



# Co-ownership of intellectual property: Exploring the value creation and appropriation implications of co-patenting

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# Introduction (1)

- Open innovation ‘paradigm’ suggests that firms should open up and collaborate with external partners (Chesbrough, 2003 & 2006)
- Firms have increasingly engaged in ‘open innovation’ practices (Chesbrough, 2003; Huston and Sakkab, 2006; Kirschbaum, 2005; Rojakkers and Hagedoorn, 2002)
- R&D collaboration might imply multiple benefits, such as:
  - Access to complementary resources (Eisenhardt and Schoonhoven, 1996)
  - Cost and risk sharing (Hagedoorn, 1993; Belderbos et al., 2004)
  - Faster product development (Du, Leten and Vanhaverbeke, 2012)
- But, collaboration creates appropriation problems (Chesbrough and Rosenbloom, 2002; Henkel, 2006; Laursen and Salter, 2005; Faems et al., 2010; Belderbos et al., 2010)
  - **“Paradox of openness”** (Laursen and Salter, 2005)

# Introduction (2)

## This paper

- Further investigating the complexity of ‘open innovation’ practices by focusing on the impact of co-patents
- Co-patents signal the presence of R&D partners opting for co-ownership of jointly created innovations (foreground IP)
- Co-patents have been labelled as a ‘second-best’ solution
  - Hagedoorn (2003): co-ownership reduces value appropriation
  - Belderbos, Faems, Leten and Van Looy (2010): negative effect of co-patents on the market value of large companies
- But, firms frequently choose co-patent IP arrangements
  - Hagedoorn (2003): 5% of USPTO patents are co-patents

# Introduction (3)

## This paper

- Explore role and performance implications of co-patents
- Two-step empirical approach:
  - Expert interviews with 10 IP managers from large, R&D intensive organizations (n=9) and knowledge institute (n=1)
  - Quantitative analysis of value creation and value appropriation implications of co-patents using firm-level panel dataset (n=166)
- Main findings:
  - Co-patents have value creation and appropriation effects
    - Value creation and appropriation effects depend on the type of R&D partners
  - Distinguish between IP ownership and IP exploitation rights

