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How to balance the dilemma in online technology market for sellers?

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Abstract. This study analyzes how sellers balance the dillemma in online marketplaces for technology which support the listing, search, and exchange of technological inventions by sellers and buyers.Online marketplaces for technology entail great benefits as well as challenges:they reduce search costs but raise risks of expropriation. We investigate that how participates of online technology marketplaces sovle this dillemma and identify possible in fluencing factors. Using the China Patent Database and an original database of patented technologies collected from online technology marketplaces, we get the result that indicates that firms with small social circle are more willing to participate in online marketplaces to reduce search costs and technology with lower value are more possible to be marketed to online technology marketplaces to reduce risks of exproriation. Results enhance our consciousness of online market for technology.

1. Introduction

Markets for technology grew dramatically over recent decades worldwide[1, 2], knowledge has been increasingly traded on markets as a 'free-standing' entity, 'disembodied' from individuals, organizations and products [3], The result is a large body of work investigating a broad range of issues important for the market for technology.These issues include factors driving inventors' participation in these markets [4-7], the way in which the exchange is organized[8-10], and institutions supporting the market for technology [11, 12].

In this paper, we study a phenomenon that has appeared recently in the market for technology: online technology marketplaces, These marketplaces use information technology and the Internet to facilitate the listing, search and exchange of technology between inventors and technology owners or sellers on one hand prospective licensees or technology buyers on the other [13-15]. For over a decades, a number of marketplaces operated successfully, such as yet2. Com, UTEK and UVenture. Anecdotal evidence suggests that online marketplaces have the potential to expand the reach of markets for technology between sellers and buyers.However, while a growing number of firms participate in such online marketplaces[2], some challenges still influence the development of online market for technology.

The focal point of the paper is to study how the sellers of online technology market balance the advantage and disadvantage of online technology market. We will devote to solving two problems that (i): how sellers use online technology market to reduce search cost and (ii): how sellers avoid to raise risks of c when posting a technology in online technology market? According to existing research,we know that social ties can reduce rearch cost, while online market for technology will not depend on social ties to indentify buyers and sellers, so we guess firms with small social circle may more likely to use the advantage of reducing search cost to find their buyers, because online markets can expand the reach of markets for technology between sellers and buyers in strangers, similar to online marketplaces for consumer goods(eg. Amazon or eBay). We suppose that technologies are not the same important for the holders, in consideration of the risks of expropriation, sellers of online technology may more willing to post lower quality technology to attract buyers while keep high quality technolgy secret.

To test our hypothesis, we study Chinese prominent websites that act as technology markets that connected inventors and technology seller with technology buyers in 2017. In these websites, technologies are revealed by listing according to catalog, and the detail information of technologies include a brief introduction, the patent number, the contact way, ect. most of these are free for participants. we get the patent number of technolgies from these websites, match the infomation from the China Patent Database and calculate firms characteristics according to the patents' information. we can therefore investigate the impact of these characteristics on the presence of online markets for technology. After controlling for different other sources of variation,the results illuminate our conjecture about the influence factors that driving firms participate to online marketplaces for technology.

2. Theory and hypotheses

2.1 Online markets for technology

We define online technology markets as virtual marketplaces, which facilitate the listing, search and exchange of knowledge assets[15]. online marketplaces further reduce search costs by offering standardized representation of information. Knowledge available on the websites is codified in a standardized way[16]. And can match disper technology owners and seekers. Extant literature indicates that a growing number of firms that participate in technology licensing have begun to utilize online marketplaces that facilitate trades between buyers and sellers[2]. Online technology market like a technology trading supermarket where can provide diversified services, and can change, accelerate and improve the technological transaction process. At the same time, shorten the cycle of technology transfer.

Online technology markets can accelerate the process of technological transaction and facilitate interactions among strangers without the limitation of time and geography, but some problems must be heeded, when inventors post innovation to online market for techonogy may raise risks of expropriation, so how to get a tradeoff is the key for firms to participate in online market for technology, and we will have this two questions:

(1) how sellers use online technology market to reduce search cost?

(2) how sellers avoid to raise risks of c when posting a technology in online technology market?

