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# 5. The Perceptual Barriers of Academics' Patenting Intention in Hungary

Sándor Huszár

*The patenting activity of universities has gained an increasing attention in the recent decades. Patenting can foster economic development and facilitates to acquire financial resources from commercialization; however this activity still remained at lower level at universities in Hungary. While academics play an essential role in the patenting process, only a few studies investigated the factors affecting their patenting intention. Therefore we put our research focus on the individual scientists in order to get a better understanding of the main influencing factors that can motivate or hinder academics' patenting intention.*

*In our study we adopted Theory of Planned Behavior (TPB) to investigate the importance of TPB factors and potential perceptual barriers relating to patenting intention. In the TPB model only attitude and social norms towards patenting had relationship with patenting intention while the perceived behavioral control did not. Despite of the small rate of scientists planning to patent, a high proportion of scientists are tend to patent if they got possession of patentable research results. Surprisingly, academics perceive less encouragement to patent from university management than from peers, family members and friends. Building on a qualitative study conducted in 2014 we tested potential perceptual barriers of patenting, but only the preference towards patenting against publication plays important role in the patenting intention.*

*Keywords: university, patenting, TPB model, barriers, academics*

## 1. Introduction

Patents are one of the well-known forms of intellectual property which play an essential role in the economic development. On one hand the scientists are entitled to be designated as an inventor and on the other hand assignees are granted to the exclusive rights for the commercialization of the intellectual property. Although a general increase in university patenting activity took place after the Bayh-Dole Act in the United States (Shane 2004a) and in Europe as well (Geuna – Rossi 2011), the significance of patents remained lower in the university-industry context. In order to broaden our knowledge in university patenting an increasing number (but still a few) of studies has investigated motivations and obstacles of patenting. Potential personal earnings from patenting activity have found to be important in scientists' motivation (D'Este – Perkmann 2011, Lach – Schankerman 2008, Nilsson et al. 2010), but there are opposite evidences as well (Baldini 2007). Lam (2011) found personal economic incentives important only in a small proportion of scientists.

Another motivational factor can be the prestige and reputational gain which play important role in the patenting activity (Baldini 2007; Lam 2011). Furthermore, Baldini (2007) found that scientists are also motivated in patenting if they can access resource for further research activities.

In contrary to the motivations there are obstacles which can pull back scientists from patenting. Davis et al. (2011) found that a significant proportion of scientists are skeptical about the positive effects of patenting activity. These results raise a question how to motivate scientists to engage in patenting if they perceive more disadvantages than benefits. In a comparison of the most common knowledge transfer channels, both academics and industrial actors perceive patents as a less important knowledge transfer channel (Agrawal – Henderson 2002, Cohen et al. 2002), but little is known about the disadvantages. The effect of patenting activity on knowledge sharing varies by scientific fields, but in some cases too much patenting can divert scientists from other knowledge transfer channels (Crespi et al. 2011). Furthermore, licensing patents do not substitute the personal (face-to-face) contact and do not accompany with the transfer of tacit knowledge for successful knowledge transfer (Schartinger et al. 2002), however the importance of scientists' tacit knowledge and attitudes in the commercialization process is high (Wu et al. 2015, Shane 2004b). Universities can foster the patenting activity, e.g. establishing university regulations which may reduce the obstacles or express commitment for patenting (Baldini 2007), but at the same time D'Este and Perkmann (2011) emphasize that university regulations should consider other factors than focusing only on financial incentives.

Despite of the increasing attention of the topic there is a lack of studies investigating scientists' patenting intention in Hungary. We should broaden our scope to entrepreneurship to find any results of recent studies. Novonty (2013) revealed that the time spent on applied research and development, the entrepreneurial spirit of the department and the industrial relations play important role in scientists' involvement in technology transfer. These factors can have impact on patenting as well. In another study focusing on obstacles of spin-off creation Buzás (2004) concluded that the lack of motivation, the lack of competence and the lack of confidence from industrial partners reduce the scientists' entrepreneurial intentions. However spin-off creation and patenting are different form of research commercialization, the results of previous studies can contribute to the better understanding of drawbacks in Hungary.

