	1.99	1.25	1	19
Backward Citations	5.22	5.30	0	142	4.96	4.28	0	129

Table 2. Descriptive statistics (experience in years)

	All patents (N=555,811)				Granted patents (N=227,991)			
	mean	sd	min	max	mean	sd	min	max
Grant lag					1875.75	841.42	84	7744
Grant	0.41	0.49	0	1				
Experience	8.26	5.71	0	31	7.68	5.46	0	31
Gender	0.16	0.36	0	1	0.14	0.35	0	1
Patent Scope	1.92	1.20	1	16	1.98	1.24	1	16
Backward Citations	5.36	5.66	0	134	5.07	4.50	0	129

Table 3. Descriptive statistics (forward citation)

	Experience: cum. numbers of patents (N=348,009)				Experience: number of years (N=179,932)			
	mean	sd	min	max	mean	sd	min	max
Forward citations	0.50	1.30	0	57	0.45	1.28	0	51
Experience	212.14	281.96	0.50	3703.50	7.15	5.06	0	25
Gender	0.13	0.34	0	1	0.14	0.35	0	1
Exam	0.67	0.47	0	1				
Patent Scope	2.06	1.30	1	19	2.09	1.30	1	16
Backward citations	4.87	4.09	0	129	4.96	4.26	1	127

A two-step selection model (Heckman, 1979) is applied in order to estimate the relationship between grant lag and the experience of the patent attorney. In addition, the relationship between forward citations and experience is estimated with a linear regression model.

III. Findings

In the following regressions Table 3 and Table 4 the relationship between the experience of the patent attorney and grant is visualized. It is clearly visible that experience exerts a positive effect on the grant (i.e., the time it takes for the patent to be granted is reduced). For a more detailed elaboration on the correlation coefficients refer to Appendix A.

Table 3. Regression table (Experience: cumulative number of patents)

	Grant lag		Grant	
	b	se	b	se
Experience				
Experience Attorney	-0.1503***	0.007	-0.0001***	0.000
Experience Attorney (squared)	0.00004***	0.000	0.00000***	0.000
Gender (Dummy)	3.3725	3.415	-0.0321***	0.004
Exam (Dummy)	84.6464***	2.661	0.0091**	0.003
Patent Scope	71.0907***	0.993	0.0161***	0.001
Backward Citations	22.5874***	0.274	-0.0067***	0.000
Technology Field (35 Dummies)	YES		YES	
Country Attorney (42 Dummies)	YES		YES	
Filing Year (32 Dummies)	YES		YES	
Mills	-40.3915***	1.252		
Constant	899.0189***	60.950	-0.0253	0.072
N	410,782		902,386	
F	1,390.11***			
LR chi2			143,675.91***	

Note: *** (**, *, +) indicate significance at the 0.1% (1%, 5%, 10%) level.

Table 4. Regression table (Experience: number of years)

	Grant lag		Grant	
	b	se	b	se
Experience				
Experience Attorney	-4.9686***	0.862	-0.0095***	0.001
Experience Attorney (squared)	0.0727+	0.043	0.0005***	0.000
Gender (Dummy)	-2.0158	4.386	-0.0301***	0.005
Patent Scope	63.6637***	1.325	0.0086***	0.002
Backward Citations	21.0814***	0.342	-0.0066***	0.000
Technology Field (35 Dummies)	YES		YES	
Country Attorney (42 Dummies)	YES		YES	
Filing Year (32 Dummies)	YES		YES	
Mills	-25.9030***	1.180		
Constant	521.5217	713.523	-0.3005	0.748
N	227,911		555,811	
F	859.03***			
LR chi2			86,578.13***	

Note: *** (**, *, +) indicate significance at the 0.1% (1%, 5%, 10%) level.

In addition, these results are also supported when looking at forward citations (Table 5) as quality indicator. In the following regression only granted patents are considered.