2.2 Patent value

The value of innovations is positively correlated with the value of patent rights [17], which can be represented by patent quality [18]. On the basis of the premise that patent quality can be framed in the technological and value dimensions of an innovation, several concepts have been thought to be subsets of patent quality, such as importance, innovativeness, economic value, strength of protection, and technological scope [19, 20]. Among the subsets, scope and importance of patent are highlighted as universal concepts because other concepts are subject to patent citation activities that can be easily biased and distorted[20].

Scope refers to a dimension of the technical space covered by innovation. In patent protected technologies, the larger the scope, the larger the number of potential products that will infringe the patent[21], scope is also shaped by how inventors or their lawyers "design" the patent, that is, by the legal description of the innovation(NeusPalomes,2007). Shane(2001) finds that scope confers an extra protection that is especially valuable to entrepreneurs mean while they acquire the assets needed to develop the technology[22]. Independently of the direction of the causality between broadness and protection, the key is that the stronger legal protection associated with broad innovations is worth while in licensing transactions [23, 24], especially when the risks involved increase.

Importance reflects the extent of the investment of an enterprise. The more resources the enterprise has invested, the more important it is to the enterprise. In order to maintain competitive advantage, enterprises will choose internal commercialization or keep secret from outside. We therefore propose:

Hypothesis 1 There is a negative relationship between the degree of scope and marketing the technology in online technology market.

Hypothesis 2 There is a negative relationship between the degree of importance and marketing the technology in online technology market.

2.3 Social circle

Teece(1997) suggests that a firm gains knowledge transfer capability from its experiences over time[25], and managers often search for information and solutions in familiar territory because they cannot easily comprehend or observe the broader environment[26-28], small firms are inclines to gain benefits in a short-time from their innovations. Survival and the stability, rather than maximizing profits. So if a firm is young and small in size,we think it has less experiences of trading technologies, we thus measure a firm's knowledge transfer capability based on firm age. Teece (1986) and Arora and Ceccagnoli (2006) argue that firms lacking downstream assets for selling their own products (manufacturing, distribution and marketing capabilities) are more likely to license[25, 29], and according Caviggioli and Ughetto (2013)'s questionnaire survey, large firms are revealed to have a particularly negative view of the degree of development of online platforms (73% consider them as not sufficiently developed)[30]. so we use firms' innonvation age (firm age) as a proxy of firm size to verify the influence of firm size on participation in online technology markets.

Maria Garcia(2006) suggests that specialization can facilitate the transfer of knowledge between the core technologies of the firm, and benefit from the technological 'comparative advantages' of the firm. Internal use or easier to trade offline for a high degree of specialization of the firm's technology, and a higher degree of corporate technological diversification is neither completely for internal use, nor timely trade offline in their social circle, so we predict that the higher degree of specialization of the enterprises,the weaker the willing to participate in online technology market, while the higher degree of diversification of enterprise technology, the stronger the willing to participate in online technology market. So we therefore propose:

Hypothesis 3 There is a negative relationship between the degree of firm age and marketing the technology on online technology market.

Hypothesis 4 There is a negative relationship between the degree of specialization and marketing the technology on online technology market.

3. Data and viarables

3.1 Data

First, we identify some leading online marketplaces that were connecting inventors or technology sllers with potencial technology buyers or licensors in China, these marketplaces allow inventors or technology seller listing their technologies including patent number, abstract etc. for free. we collected the patent number using data mining from these websites.

Second, we match the patent information from a secondary patent database which clean up from the patent literature during 1985-2015 from SIPO(China's State Intellectual Property Office) by patent numbers which we collecting above, then we got some patent information such as apply year, grant year, cliam number, inventor number etc, we calculated some indexes through extant information, such as the innovation age, HHI, etc. . and generate a new variable Market equal to 1.

Control groups: we combine apply year, type of the first applicant and the first industry of patent to creat a new variable x in both our sample and the secondary patent database, randomly match control groups according 1:1, 1:3, 1:5 by x, then we got three groups samples, where the variable Public equal to 0. through statistics, we find the apply year centralized in 2008-2014, so we select these patents to emprical study.

We get three sets of data appending the sample group to control groups separately. The respective sample sizes are separately 2295, 4135, 6051.

3.2 Variables

3.2.1dependent variable

We construct a dummy variable market to indicate the option for whether a technology will be marketed to online technology market, the depentent variable market is a dichotomous variable equal to 1 if the patent was marketed to online technology market and 0 if not.