As previous studies revealed, there are benefits and disadvantages of patenting (or any form of commercializing research results) which can highly influence scientists' decision.

Therefore we put our research focus on academics that play important role in the patenting process. Even at those universities, where patenting activity and technology transfer mechanisms are more developed (like MIT), patent disclosure usually happens only if the scientist want to patent his research results (Shane 2004).

## 2. Theoretical framing

We adopt Theory of Planned Behavior (TPB model) to determine influencing factors of patenting which has been extended the scope with the potential perceptual barriers. In our model we suppose that the influencing factors of the TPB model and the potential perceptual barriers can stimulate or pull back scientists from patenting.

### *2.1. Theory of Planned Behavior*

The Theory of Planned Behavior is widely used as a theoretical framework for predicting intentions in psychology and also in the commercialization of university scientific results, mainly in entrepreneurship (Goethner et al. 2012, Kautonen et al. 2011, Krueger − Carsrud 1993, Küttim et al. 2014, Yurtkoru et al. 2014). The theory supposes that the intention towards certain behavior (intention) is affected by the attitudes, social norms and perceived behavioral control related to the given behavior.

The model also measures the linkage between the intention and the behavior[3] as well (Ajzen 1991). The theory allows researchers to measure the relationships and to determine the most influential factors within the model.

The theory has gained an increasing attention in the commercialization of university research results, but the above mentioned studies were focusing rather on entrepreneurial intentions. On the contrary, we brought in focus patenting intentions.

[3] In our study we do not investigate the relationship between patenting intention and patenting (as behavior) because we did not conduct research on behavior due to the time constraints. According to the theory, we should carry out a second survey on the behavior which investigate whether the intention transformed or not into behavior. Due to the long time length of patenting, we should wait for at least 1 year between the two surveys. Thus, in our study suppose that patenting intention triggers behavior.

### *2.2. Potential perceptual barriers*

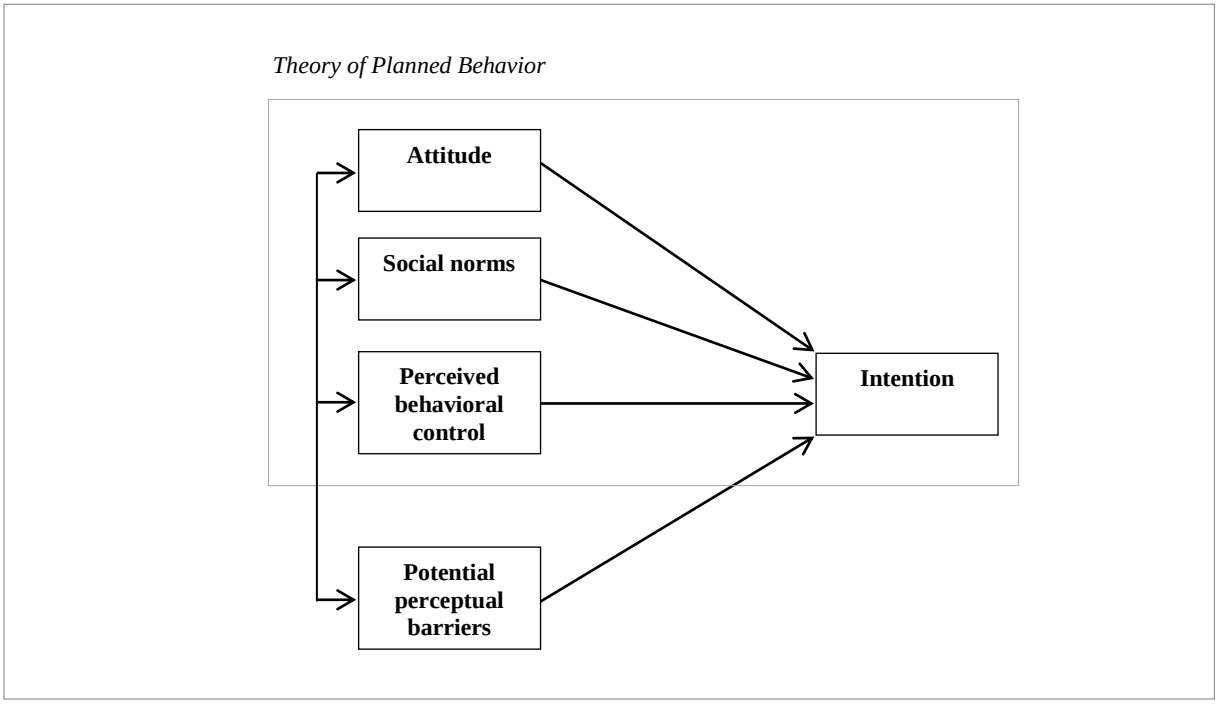
The above mentioned recent studies have revealed some hindering factors which may keep researchers away from patenting activity. In 2014, we carried out 21 semi-structured individual interviews[4] at scientifically respected universities in Hungary in order to better understand scientists' attitudes towards patenting and highlight contextual characteristics of patents between the university and industry. This study allowed us to investigate the role of potential hindering factors determined by other studies, and implement them into the Hungarian context (Huszár et al. 2014). In this research academics stated that (1) commercialization activity of university patents usually does not overweight the expenditures of patenting which raise a fundamental question from the economic point of view. A significant proportion of researchers claimed that, (2) most of the university patents do not provide appropriate solution for potential industrial partners, because real industrial needs are usually not taken into consideration during the research projects or cannot be recognized by the academics. (3) The characteristics of patenting differ from the norms of open science, while engaging in patenting can cause role identity modification problems among academics which is consistent with Jain et al. (2009). (4) Although the available EU and state funded programs fostering technology transfer activities increased the academic patenting activity but also had negative effect on the perception of university patents. Finally, our results also pointed out that (5) scientists' involvement in the commercialization of patents is necessary which emphasizes the importance of scientists' tacit knowledge gained during the development of invention.