Table 5. Regression table (Forward citation)

	Experience (cumulative)		Experience (years)	
	b	se	b	se
Experience				
Experience Attorney	0.0003***	0.000	0.0051**	0.002
Experience Attorney (squared)	-0.0000***	0.000	-0.0002*	0.000
Gender (Dummy)	-0.0027	0.007	-0.0113	0.009
Exam (Dummy)	0.0139**	0.005		
Patent Scope	0.0399***	0.002	0.0366***	0.003
Backward Citations	0.0065***	0.001	0.0049***	0.001
Technology Field (35 Dummies)	YES		YES	
Country Attorney (42 Dummies)	YES		YES	
Filing Year (28 Dummies)	YES		YES	
Constant	0.5347***	0.108	5.7821***	1.269
N	348,009		179,932	
F	82.09***		37.12***	

Note: *** (**, *, +) indicate significance at the 0.1% (1%, 5%, 10%) level.

IV. Discussion

Even though the role and contribution of the patent attorney in the patenting process cannot be neglected, this has only recently been recognized (Reitzig, 2004; Reitzig & Punaram, 2009; Somaya et al., 2007; Wagner, Hoisl, & Thoma, 2014). Our results add a new facette to these findings:

The results clearly show that experience significantly reduces the time in which a patent is granted (i.e., each additional patent application the attorney gets granted/year of experience of the attorney reduces the grant lag of subsequent patents). Additionally, we observe a non-linear relationship of experience.

That implies that the more experience patent attorneys have the less time it takes them to get the patent granted. Basically, that can have two causes. First, more experienced attorneys write more convincing patent applications and hence achieve a faster grant. Second, more experienced attorneys select the projects and application assignments which have a higher likelihood of being granted or of being granted faster or being granted at all.

Additionally, it is found that the larger the scope of the patent the more time it takes for the patent to be granted. The patent scope, however, has a significant positive influence on the grant of the patent, which fits with the findings by Lerner (1994), who argues that a broader scope of the patent implies more value (i.e., the broader the patent the more likely it is to be granted).

Furthermore, we can observe that backward citations exert a negative influence on the grant of the patent (i.e., the higher the number of backward citations the less likely it is for the patent to be granted). This nicely builds on previous research that backward citations may be a sign for incremental innovation, which are less likely to pass the application process (Lanjouw & Schankerman, 2001).

So far, we did not yet find a suitable explanation why patent attorneys who took the EPO exam need more time until the patent is granted compared to attorneys who have not taken the exam.

These results are supported by the findings that an increase in experience increases the number of forward citations of the respective patent. The higher the number of patent citations is the higher the value of the respective patent is considered to be.

The research, however, has a number of limitations up until now. Due to the large variety of aspects exposing an influence on patent quality, the experience of the patent attorney is only one minor aspect. Therefore, a more comprehensive and concise indicator for experience has to be aimed at. In addition, for future research it would be interesting to analyse whether the observed effects are equally relevant for all technology fields (interaction effects) and whether these effects are constant over the whole distribution of the dependent variable (quantile regression).

It can be concluded that this clearly supports and adds an important aspect to the discussion about the significance of patent attorneys in the patenting process. Furthermore, it provides the groundwork for future research, in which the analysis regarding the importance and influence of the patent attorney will not only be explained by experience of the patent attorney but also by criteria like whether there is in-house legal expertise or patent attorneys have to be hired. Furthermore, the effect of the specialization of the patent attorney (Somaya et al., 2007) as well as the distance between the patent attorney and patent office/key actors in the IP value chain will be considered.

Funding

Partial funding by the Tyrolean Science Fund is gratefully acknowledged.

References

- Acs, Z. J., Anselin, L., & Varga, A. (2002). Patents and innovation counts as measures of regional production of new knowledge. *Research Policy*, *31*(7), 1069–1085.
- Arundel, A., van de Paal, G., & Soete, L. (1995). *Innovation strategies of Europe's largest industrial firms* (PACE Report, MERIT), Maastricht, Netherlands: University of Limbourg.
- Barry, B., & Friedman, R. A. (1998). Bargainer characteristics in distributive and integrative negotiation. *Journal of Personality and Social Psychology*, *74*(2), 345–359. doi:10.1037//0022-3514.74.2.345
- Blind, K., Edler, J., Frietsch, R., & Schmoch, U. (2006). Motives to patent: Empirical evidence from Germany. *Research Policy*, *35*(5), 655–672.
- Cockburn, I., Kortum, S., & Stern, S. (2002). *Are all patent examiners equal?: The impact of characteristics on patent statistics and litigation outcomes* (NBER Working Paper Series No. 8980). Retrieved from <http://www.nber.org/papers/w8980>