# Co-ownership: A legal perspective

## No common legal concept of co-ownership

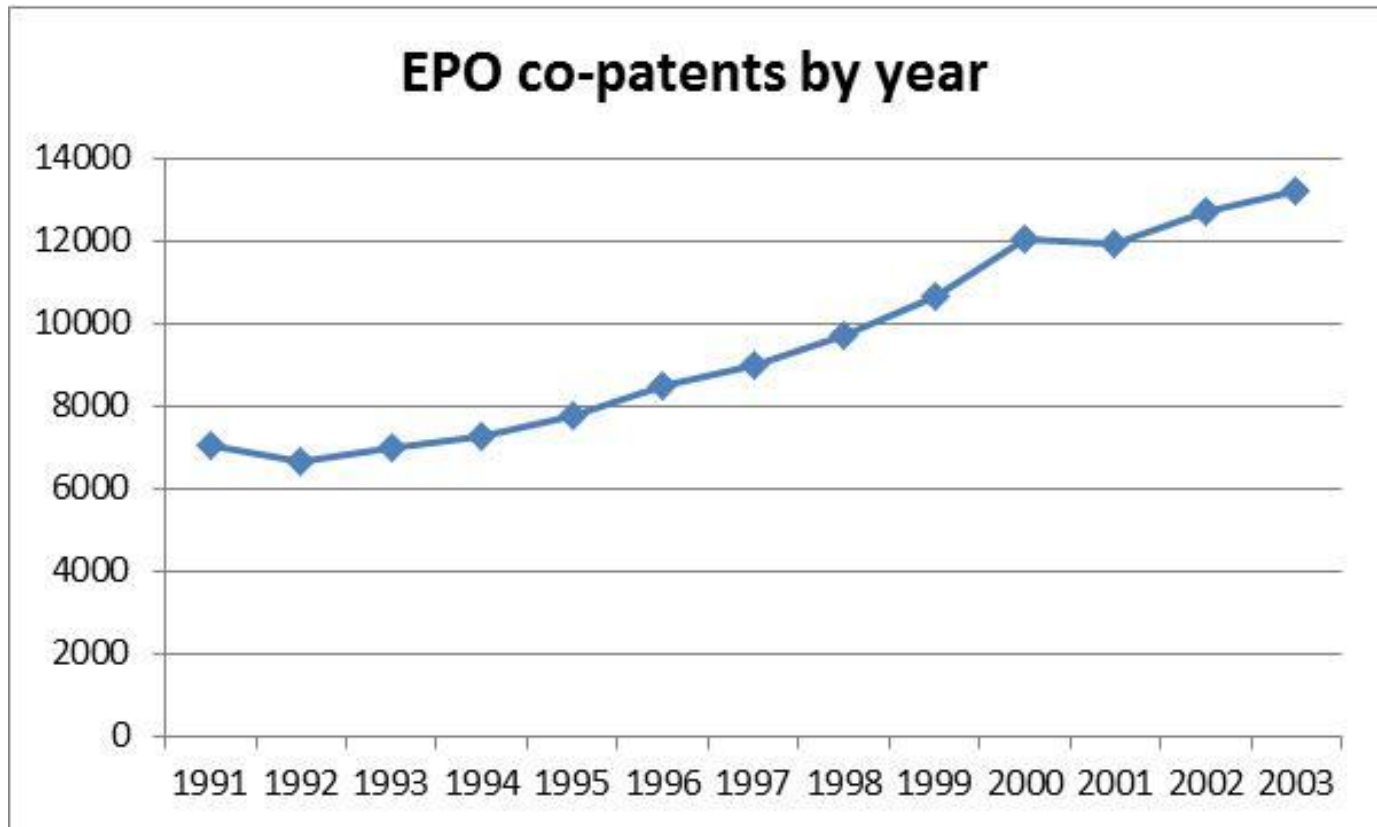
### Co-patents in Europe (most EU countries)

- right to exploit the IP for your own benefit without accounting to the others (co-owners)
- But cannot grant a licence or assign interest in the IP without the consent of the other owners