### *2.3. Building a conceptual model*

Following Ajzen's (1991) presumptions, attitudes, social norms and perceived behavioral control influence scientists' patenting intention. We extend this model with potential perceptual barriers determined by recent studies (Figure 1). We suppose that, these factors can pull back scientists from patenting. This model allows us to test the reliability of Ajzen's model in patenting intention and investigate the potential barriers.

[4] The results of 14 individual interviews were presented in a conference in Barcelona. In order to gain more experience the study was extended with 7 academics to 21.

*Figure 1* Conceptual model




*Source*: own construction

The present study was carried out among academics at four universities in Hungary in order to determine the potential barriers of university patenting[5].

### *3.1. Measurement*

In the theory of planned behavior we measured attitudes[6], social norms, perceived behavioral control and intention with 5-point-likert scales ranged from -2: „not agree at all" to 2: „fully agree", where respondents had to mark whether they agree or not with the statements. The variables were created based on a Guide Book focusing on building questionnaire for TPB models[7] and from the results of our qualitative study (Huszár et al. 2014).

Regarding the potential perceptual barriers, we let researchers to decide whether the given statement has positive or negative direction. We measured these statements also with 5-

[5] The pilot study allows us to test our presumptions and determine unforeseen errors before extending the survey to other Hungarian universities.

[6] Attitudes were measured by 3 statements, which were focused on the 3 components of attitude (affective component, behavioral component and cognitive component).

[7] See Francis, J. J. – Eccles, M. P. – Johnston, M. – Walker, A. – Grimshaw, J. – Foy, R. – Kaner, E. F. S. – Smith, L. – Bonetti, D. (2004): *Constructing questionnaires based on the Theory of Planned Behaviour.* Centre for Health Services Research, University of Newcastle.

point-likert scales ranged from -2 to 2, but with different endings of the statements at the endpoints (e.g. „Patenting is ..., than publication." The two endpoints of the scale: more important and less important). The variables were constructed based on our qualitative study (Huszár et al. 2014).

### *3.2. Hypotheses*

During the pilot study we test two hypotheses related to the patenting intention of academics. Taking the psychological assumptions of Ajzen (1991), we suppose that attitudes, social norms and perceived behavioral control play important role in the patenting intention.
Hypothesis 1: Attitudes, social norms and perceived behavioral control towards patenting play important role in the patenting intention.