- Crépon, B. & Duguet, E. (1997). Estimating the innovation function from patent numbers: Gmm on count panel data. *Journal of Applied Econometrics*, 12(3), 243–263.
- Czarnitzki, D., Ebersberger, B., & Fier, A. (2007). The relationship between r&d collaboration, subsidies and r&d performance: empirical evidence from Finland and Germany. *Journal of Applied Econometrics*, 22, 1347– 1366. doi:10.1002/jae
- Czarnitzki, D., Kraft, K. & Thorwarth, S. (2009). The knowledge production of “R” and “D.” *Economics Letters*, 105(1), 141–143.
- De Rassenfosse, G., & van Pottelsberghe de la Potterie, B. (2009). A policy insight into the R&D–patent relationship. *Research Policy*, 38(5), 779–792.
- Dodgson, M., Gann, D. & Salter, A. (2008). *The management of technological innovation: The strategy and practice* (2nd ed.). Oxford, UK: Oxford University Press.
- Ebersberger, B., & Becke, F. M. (2010). Technological specialization and variety in regional innovation systems. In P. Ahrweiler (Ed.), *Innovation in Complex Social Systems* (pp. 88–109). New York: Routledge.
- EPO. (2015). How to apply for a European patent. Retrieved February 20, 2015, from <http://www.epo.org/applying/basics.html>
- Ethiraj, S. (2007). Allocation of inventive effort in complex product systems. *Strategic Management Journal*, 584(January), 563–584. doi:10.1002/smj
- Fernandez, E., Montes, J. M., & Vazquez, C. J. (2000). Typology and strategic analysis of intangible resources A resource-based approach. *Technovation*, 20, 81–92.
- Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review*, 33, 114–135.

- Guellec, D., & Van Pottelsberghe de la Potterie, B. (2002). The value of patents and patenting strategies: Countries and technology areas patterns. *Economics of Innovation and New Technology*, 11(2), 133–148. doi:10.1080/10438590210896
- Guellec, D., & van Pottelsberghe de la Potterie, B. (2000). Applications, grants and the value of patent. *Economics Letters*, 69, 109–114.
- Hagedoorn, J., & Cloudt, M. (2003). Measuring innovative performance: Is there an advantage in using multiple indicators? *Research Policy*, 32, 1365–1379.
- Hall, B., Jaffe, A., & Trajtenberg, M. (2005). Market value and patent citations. *RAND Journal of Economics*, 36(1), 16–38. doi:10.1057/jors.1995.38
- Harhoff, D., & Reitzig, M. (2001). Strategien zur Gewinnmaximierung bei der Anmeldung von Patenten. *Zeitschrift für Betriebswirtschaft*, 71(5), 509–529.
- Harhoff, D., Narin, F., Scherer, F. M., & Vopel, K. (1999). Citation frequency and the value of patented inventions. *Review of Economics and Statistics*, 81(3), 511–515.
doi:10.1162/003465399558265
- Harhoff, D., Scherer, F.M., & Vopel, K. (2003). Citations, family size, opposition and the value of patent rights. *Research Policy*, 32(8), 1343–1363.
- Harhoff, D., & Wagner, S. (2009). The duration of patent examination at the European Patent Office. *Management Science*, 55(12), 1969–1984.
- Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research Policy*, 35(5), 715–728. doi:10.1016/j.respol.2006.03.005
- Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47(1), 153–161.
- Hufker, T., & Alpert, F. (1994). Patents: A managerial perspective. *Journal of Product & Brand Management*, 3(4), 44–54. doi:10.1108/10610429410073138