### Co-patents in USA

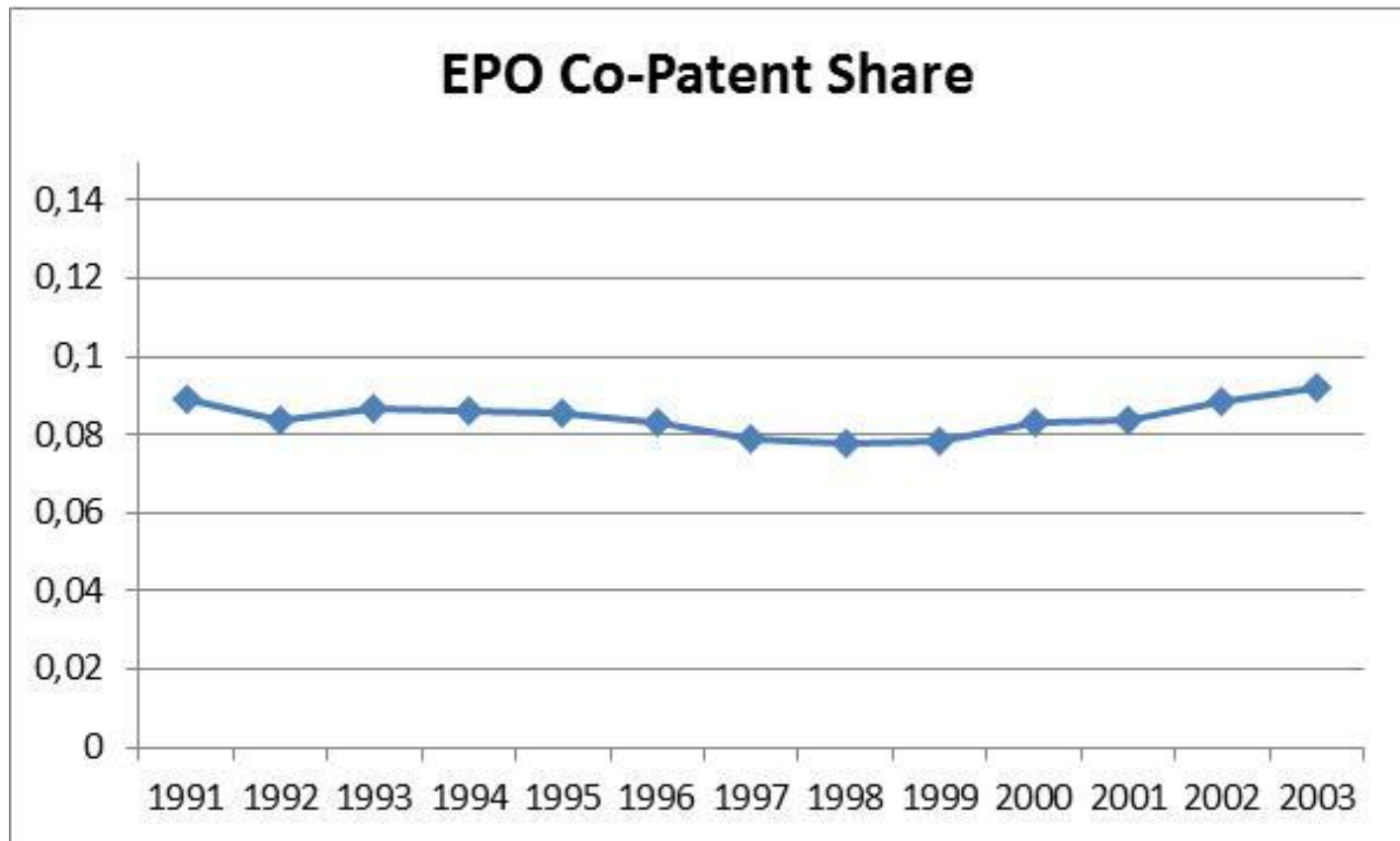
- right to use, sell or license a patent without the consent of the other co-owners *(35 U.S.C. 262 Joint owners-Patent Laws 1999)*

# Co-patenting is important phenomenon (1)



Azzola, Landoni, Van Looy (2010). Patstat data ECOOM/INCENTIM (KU Leuven)

# Co-patenting is important phenomenon (2)



Azzola, Landoni, Van Looy (2010). Patstat data ECOOM/INCENTIM (KU Leuven)

# Expert Interviews: Questions

- Dealing with foreground IP in R&D collaborations
  - Role of IP co-ownership (co-patenting)
  - Advantages and disadvantages of co-patenting
- Antecedents of co-patenting
  - Role of commercialization strategies and bargaining power
- Co-patenting and value creation
  - Impact of co-patenting on R&D collaboration process
- Performance implications of co-patenting
  - Impact of co-patenting on financial performance of firms
  - Drivers of relationship between co-patenting and firm performance



# Expert Interviews: Insights (1)

- Co-patenting and value appropriation

- Co-patenting creates a duopoly in which joint owners (can) compete against each other for R&D profits (Hagedoorn, 2003)
- IP co-ownership creates uncertainty on the control that each co-owner has on the co-owned IP (interviews)

*“Under Swedish law, a co-owner has the right to get rid of the patent and sell his rights. The other co-owner can bid for the rights, but the selling co-owner has the right to sell his ownership to the biggest bidder. This can be a competitor, who uses the patent to compete with the other co-owner”*

*“There is always a risk that they [i.e. the patent co-owner] will go bankrupt and their rights on the co-patents are sold”*

# Expert Interviews: Insights (2)

- Costs and complexities of co-patenting

- Co-patents agreements complicate and slow-down the negotiation of joint development agreements

*“It is very difficult and time-consuming to negotiate R&D contracts when co-patents are in place, since co-owners have to decide up-front on patent application trajectories and patent commercialization trajectories”*