Based on the results of previous studies and our qualitative research we investigate the relationship of potential perceptual barriers and patenting intention. We suppose that the potential perceptual barriers can pull back scientists from patenting.
Hypothesis 2: The potential perceptual barriers play important role in scientists' patenting intention.

### *3.3. The sample*

The e-mail addresses of academics were collected from the relevant departments' websites. Two principals were taken into consideration during the data collection process. Firstly, the scientific field represented at the department must be relevant to patenting[8] which means that the departments were distinguished whether the scientific field represented at the department are relevant to patenting (e.g. chemistry, engineering, biology, etc.) or not (e.g. literature, history, etc.). Secondly, the personnel listed on the websites must be relevant to research activity[9], others were excluded (e.g. assistants, technical staff, administrators, etc.). Finally, 3.993 relevant e-mail addresses have been collected. Due to time constraints we could receive responses between 26 February 2015 – 20 April 2015. During this period 154

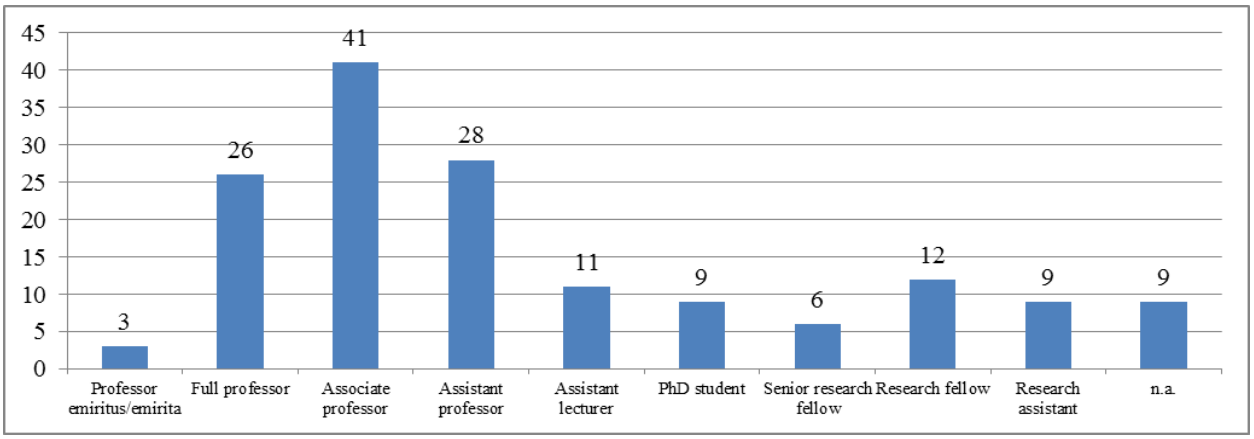
[8] There are scientific fields which support patenting activity, but some scientific fields do not allow patenting due to the strict criteria of intellectual properties. Therefore only those departments are represented in this study which is related to engineering, natural sciences and life sciences.

[9] We have sent our questionnaire only to those academics, who held one of the following positions: full professor, associate professor, assistant professor, assistant lecturer, PhD student; or who held research related position (e.g. research fellow or head of research) according to the website.

respondents took part in the survey (response rate: 3.86%). The data was collected by the EVASYS web-based survey system.

About one-fourth of the researchers are associate professors in our sample and the share of full professors and assistant professors are also notable (Figure 2). These three groups represent the two-third of the respondents.

