

# THE VALUE OF PATENT AND TRADEMARKS PAIRS

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# Motivations

- Patent indicators to measure the intrinsic value of technology (Nagaoka et al.)
- The economic potential of an invention depends on appropriability conditions and complementary assets (Teece)
- Strategic behavior of the innovator not considered (McGahan and Gambardella)

# Goals

## ■ Composite value index

- Selecting and validating patent indicators
- Aggregating multi dimensional information

## ■ Gauging patent and trademark pairs

- Analyze the impact of trademark strategy on patent value
- Indicators that combine both patent and trademark information

# Background (1)

- Patents as signaling indexes (Spence)
- ... patent grants improve access to venture capital (Hsu and Ziedonis)
- Patent citations can anticipate the granting decision (Haeussler et al)
- Patents are considered credible signals by external investors (Debb)
- Patent indicators can predict the probability of default (Pederzoli et al.)

# Background (2)

- Paucity in the analysis of the confluence of different IP strategies
- Patenting and secrecy (Arora)
- R&D mode and patenting (Katila & Ahuja)
- Trademarks and copyright (Graham and Somaya)
- Patents and trademarks (Korkeamäki and Takalo)

# Background (3)

## ■ Mediating factors of the IP strategies:

- Appropriability conditions at the industry level (McGahan and Silverman)
- Fragmentation of product submarkets (Giarratana and Gambardella)
- Technological trajectories "Pavitt's taxonomy" (Greenlagh and Rogers)
- Institutional factors (Allred and Park)

■ Mostly, firm level analysis and not market value of single inventions (Gambardella et al)

# Background (4)

- Anecdotal evidence
- Cosmetics: L' Oreal – Aminexil case study
- Trademarks facilitate trust over technology (Rujas)

*"... known expertise in securing and managing intellectual property rights and handling patent disputes can add value to overall brand reputation. Good patents held by high-profile brands often appear to be worth more.  
Bruce Berman, 2012"*

Patent Mark		Patent Title	Wordmark	Company	Country	Sector	Large firm*	Listed firm
1779301	75116317	PUSHMATIC SMART CARD CONNECTOR	PUSHMATIC	AMPHENOL TUCHEL ELECTRONIC	DE	Communic.	no	no
1814931	73312413	ORGASOL SYNTHESIS METHOD WITH LARGE GRAIN SILICA	ORGASOL	ARKEMA FRANCE	FR	Chemicals	yes	no
1814931	78754248	ORGASOL SYNTHESIS METHOD WITH LARGE GRAIN SILICA	ORGASOL	ARKEMA FRANCE	FR	Chemicals	yes	no
1490118	76046776	SCAR-REDUCING PLASTER	CURAD SCAR THERAPY	BEIERSDORF	DE	Chemicals	yes	yes
629706	73685013	Improved method for nucleic acid amplification by NASBA	NASBA	BIOMERIEUX	NL	Pharma&Bio	no	no
1311670	76485280	METHOD FOR MASSIVE DIRECTED MUTAGENESIS	M MASSIVE MUTAGENESIS	BIOMETHODES	FR	R&D serv.	no	no
1838343	78961723	PRRS VACCINES	INGELVAC PRRS	BOHRINGER INGELHEIM VETMEDICA	DE	Pharma&Bio	no	no
740448	75746412	Method for call blocking/unblocking in an ISDN telephone network	ISDN	DEUTSCHE TELEKOM	DE	Telecom	yes	yes
1641469	78419667	AIVLOSIN FOR THE TREATMENT OF DISEASE TO BRACHYSPIRA PILOSICOLI OR ORNITHOBA	AIVLOSIN	ECO ANIMAL HEALTH	GB	Trade&Dist	yes	no
974672	74588072	Improved primers for AFLP amplification	AFLP	KEYGENE	NL	R&D serv.	yes	no
974672	75408979	Improved primers for AFLP amplification	AFLP	KEYGENE	NL	R&D serv.	yes	no
1158056	74588072	Microsatellite-AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1158056	75408979	Microsatellite-AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1175512	74588072	Method for the analysis of AFLP reaction mixtures using primer extension techniq	AFLP	KEYGENE	NL	R&D serv.	yes	no
1175512	75408979	Method for the analysis of AFLP reaction mixtures using primer extension techniq	AFLP	KEYGENE	NL	R&D serv.	yes	no
1282729	74588072	MICROSATELLITE-AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1282729	75408979	MICROSATELLITE-AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1581661	74588072	AFLP-BASED METHOD FOR INTEGRATING PHYSICAL AND GENETIC MAPS	AFLP	KEYGENE	NL	R&D serv.	yes	no
1581661	75408979	AFLP-BASED METHOD FOR INTEGRATING PHYSICAL AND GENETIC MAPS	AFLP	KEYGENE	NL	R&D serv.	yes	no
1639135	74588072	SPLICE SITE AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1639135	75408979	SPLICE SITE AFLP	AFLP	KEYGENE	NL	R&D serv.	yes	no
1725252	75381002	ANTITUMOUR TREATMENTS WITH METXIA AND CYCLOPHOSPHAMIDE OR 5T4 VACCINE	METXIA	OXFORD BIOMEDICA	GB	Pharma&Bio	yes	yes
1812653	78867418	SOFT QUAY MOORING SYSTEM	SOFT QUAY	SINGLE BUOY MOORINGS	CH	Mach.Tool	yes	no
1715876	78188920	NEW SYNBIOTIC USE	SYNBIOTIC 2000	SYNBIOTICS	SE	R&D serv.	no	no
1455760	74028100	ULTRAPURE ORAL FLUDARA FORMULATION WITH A FAST RELEASING ACTIVE SUBSTANCE	FLUDARA	SCHERING	DE	Pharma.	yes	yes