- The administration and governance of co-patents is complex

*“The administration and governance of co-patents takes a lot of time. We have to communicate and come to an agreement with the co-owners on all patent matters, such as the wording of the patent claims, communication with the different patent authorities and the payment of renewal fees”*

*“Co-patents imply extra overhead costs in terms of administration”*

# Expert Interviews: Insights (3)

- IP Co-ownership versus IP exploitation rights

- Value appropriation problems of co-patents can be mitigated by negotiating clear rules about the division of exploitation rights

*“Collaboration can result in co-ownership of IP. However, we will make sure that exploitation rights on co-owned IP are divided among the partners”*

- Ability to define ex-ante separation of exploitation rights on co-owned IP depends on the type of R&D partners that are involved
  - Easier to negotiate with vertical partners (suppliers and customers) who have different exploitation domains and/or geographical markets

*“When we collaborate with suppliers, a standard agreement is that we get the right to exploit the IP within the application domain of our products, whereas the partner can exploit the IP in other domains outside our interest”*

# Expert Interviews: Insights (4)

- Value appropriation with universities

- Universities mostly lack the incentives and abilities to commercially exploit the co-owned technologies and compete with co-owners

*“The business of universities is not to compete with companies. Universities are rather in the business of educating people, developing their faculty and doing basic research. Hence, financial markets are less concerned when companies co-own patents with universities (compared to firms)”*

- It is standard procedure to contractually negotiate with universities that they don't have the rights (at least within first couple of years) to license co-owned technologies to direct competitors

*“In most cases we sponsor 100% of the joint research, and we are in a good bargaining position to negotiate full exploitation rights on co-patents”*

# Expert Interviews: Insights (5)

- Value creation in R&D collaborations
  - Organizations that collaborate can combine complementary resources and generate valuable inventions (Doz and Hamel, 1997; Vanhaverbeke, 2006)
  - Intensive interaction between partners is needed to realize synergies (Doz, 1996; Faems, Janssens and Van Looy, 2007)
  - But, the willingness of R&D partners to cooperate intensively is often low because of ex-ante knowledge appropriation concerns and low-levels of inter-relational trust (Madhok and Tallman, 1998; Heiman and Nickerson, 2004)
    - Ex-ante IP arrangements mitigate appropriation concerns

# Expert Interviews: Insights (6)

- Co-patenting and value creation

- Co-patenting mitigates value appropriation concerns for inventions in the “gray knowledge zone” (Hagedoorn, 2003)
- Co-patenting has a relational function and may contribute to increased trust levels between collaboration partners (interviews)
  - Intensive interactions between R&D partners are necessary for successful R&D (Doz, 1996; Faems et al., 2007; Madhok and Tallman, 1998)

*“Co-patent arrangements provide a signal of trust which strengthens the connection between the partners and stimulates cooperation”*

*“As a large company, we sometimes use co-patents to reduce the distrust of small partners. It is about creating goodwill and the necessary trust between partners to increase the probability of collaborative success”*

# Research Propositions

- Three research propositions
  - 1) Co-patents hinder value appropriation
  - 2) Co-patents with horizontal partners hinder value appropriation more than co-patents with vertical partners and universities
  - 3) Co-patents stimulate value creation
- Quantitative analysis on firm-level dataset
  - Panel dataset of patent portfolios of 166 large EU/US/JP firms
  - Impact of co-patents on the value of technologies (value creation) and the financial performance of firms (value appropriation)

# Sample and Data

- **Firm-level panel dataset (1996-2003)**
  - 166 R&D intensive European, US and Japanese firms
  - Five industries (pharmaceuticals, chemicals, electrical machinery & electronics, IT hardware, non-electrical machinery)
- **Patent data**
  - EPO patent data (instead of USPTO data)
  - Annually consolidated data
    - 17,6% of firm patents are not filed under the current parent firm name
    - Sample firms own altogether about 25% of all EPO patents
  - Granted EPO patents
    - Grants because of focus on value appropriation effects of co-patents