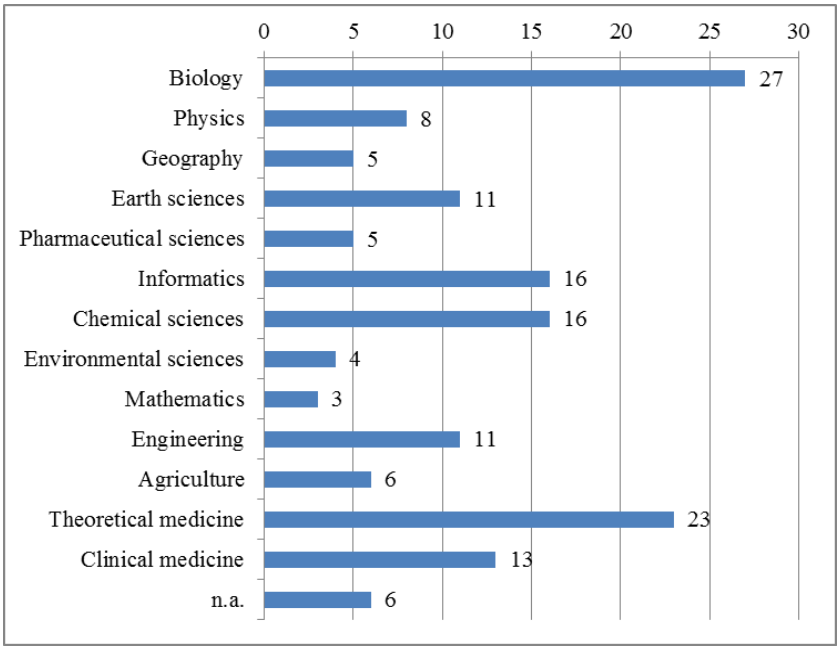
*Figure 2* Positions held by the researchers




*Source:* own construction

Regarding the represented disciplines, researchers relating to biology, medicine (theoretical and clinical), informatics and chemical sciences dominate in the sample (Figure 3). These 5 of 13 scientific disciplines represent the 62% of the sample.

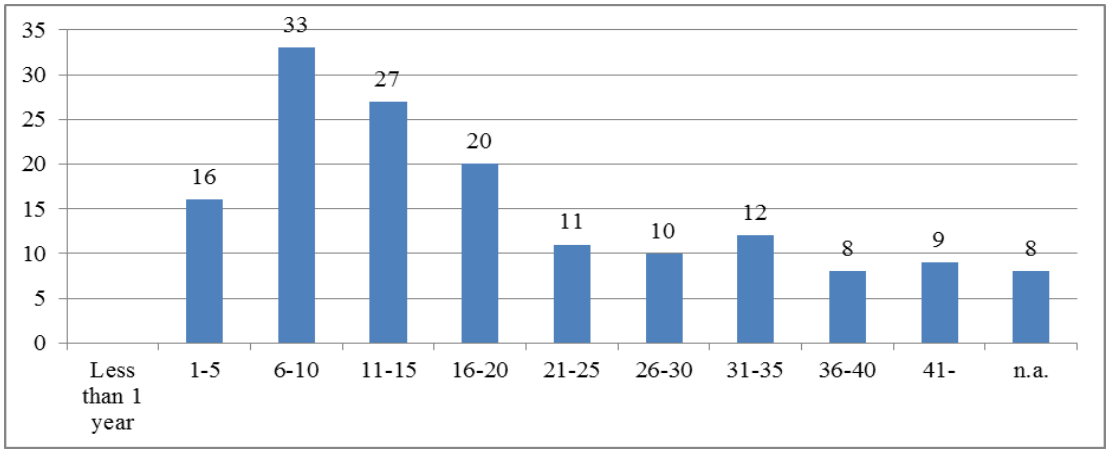
*Figure 3* Represented disciplines




*Source:* own construction

One-third of the respondents have spent more than 20 years in research activity, one-third of them have spent 11-20 years and the rest deals with research activity for less than 10 years. From this point of view our sample consists of researchers with significant research experiences (Figure 4).

*Figure 4* Scientists' experience in research activity (in years)




*Source:* own construction

In our sample only 22 researchers (14,3%) stated that he possess at least one patent that have been already successfully commercialized, while 27 researchers have already patented, but those patents were not commercialized yet (Table 1). Furthermore, two-third of the scientists have never patented any research result.