Notes: \* Firm with more than 250 employees.



# Hypotheses

- **HP 1:** Patent and trademark pairs provide useful signaling information about the success of an invention project and therefore they impact positively the market value of the underlying invention above and beyond the patent indicators.
- **HP 2:** The selectivity of the signaling of the patent and trademark pairs provides additional useful information about the value of the underlying invention that will be incorporated in the invention's market value.
- **HP 3:** Patent and trademark pairs provide useful signaling information about the tail of the invention value distribution and therefore they are disproportionately associated with blockbuster inventions.

# Data & Sources

- EPO patent applications 1978-2011
- PATSTAT 10/2012 & EPO-XML files 12/2012
- Benchmark: survey information on market value of patents (Gambardella et al, 2008)
- US trademarks: USPTO SGML files 10/2007
- EPO PRS files for Oppositions and Renewals
- Demographic and financial information from AMADEUS business directory

# Methods (1)

- Selecting & validating patent indicators (Ernst and Omland)
  - Scope and technology potential (6)
  - Prior art and background of the invention (6)
  - Filing and procedural aspects of the patent(7)
- Dependent variable: market value estimate
- Detrending for time/technology effects
- Aggregating patent value indicators with the mean of factor analysis

**Table 1 OLS regression of patent value**

Dependent variable	Model 1			Model 2		
	log (value)			log (log (value))		
	coeff	s.e.	p-val	coeff	s.e.	p-val
Costant	0.169	(0.01)	***	0.179	(0.005)	**
No forward citations	0.000	(0.003)		-0.002	(0.002)	
No backward citations	0.010	(0.007)		0.006	(0.003)	**
Patent family weighted	0.024	(0.011)	***	0.013	(0.006)	***
Patent family	0.042	(0.007)	***	0.021	(0.004)	***
Forward citations	0.011	(0.003)	***	0.005	(0.001)	***
Claims	0.012	(0.004)	***	0.007	(0.002)	***
Backward citations	0.005	(0.003)	**	0.003	(0.001)	**
XY backward citations	0.005	(0.002)	**	0.002	(0.001)	**
SSR	-0.070	(0.032)	***	-0.036	(0.014)	***
PCT route	0.013	(0.005)	***	0.008	(0.003)	***
Adjusted R2	0.052			0.050		

# Results (1) of stepwise regression

- Patent family as the main predictor of value followed more distantly by cites
- The weighted family size adds further explanatory power
- Citations are a noisy indicator
- SSR is negatively related to value
- Other patents indicators have a smaller impact on value
- R2 is 2x bigger than Gambardella et al.(2008)

**Table 3 Factor loadings of principal component analysis with maximum likelihood**  
**Overall EPO patents with priority years 1978-2007 - 2,008,134 patent applications**