# Co-Patent Variables

- A patent is considered as *co-owned* when it is jointly owned with an economic actor that is not part of the focal firm  
(Belderbos, Faems, Leten and Van Looy, 2010)
- Patents that are co-owned with individuals are removed
- Use of sector allocation algorithms to differentiate between firms, universities and individuals (Van Looy et al., 2006)
- Distinction between horizontal and vertical co-patent partners on the basis of the (main) sectors of co-patentees
  - Horizontal partner = firm active in same main industry
  - Vertical partner = firm active in different main industry

# Empirical Methods (1)

- **Value Creation**

- Impact of co-patenting on technological performance
- Patent-level analysis
- Dependent variable = patent value
- Patent value = forward citations (Harhoff, 1999; Gambardella et al., 2008)
- The 166 sample firms were granted 86'820 patents in 1996-2003
- Co-patenting variables = dummies
- Negative binomial regression

# Control variables (1)

- **Value Creation (patent-level)**

- Patent scope = number of patent classes
  - Determines extent of patent protection and economic value of inventions
- Number of backward patent citations
- Number of backward non-patent (scientific) citations
- Number of patent inventors
  - Likely to be correlated with the co-patent variable (number of organizations)
- Technology field dummies (n=120)
- Application year dummies (n=7)
- Parent firm dummies (n=166)

# Empirical Methods (2)

- **Value Appropriation**

- Impact of co-patenting on financial performance
- Firm-level analysis
- Market value equation (Hall et al., 2005; Czarnitzki et al., 2011)
- Dependent variable = Tobin's Q
  - Tobin's Q = market value/book value
  - Forward-looking indicator of firm value
- Dynamic growth specification
  - Regress growth of Tobin's Q on contemporaneous patent variables and lagged Q
- Co-patenting variables = share of co-patents (specific type)
- Ordinary least squares

# Control Variables (2)

- **Value Appropriation (firm-level)**
  - Lagged Tobin's Q
    - To account for dynamics in market valuation growth (negative sign expected)
  - R&D intensity (R&D/assets)
  - Patent propensity (patents/R&D)
  - Patent value (citations/patents)
  - Product diversification
    - To control for a conglomerate discount (Montgomery, 1994)
  - Sector dummies (n=5)
  - Home country dummies (n=11)
  - Year dummies (n=6)

# Results: Value Creation (1)

**Table 1. trends in copatenting activity of the 166 sample firms**

<b>year</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
copatents - vertical partners	302	311	244	299	263	314	237	167	84
<i>% total</i>	2,9	2,8	2,2	2,7	2,4	3,0	2,5	2,4	1,7
copatents - horizontal partners	98	132	158	145	158	140	114	107	56
<i>% total</i>	0,9	1,2	1,4	1,3	1,4	1,3	1,2	1,5	1,1
copatents - universities	15	20	16	16	11	21	9	4	7
<i>% total</i>	0,14	0,18	0,14	0,14	0,10	0,20	0,10	0,06	0,14
all patent grants	10548	10920	11289	11145	11184	10560	9295	6938	4941

# Results: Value Creation (2)

**Table 2. Characteristics of copatents**

	copatents				other patents
	vertical	horizontal	university	all	
forward citations	1.080	1.380	1,622	1.195	1,024
backward citations	4.859	4.479	3,546	4.692	4,452
non-patent citations	0.482	0.528	2,874	0,579	0,569
number of technology fields	1.392	1.408	1,630	1.406	1,302
number of inventors	4.593	4.738	4,580	4.639	2,795

# Results: Value Creation (3)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
copatent - all	0.185*** [0.028]	0.184*** [0.028]	0.073*** [0.028]			
copatent - vertical partners				0.161*** [0.035]	0.162*** [0.035]	0,054 [0.035]
copatent- horizontal partners				0.242*** [0.047]	0.240*** [0.047]	0.123*** [0.047]
copatent - universities				0,075 [0.137]	0,045 [0.138]	-0,038 [0.137]
backward patent citations		0.030*** [0.002]	0.027*** [0.002]		0.030*** [0.002]	0.027*** [0.002]
non-patent citations		0.037*** [0.004]	0.035*** [0.004]		0.037*** [0.004]	0.035*** [0.004]
number of technology fields		0.219* [0.131]	0.228* [0.130]		0.220* [0.131]	0.229* [0.130]
number of inventors			0.069*** [0.003]			0.069*** [0.003]
3-digit IPC dummies	Included	Included	Included	Included	Included	Included
firm dummies	Included	Included	Included	Included	Included	Included
year dummies	Included	Included	Included	Included	Included	Included
Observations	86820	86820	86820	86820	86820	86820
Loglikelihood	-113'263	-113'092	-112'812	-112'811	-113'090	-113'261
LR chi square (DF)	12907(304)	13249(307)	13808(308)	13810(306)	13252(309)	12909(310)