3.2.2 independent variable

We use the number of claims as a proxy for Scope. A greater number of claims indicate that a patent has a broader technological scope [19, 31]. Firms carefully review information on claims when transacting patents for acquisition or licensing[20] as the number of claims is often used to assess economic value. However, the number of claims has to be considered carefully, since some researchers argue that it could indicate the strength of a patent [20]. there is an incentive to claim as broad a technological space as possible[31]. Thus,a larger number of claims may mean that the field is more open or that the technology can make more allegations of protection.

The number of inventors is used as an indicator of Importance. It primarily suggests the extent of resource investment because the number of inventors correlates to the resource inputs for achieving expected outputs during the research and development process. The number of inventors also implies the factors contributing to innovation. Palomeras(2007) postulates that the number of inventors might be related to the characteristics of innovation such as diversity of knowledge sources[19] and complexity of the invention [32]. These meanings of importance can be interpreted in diverse ways owing to the broad use of terminology. In this study, Importance is regarded as the significance of the patented invention or the scale of the research project.

We calculated the firm's innovation age as a proxy for the firm age, the firm's innovation age equals the gap years between first and last patent that the firm applied, because as a firm's innovation age becomes older, it may build up more downstream resources and rely less on licensing as a commercialization strategy.

Specialization is measured by a Herfindahl index of concertration. For each firm its technological portfolio is calculated in the following way, with 99 technological fields indexed by j=1, …, 99, if ith firm has N_i patents in the analysed period, each patent can be assigned to a technological field. Let N_{ij} denote the number of patent that the ith firm holds in category j, such that $\sum_{j=1}^{99} N_{ij} = N_i$. A Herfindahl index of specialization can be obtained for each firm, the value variable specialization is constructed as follows:

$$specialization = \sum_{i=1}^{99} \frac{N_i}{N_{ij}} \qquad (1)$$

Table1 shows that there is no critical correlation between independent variables;thus, a serious multicol linearity problem would not occur.

Table1:Correlations of variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Claim	1								
Inventor	0. 0220	1							
Hhi	-0. 041**	0. 082***	1						
Firm age	0. 453***	0. 0110	-0. 249***	1					
Frm num	0. 411***	-0. 079***	0. 066***	0. 722***	1				
Page	0. 398***	0. 075***	0. 00800	0. 294***	0. 295***	1			
Cortech b5	-0. 410***	0. 0200	0. 051**	-0. 543***	-0. 495***	-0. 240***	1		
Market structure	0. 404***	-0. 059***	0. 00600	0. 558***	0. 685***	0. 305***	-0. 532***	1	
Coapply	0. 221***	0. 046**	-0. 383***	0. 292***	0. 055***	0. 062***	-0. 257***	0. 0230	1

4. Methodology

To adress the driving factors for firms to participate in online technology markets, we estimate the probability of a patent holder participate in online technology markets. in this model, We start by estimating a probit equation for the probability of technology marketed using our full sample of 2295 granted patents applied by firms. We denote marketing the patent in online marketplaces as m, where m=1 for adoption of matketing in online marketplaces, and m=0 for non-adoption of marketing in online marketplaces."X"- patent value, social circle, etc.

$$U_{i1} = \beta_1 X_1 + \varepsilon_{i1} \text{ for adoption and } U_{i0} = \beta_0 X_0 + \varepsilon_{i0} \text{ for non-adoption} \quad (2)$$

only if $U_{i1} > U_{i0}$ will the ith patent adopt the alternative. Thus, for the ith patent, the probability of adoption is denoted as follows:

$$P(1)=P(U_{i1} > U_{i0}) \quad (3)$$

$$P（1）=P(\beta_1 X_1 + \varepsilon_{i1} > \beta_0 X_0 + \varepsilon_{i0}) \quad (4)$$

$$P（1）=P(\varepsilon_{i0} - \varepsilon_{i1} < \beta_1 X_1 - \beta_0 X_0) \quad (5)$$

$$P(1)=P(\varepsilon_i - \beta X_i) \quad (6)$$

$$P(1)= \Phi(\beta X_i) \quad (7)$$

Where Φ(.) denotes the normal cumulative distribution function forε, Xi represents the independent variables that affect whether the technology public in the online technology market, β represents the correlation coefficient of the independent variables, yi represents whether the patent i appears in online technology market. A probit model is based on the normal distribution for ε, thus, the probability of patent i marketing in online marketplaces is given by:

$$\Phi(\beta X_i)=\int_{-\infty}^{\beta X_i} \frac{1}{\sqrt{2\pi}} \exp(\frac{-t^2}{2}) dt \quad (8)$$

The underlying algorithm for probit estimation is examined on STATA 14. In addition, as a robustness test, we also make empirical studies of the other two groups of samples as contrast groups.