- Knott, A. M., Bryce, D. J., & Posen, H. E. (2003). On the strategic accumulation of intangible assets. *Organization Science*, *14*(2), 192–207.
- Lang, J. C. (2001). Management of intellectual property rights: Strategic patenting. *Journal of Intellectual Capital*, *2*(1), 8–26. doi:10.1108/14691930110380464
- Lanjouw, J. O., & Schankerman, M. (2001). Characteristics of patent litigation: A window on competition. *The RAND Journal of Economics*, *32*(1), 129–151. doi:10.2307/2696401
- Lerner, J. (1994). The importance of patent scope: An empirical analysis. *The RAND Journal of Economics*, *25*(2), 319–333.
- Lipscomb, R. F. (1986). Can patents be used to gain market objectives? *Journal of Business Strategy*, *6*(3), 87–93. doi:10.1108/eb039124
- Macdonald, S. (2004). When means become ends: Considering the impact of patent strategy on innovation. *Information Economics and Policy*, *16*(1), 135–158.
doi:10.1016/j.infoecopol.2003.09.008
- Macdonald, S., & Lefang, B. (1997). Innovation and the patent attorney. *Prometheus*, *15*(3), 329–343.
- Macdonald, S., & Lefang, B. (1998). Measuring innovation: The patent attorney as an indicator of innovation. *Computer Law & Security Report*, *14*(1), 8–13.
- Makri, M., Hitt, M. A., & Lane, P. J. (2010). Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions. *Strategic Management Journal*, *628*(November 2009), 602–628. doi:10.1002/smj
- Meyer, M. (2000). What is special about patent citations? Differences between scientific and patent citations. *Scientometrics*, *49*(1), 93–123. Retrieved from <http://www.springerlink.com/index/R36112LT6562H343.pdf>

- Moran, S., & Ritov, I. (2007). Experience in integrative negotiations: What needs to be learned? *Journal of Experimental Social Psychology, 43*(1), 77–90. doi:10.1016/j.jesp.2006.01.003
- Murnighan, J. K., Babcock, L., Thompson, L., & Pillutla, M. (1999). The information dilemma in negotiations: Effects of experience, incentives, and integrative potential. *The International Journal of Conflict Management, 10*(4), 313–339.
- Nesta, L., & Patel, P. (2004). National patterns of technological accumulation: Use of patent statistics. In H. F. Moed, W. Glänzel, & U. Schmoch (Eds.), *Handbook of Quantitative Science and Technology Research* (Vol. 24, pp. 531–551). Dordrecht: Kluwer. doi:10.1002/(SICI)1520-6378(199908)24:4<297::AID-COL11>3.3.CO;2-6
- O'Connor, K.M., Arnold, J.A. & Burriss, E.R. (2005). Negotiators' bargaining histories and their effects on future negotiation performance. *The Journal of Applied Psychology, 90*(2), 350–562.
- Quillen, C. D., & Webster, O. H. (2001). Continuing patent applications and performance of the U.S. patent and trademark office. *Federal Circuit Bar Journal, 11*(1), 1–21.
- Quillen, C. D., Webster, O. H., & Eichmann, R. (2002). Continuing patent applications and performance of the U.S. patent and trademark office - Extended performance of the U.S. patent and trademark office – Extended. *Federal Circuit Bar Journal, 12*(1), 35–55.
- Reitzig, M. (2003). What determines patent value? Insights from the semiconductor industry. *Research Policy, 32*(1), 13–26.
- Reitzig, M. (2004). Improving patent valuations for management purposes—validating new indicators by analyzing application rationales. *Research Policy, 33*(6-7), 939–957.
doi:10.1016/j.respol.2004.02.004
- Reitzig, M. & Puranam, P. (2009). Value appropriation as an organizational capability: the case of IP protection through patents. *Strategic Management Journal, 30*(7), 765–789.