# Results: Value Appropriation (1)

**Table 5. Tobin's Q: firms with and without copatenting activity**

	firms with	# firm obs	firms without	# firm obs	stat diff
copatents - horizontal partners	1,53	315	1,87	830	p< 0,01
copatents - vertical partners	1,33	422	2,03	733	p< 0,01
copatents - universities	2,48	175	1,65	970	p< 0,01

*note: based on 1145 firm-year observations*

# Results: Value Appropriation (2)

**Table. The effect of Copatenting on the Growth in Market valuation (Tobin's q)**

	1-year growth		2-year growth	
	Model 1	Model 2	Model 3	Model 4
copatents - vertical partners		0,047 [0.124]		0,097 [0.236]
copatents - horizontal partners		-0.357* [0.194]		-0.978*** [0.367]
copatents - universities		-0,081 [0.609]		0,506 [1.125]
Lagged Tobin's q	-0.235*** [0.019]	-0.237*** [0.019]	-0.450*** [0.024]	-0.453*** [0.024]
R&D/assets	0.785*** [0.293]	0.827*** [0.295]	1.354*** [0.435]	1.456*** [0.438]
patents/RD	1.049 [0.76]	1.012 [0.77]	2.820** [1.13]	2.647** [1.10]
citations/patents	0,013 [0.015]	0,014 [0.016]	0.063** [0.026]	0.069*** [0.026]
product diversification	-0.014** [0.006]	-0.013** [0.006]	-0.018** [0.008]	-0.018** [0.008]
country dummies	Included	Included	Included	Included
sector dummies	Included	Included	Included	Included
year dummies	Included	Included	Included	Included
Observations (firms)	1145 (166)	1145 (166)	1023 (165)	1023 (165)
R squared	0,315	0,318	0,443	0,447
F test	19.1***	17.3***	30.5***	27.7***

# Size of Estimated Co-Patent Effects

- Value creation
  - Co-patents are 12-24 per cent higher in economic value
- Value appropriation
  - One standard deviation change in co-patent share with horizontal partners reduces 2-year growth in Tobin's Q with 5 per cent
- Net-effect of co-patent on performance = Negative
  - Difficult to assess because of direct and indirect effects
  - One st.dev. increase in share of horizontal co-patents (+0,05)
    - Direct effect: decrease in financial growth of 5 %
    - Indirect effect: increase in financial growth of 0,1%

# Conclusions and further research (1)

## Main Contributions:

- **Performance implications of co-patenting**
  - Co-patents have both value creation and appropriation effects
  - Both effects are more pronounced for co-patents with horizontal R&D partners (compared to vertical partners and universities)
- **Distinction between ownership and exploitation rights**
  - Effects of co-ownership depend on negotiated exploitation rights
  - Exploitation rights can be easier split up when R&D partners have different exploitation trajectories (vertical partners, universities)

# Conclusions and further research (2)

## Further Research

- **Study of the antecedents of co-patents**
  - Which role is played by commercialization strategies? Are co-patent deals more likely when R&D partners opt for joint business models?
  - How important is bargaining power? How to measure this?
    - First analyses show a negative effect of lagged Q on share of co-patents
- **Project-level analysis of foreground IP arrangements in collaboration contracts and their implications**
  - Project-level studies are needed (cf. Phd research Jingshu Du)
  - Coding of foreground IP arrangements (ownership and exploitation rights) in joint-development agreements of R&D project teams