5. Results

Table 2 reports regression analysis result, Model 1 is the baseline model, we can learn from the result that claims, invetors, firm age and HHI are all negative and statistically signigicant.

Table 2:Probit regression

Variables	Model1 Public	Model2 Public	Model3 Public
Claim	-0. 0481***(0. 0100)	-0. 0337***(0. 00762)	-0. 0311***(0. 00692)
Inventor	-0. 150***(0. 0141)	-0. 157***(0. 0117)	-0. 151***(0. 0107)
Hhi	-1. 112***(0. 132)	-1. 077***(0. 106)	-1. 017***(0. 0951)
Firm_age	-0. 0542***(0. 0111)	-0. 0590***(0. 00865)	-0. 0521***(0. 00780)
Firm_num	0. 000127***(1. 45e-05)	8. 74e-05***(1. 12e-05)	8. 02e-05***(9. 93e-06)
Page	-0. 0327***(0. 00724)	-0. 0372***(0. 00607)	-0. 0405***(0. 00555)
Market_structure	-1. 637***(0. 612)	-1. 392***(0. 499)	-1. 346***(0. 441)
Coapply	0. 356***(0. 100)	0. 350***(0. 0758)	0. 369***(0. 0676)

Standard errors in parentheses*** p<0. 01, ** p<0. 05, * p<0. 1

First, our model clarifies a potent result that the scope of patent is a reason for firms to attend to online technology market, even though preceding literature have showed that broader scope actually leads to greater financial value, given that the patent to be sold, but before buyers and sellers identify each other. the scope hinders patent supplier to market the patent supporting for hypothesis 1.

As for importance, as the number of inventors increase, the willing to public to online technology market decrease. It illustrates firms are more willing to market the less important innovation in online technology market.

6. Discussion and Conclusion

In this paper, we claim that online technology market is not perfect: it takes great profits as well as challenges. Specifically, we investigate the influence of firms to marekt technology to online technology marekt.we collect patents from online markets for technology and exam the possible reasons.

From our results, patent value is a factor for firms to attend to online market for technology, base on the emprical results of cliams and inventors.if a patent have broader scope, higher economic value and more important for firms, there has a less possible the patent would be publiced on online market for technology to trade. The result illustrates that firms will market technology with low value to online technology market to find buyers while protect high quality technology to reduce risks of expropriation, when sellers find buyers ,further, may intorduce their other innovations which haven't market in onine technology market. Hence,firms can not only protect innovatons but find technology buyers.

Firms' social circle is also a influencing factor to engage in online market for technology, based on the emprical results of firm age and HHI, the older firms are, the more industry concentrate, the less possible for firms would be engage in online market for technology. that is, the smaller the firms' social circle, The less likely it is to participate in the online technology market.

Our study about online markteplaces for technology can help us to expand general understanding of market for technology. our qualitative insights reveal that online marketplaces for technology serve for those low economic value for firms and firms with small social circl, above this, the role of online marketplaces for techonogy in China is a suppulement to the offline or traditional market for technology owing to the function to expand potential buyers and sellers and break the limits of time and geography.

There are some clear limitation and provide abundant opportunity for future research in this paper. first, we explore the patents and firms' characteristics of online market for technology by listing patents number on the websites, however, we have no data concerning which transactions succeed within each of those marketplaces. then, we can't get the date which patents were made marekt to online market for technology

Second, our study just explain the dillemma for sellers to market technolgy to online technology marekt and driver factors for sellers to engage in online markets for technology, while not explain the difference between sellers and buyers to engage to online markets for technology, answering this question would require a more explicit explanation of what the dillemma to buy technology from online technology market for buyers. This research line, however, is left for future research.

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