		Factor 1	Factor 2	Factor 3
(1)	Patent family weighted	0.273	-0.048	-0.255
(2)	Patent family	0.329	0.020	-0.464
(3)	Forward citations	0.158	-0.094	0.198
(4)	Claims	0.036	0.014	0.057
(5)	Backward Citations	0.354	-0.159	0.497
(6)	XY Backward Citations	0.022	0.078	0.148
(7)	PCT route	0.061	0.435	-0.122
(8)	SSR	0.050	0.465	0.209
Eigenvalues of variance covariance matrix		2.257	0.836	0.410

# Results (2) of factor analysis

- All indicators are correlated at 1% level
- Extend the estimation to overall dataset
- We confirm the presence of three common factors
  - F1: Scope & techn. potential (family+cites)
  - F2: Filing & procedural factors (PCT+SSR)
  - F3: Prior art and background of the invention (backward & XY cites)

**Table 1 (cont) OLS regression of patent value**

Dependent variable	Model 3 log (value)			Model 4 log (log (value))			Model 5 log (value)			Model 6 log (log (value))		
	coeff	s.e.	p-val	coeff	s.e.	p-val	coeff	s.e.	p-val	coeff	s.e.	p-val
Costant	0.229	(0.003)	***	0.218	(0.002)	***	0.245	(0.006)	***	0.219	(0.003)	***
No forward citations	-0.004	(0.001)	**	-0.005	(0.001)	***	-0.001	(0.003)		-0.002	(0.001)	
No backward citations	-0.005	(0.003)	**	0.004	(0.002)	*	0.012	(0.006)	**	0.007	(0.003)	**
Factor index (from all EPO dataset)							0.028	(0.002)	***	0.014	(0.001)	***
Factor index (from the survey dataset)	0.007	(0.001)	***	0.009	(0.001)	***						
Adjusted R2	0.032			0.031			0.046			0.044		
R2 relative reduction	39.4%			37.5%			11.3%			11.8%		



**Table 1b Log linear regression of patent value with clustered standard errors**

(8,277 EPO patents from the survey dataset)

Dependent variable	Model 7 log(value)	Model 8 log-log(value)	Model 9 log(value)	Model 10 log-log(value)
Costant	0.252 *** (0.007)	0.222 ** (0.003)	0.233 *** (0.007)	0.213 *** (0.003)
No forward citations	-0.013 *** (0.003)	-0.008 *** (0.001)	-0.002 (0.003)	-0.002 (0.001)
No backward citations	-0.020 *** (0.005)	-0.009 *** (0.002)	0.010 * (0.006)	0.006 ** (0.003)
D (No Renewals index)	-0.002 (0.005)	-0.001 (0.003)	-0.004 (0.005)	-0.003 (0.003)
Renewals index (log)	0.209 *** (0.035)		0.118 *** (0.037)	
Renewals index (log-log)		0.119 *** (0.02)		0.066 *** (0.021)
D (Opposition)	0.010 *** (0.004)	0.005 *** (0.002)	0.008 ** (0.004)	0.005 *** (0.002)
Composite index (computed in all EPO dataset - 2,008,134 pats)			0.025 *** (0.002)	0.013 *** (0.001)
Adjusted R2	0.024	0.025	0.053	0.052
R2 relative change with composite index			116.4%	106.4%
R2 relative change with post-grant information			13.8%	16.5%

# Methods (2): Patent and trademark pairs

PTP-1. Patent Title ↔ Word Mark

PTP-2. Patent Title + Abstract ↔ Word Mark

PTP-3. Patent Title + Abstract ↔ Word Mark +  
Description

PTP-4. Patent Title ↔ Word Mark + Description

# Computation of patent-trademark pairs

## ■ Weighted Jaccard Measure

- by the inverse frequency of a given token among different companies

$$J^w(X, Y) = 2 \frac{\sum_{k|x_k \in X \cap Y} w_k}{\sum_{i|x_i \in X} w_i + \sum_{j|y_j \in Y} w_j}$$