- Rothchild, R. (1987). Making patents work for small companies. *Harvard Business Review*, 65(4), 24–30.
- Scherer, F. M. (1983). The propensity to patent, *International Journal of Industrial Organization*, 1, 107–128.
- Squicciarini, M., Dernis, H., & Criscuolo, C. (2013). Measuring patent quality: Indicators of technological and economic value (OECD Science, Technology and Industry Working Papers, 2013/03). Retrieved from: <http://dx.doi.org/10.1787/5k4522wkw1r8-en>
- Siggelkow, N (2002) Misperceiving interactions among complements and substitutes: Organizational consequences. *Management Science*, 48(7), 900–916.
- Somaya, D., Williamson, I.O. & Zhang, X. (2007). Combining patent law expertise with R&D for patenting performance. *Organization Science*, 18(6), 922–937.
- Steinel, W., Abele, A. E., & De Dreu, C. K. W. (2007). Effects of Experience and Advice on Process and Performance in Negotiations. *Group Processes & Intergroup Relations*, 10(4), 533–550. doi:10.1177/1368430207081541
- Teece, D. J. (2010). Forward integration and innovation: Transaction costs and beyond. *Journal of Retailing*, 86(3), 277–283. doi:10.1016/j.jretai.2010.07.013
- Thompson, L. (1990). An examination of naive and experienced negotiators. *Journal of Personality and Social Psychology*, 59(1), 82–90.
- Thompson, L. L., Wang, J., & Gunia, B. C. (2010). Negotiation. *Annual Review of Psychology*, 61, 491–515.
- Van Zeebroeck, N., van Pottelsberghe de la Potterie, B., & Guellec, D. (2009). Claiming more: The increased voluminosity of patent applications and its determinants. *Research Policy*, 38(6), 1006–1020. doi:10.1016/j.respol.2009.02.004

Vecht, J. A., Athanasiou, T., Ashrafian, H., Mayer, E., Darzi, A., & von Segesser, L. K. (2009).

Surgeons produce innovative ideas which are frequently lost in the labyrinth of patents.

European Journal of Cardio-Thoracic Surgery, 35(3), 480–488. doi:10.1016/j.ejcts.2008.11.025

Wagner, S., Hoisl, K., & Thoma, G. (2014). Overcoming localization of knowledge - the role of

professional service firms. *Strategic Management Journal*, 35, 1671–1688. doi:10.1002/smj

APPENDIX A: Correlation Tables

	Grant lag	Experience	Experience squared	Gender	Exam	Patent Scope	Backward citations
Grant lag	1.0000						
Experience (cum. number for patents)	-0.0995	1.0000					
Experience squared	-0.0739	0.8466	1.0000				
Gender (Dummy)	0.0292	-0.0567	-0.0373	1.0000			
Exam (Dummy)	0.0514	-0.0604	-0.0610	0.0840	1.0000		
Patent Scope	0.2176	-0.0445	-0.0339	0.0479	0.0245	1.0000	
Backward citations	0.0823	0.0285	0.0178	0.0176	0.0257	0.0448	1.0000

	Grant lag	Experience	Experience squared	Gender	Patent Scope	Backward citations
Grant lag	1.0000					
Experience (year)	-0.1307	1.0000				
Experience squared	-0.1362	0.9464	1.0000			
Gender (Dummy)	0.0171	-0.0596	-0.0522	1.0000		
Patent Scope	0.2179	-0.0678	-0.0701	0.0452	1.0000	
Backward citations	0.0812	0.0251	0.0245	0.0128	0.0463	1.0000

APPENDIX B: Correlation Tables

	Forward citations	Experience	Experience squared	Gender	Exam	Patent Scope	Backward citations
Forward citations	1.0000						
Experience (cum. number for patents)	0.0152	1.0000					
Experience squared	0.0101	0.8657	1.0000				
Gender (Dummy)	-0.0159	-0.0579	-0.0427	1.0000			
Exam (Dummy)	-0.0221	-0.0872	-0.0905	0.1005	1.0000		
Patent Scope	0.0250	-0.0185	-0.0150	0.0528	0.0414	1.0000	
Backward citations	0.0132	0.0186	0.0135	0.0151	0.0251	0.0481	1.0000

	Forward citations	Experience	Experience squared	Gender	Patent Scope	Backward citations
Forward citations	1.0000					
Experience (year)	-0.0110	1.0000				
Experience squared	-0.0118	0.9473	1.0000			
Gender (Dummy)	-0.0148	-0.0542	-0.0494	1.0000		
Patent Scope	0.0173	-0.0470	-0.0480	0.0489	1.0000	
Backward citations	0.0119	0.0251	0.0173	0.0102	0.0490	1.0000