*Table 1* Patenting activity of researchers

| | **Never commercialized patents** | **Successfully commercialized at least one patent** | **Total** |
|---|---|---|---|
| Never patented | 104 | - | 104 |
| Already patented | 27 | 22 | 49 |
| Total | 131 | 22 | 153 |

*Note:* 1 respondent did not give answer
*Source:* own construction

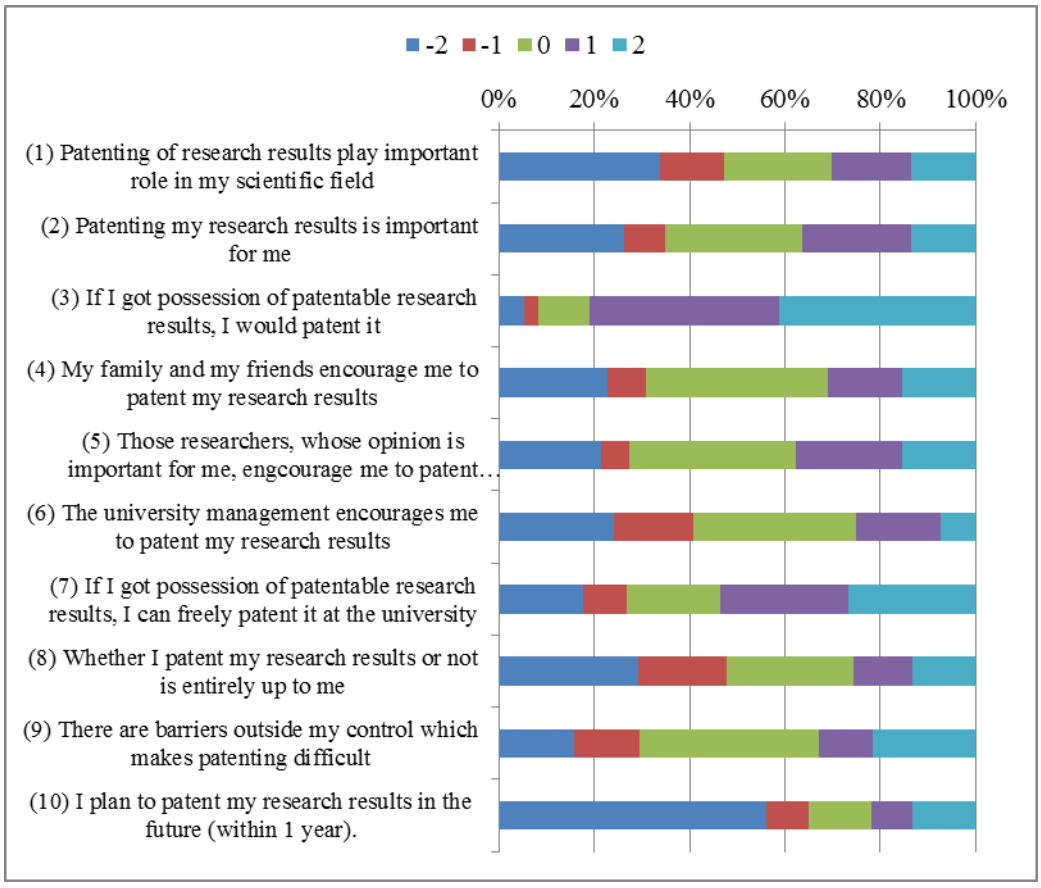
## 4. Research results

In this section we demonstrate the results of our survey conducted at four Hungarian universities. Firstly, we summarize the general opinion of researchers about patenting and issues relating to patenting activity. Secondly, we investigate the relationship of patenting intention with the TPB factors and potential perceptual barriers.

### *4.1. Descriptive statistics*

In our model, the attitude [(1), (2), (3)], social norms [(4), (5), (6)] and perceived behavioral control [(7), (8), (9)[10]] were measured with 3-3 different variables (Figure 5). Regarding the attitude, we wanted to investigate the general opinion of researchers relating to patenting activity which consists of the affective, behavioral and cognitive components of attitude. The variables of social norms focused on the influence of family members, friends, peers and the university management, because scientists may perceive differently their encouragement. Furthermore we collected answers about how much control the researchers perceive over patenting scientific results at universities. Finally, we measure patenting intention in our model with the following statement: (10) „I plan to patent my research results in the future (within 1 year)". This statement plays a central role in this model, because we investigate the relationships of all variables with the patenting intention.