**Table 5 Log linear regression results with clustered standard errors**  
(5,416 patents from the survey dataset)

<b>Dependent variable: log market value in thousands Euros</b>						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Patent-Trademark Pair						
- PTP-1		0.107 ** (0.056)				
- PTP-2			0.056 ** (0.025)			
- PTP-3				0.019 *** (0.007)		
- PTP-4					0.034 ** (0.017)	
- PTP-5						0.005 *** (0.002)
Composite Index	0.020 *** (0.002)	0.020 *** (0.002)	0.020 *** (0.002)	0.020 *** (0.002)	0.020 *** (0.002)	0.020 *** (0.002)
D (Patent Opposed)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)
Renewals Index (log)	0.107 *** (0.031)	0.108 *** (0.031)	0.107 *** (0.031)	0.109 *** (0.031)	0.109 *** (0.031)	0.109 *** (0.031)
D (No Renewals index)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)
D (No trademark)	0.005 * (0.003)	0.006 * (0.003)	0.006 * (0.003)	0.007 ** (0.003)	0.006 ** (0.003)	0.007 ** (0.003)
D (Large firm)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)
D (Listed firm)	0.007 ** (0.003)	0.007 ** (0.003)	0.006 * (0.003)	0.005 * (0.003)	0.007 ** (0.003)	0.005 * (0.003)
R&D investment 5 years grow	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.001 (0.001)	-0.002 (0.001)

Notes: It Includes dummies for geographic origin (7), sector of activity (32), and founding years (6)

**Table 6 Probit regression results with clustered standard errors - marginal effects**  
(5,416 patents from the survey dataset)

<b>Dependent variable: market value at least 20 millions of Euros</b>						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Patent-Trademark Pair						
- PTP-1		0.358 *** (0.134)				
- PTP-2			0.187 *** (0.052)			
- PTP-3				0.052 *** (0.016)		
- PTP-4					0.128 *** (0.042)	
- PTP-5						0.017 *** (0.004)
Composite Index	0.033 *** (0.006)	0.032 *** (0.006)	0.032 *** (0.006)	0.031 *** (0.006)	0.032 *** (0.006)	0.031 *** (0.006)
D (Patent Opposed)	-0.002 (0.011)	-0.003 (0.011)	-0.003 (0.011)	-0.003 (0.011)	-0.003 (0.011)	-0.003 (0.011)
Renewals Index (log)	0.196 ** (0.092)	0.196 ** (0.092)	0.193 ** (0.092)	0.199 ** (0.092)	0.198 ** (0.092)	0.197 ** (0.092)
D (No Renewals index)	0.036 (0.027)	0.038 (0.028)	0.038 (0.027)	0.036 (0.027)	0.038 (0.027)	0.038 (0.028)
D (No trademark)	-0.018 * (0.008)	-0.016 * (0.009)	-0.016 * (0.009)	-0.012 (0.009)	-0.013 (0.009)	-0.011 (0.009)
D (Large firm)	-0.004 (0.019)	-0.005 (0.019)	-0.004 (0.019)	-0.006 (0.02)	-0.005 (0.02)	-0.006 (0.02)
D (Listed firm)	0.001 (0.009)	0.000 (0.009)	-0.003 (0.009)	-0.006 (0.009)	-0.002 (0.009)	-0.006 (0.009)
R&D investment 5 years growth	-0.004 (0.005)	-0.004 (0.005)	-0.004 (0.005)	-0.004 (0.005)	-0.004 (0.005)	-0.004 (0.005)

Notes: It Includes dummies for geographic origin (7), sector of activity (32), and founding years (6)

**Table 7 Log linear regression results - estimated impact for one standard deviation change**  
(5,416 patents from the survey dataset)

<b>Dependent variable: log market value in thousands Euros</b>						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
<b>D (Patent-Trademark Pair)</b>						
- PTP-1		0.039 *** (0.011)				
- PTP-2			0.016 ** (0.007)			
- PTP-3				0.014 *** (0.004)		
- PTP-4					0.007 * (0.004)	
- PTP-5						0.017 *** (0.005)
Composite Index	0.013 *** (0.001)	0.013 *** (0.001)	0.013 *** (0.001)	0.013 *** (0.001)	0.013 *** (0.001)	0.013 *** (0.001)
D (Patent Opposed)	0.012 *** (0.003)	0.013 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)	0.012 *** (0.003)
Renewals Index (log)	0.005 *** (0.001)	0.005 *** (0.001)	0.005 *** (0.001)	0.005 *** (0.001)	0.005 *** (0.001)	0.005 *** (0.001)
D (No Renewals index)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.005 (0.007)	0.006 (0.007)
D (No trademark)	0.005 * (0.003)	0.005 * (0.003)	0.005 * (0.003)	0.006 * (0.003)	0.006 * (0.003)	0.006 * (0.003)
D (Large firm)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)	0.000 (0.006)
D (Listed firm)	0.007 ** (0.003)	0.007 ** (0.003)	0.006 ** (0.003)	0.006 * (0.003)	0.007 ** (0.003)	0.006 * (0.003)
R&D investment 5 years growth	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)

**Dummy variables**



**Table 8 Probit regression results - estimated impact for one standard deviation change**

(5,416 patents from the survey dataset)

**Dependent variable: market value at least 20 millions of Euros**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
D (Patent-Trademark Pair)						
- PTP-1		0.109 *** (0.049)				
- PTP-2			0.050 *** (0.022)			
- PTP-3				0.039 *** (0.014)		
- PTP-4					0.026 ** (0.012)	
- PTP-5						0.044 *** (0.015)
Composite Index	0.021 *** (0.004)	0.021 *** (0.004)	0.021 *** (0.004)	0.020 *** (0.004)	0.021 *** (0.004)	0.021 ** (0.004)
D (Patent Opposed)	-0.002 (0.011)	-0.001 (0.011)	-0.002 (0.011)	-0.003 (0.011)	-0.003 (0.011)	-0.003 (0.011)
Renewals Index (log)	0.009 ** (0.004)	0.009 ** (0.004)	0.009 ** (0.004)	0.009 ** (0.004)	0.009 ** (0.004)	0.009 ** (0.004)
D (No Renewals index)	0.036 (0.027)	0.038 (0.028)	0.038 (0.028)	0.036 (0.027)	0.037 (0.027)	0.038 (0.027)
D (No trademark)	-0.018 ** (0.008)	-0.017 * (0.008)	-0.017 * (0.008)	-0.016 * (0.009)	-0.015 * (0.009)	-0.016 * (0.008)
D (Large firm)	-0.004 (0.019)	-0.004 (0.019)	-0.003 (0.019)	-0.004 (0.019)	-0.004 (0.019)	-0.003 (0.019)
D (Listed firm)	0.001 (0.009)	0.000 (0.009)	-0.002 (0.009)	-0.003 (0.009)	-0.002 (0.009)	-0.004 (0.009)
R&D investment 5 years growth	-0.003 (0.004)	-0.003 (0.004)	-0.003 (0.004)	-0.003 (0.004)	-0.003 (0.004)	-0.003 (0.004)

**Dummy variables**



**Appendix 3b Log linear regression results - estimated impact for one standard deviation change**  
(63,238 patents from the PRS dataset)

**Dependent variable: maintenance of a patent before lapsing in Germany - log number of years**

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
D (Patent-Trademark Pair)						
- PTP-1		0.048 *** (0.019)				
- PTP-2			0.041 *** (0.012)			
- PTP-3				0.015 ** (0.007)		
- PTP-4					0.018 ** (0.008)	
- PTP-5						0.027 *** (0.007)
Composite Index	0.057 *** (0.003)	0.057 *** (0.003)	0.056 *** (0.003)	0.057 *** (0.003)	0.057 *** (0.003)	0.056 *** (0.003)
D (Patent Opposed)	0.018 ** (0.008)	0.018 *** (0.008)	0.017 ** (0.008)	0.017 ** (0.008)	0.017 ** (0.008)	0.017 ** (0.008)
D (No trademark)	-0.016 * (0.008)	-0.015 * (0.008)	-0.014 * (0.008)	-0.015 (0.008)	-0.013 (0.008)	-0.007 (0.009)
D (Large firm)	0.045 *** (0.017)	0.045 *** (0.017)	0.044 *** (0.016)	0.045 *** (0.017)	0.044 *** (0.017)	0.042 *** (0.016)
D (Listed firm)	-0.024 ** (0.01)	-0.025 ** (0.01)	-0.027 *** (0.01)	-0.025 *** (0.01)	-0.025 *** (0.01)	-0.028 *** (0.01)
R&D investment 5 years growth	0.007 *** (0.002)	0.007 *** (0.002)	0.007 *** (0.002)	0.007 *** (0.002)	0.007 *** (0.002)	0.007 *** (0.002)

**Dummy variables**



# Discussion and Limitations

- Timely patent indicators (OECD, 2013)
- Aggregation problem (Ozer-Balli & Sorenson)
- Not only titles/abstracts, but also claims
- Time to market
- Only US marks are considered
- Validity of the indicators with data from other offices