*Figure 5* Distribution of answers relating to the TPB model




*Source:* own construction

[10] This item has a negative endpoint, thus the values were computed into a reverse order in the analysis.

According to the researchers, about one-third of the respondents stated that patenting is important in his scientific field (30%) and patenting is important for him (37%). However a significant proportion of scientists (81%) are tend to patent his research results if they got possession of patentable research results. While patenting of research results is not important for all researchers in general, they expressed a quite positive opinion in case of getting possession of patentable results. Regarding the social norms, about one-third of the researchers receive encouragement from family, friends (31%) and peers (38%), while only one-fourth (25%) of the researchers perceive any encouragement from university management. We can suggest that, family and close friends could play more important role in the decision of patenting or not, than the university management. While about half of the researchers (53%) think that, they can freely patent research results at the university, only 26% of the respondents perceive the control about the process. Despite of the general positive attitude relating to the willingness to patent research results, if the researchers got possession of it, only 22% of the researchers plan to patent research results within 1 year.

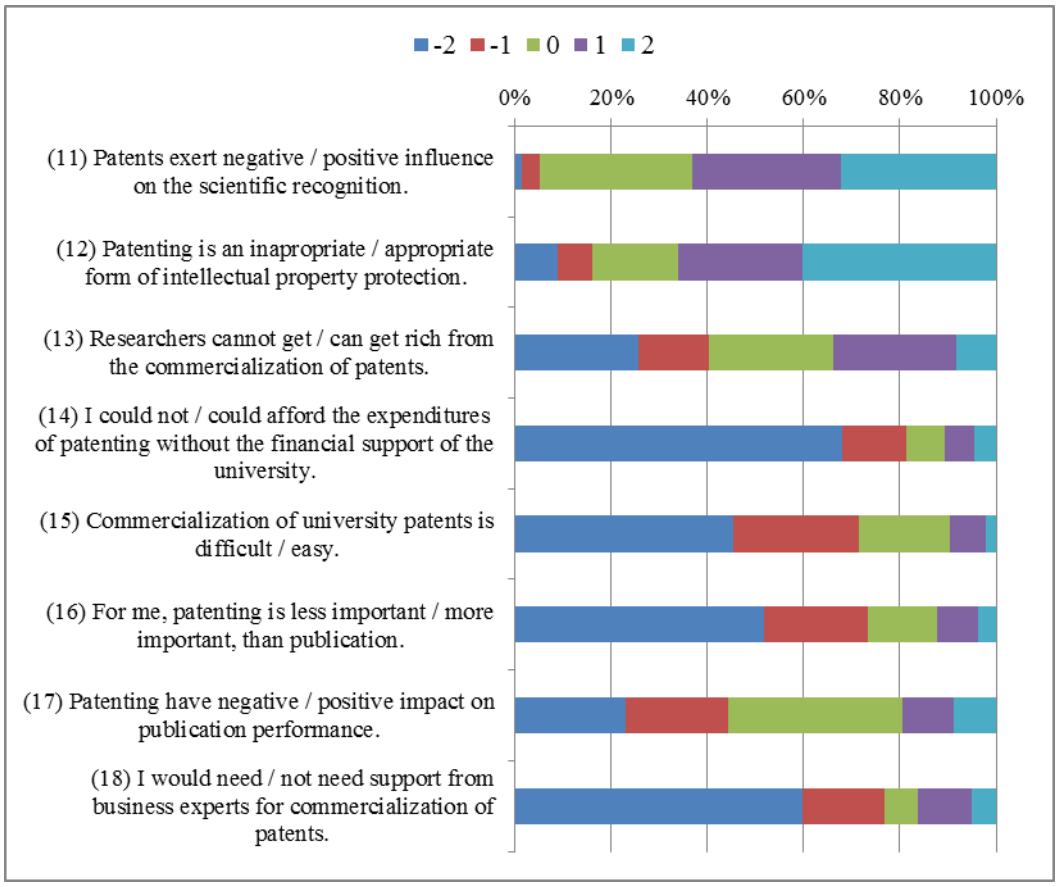
Summarizing the results, we can conclude that, about one-third of the researchers expressed positive attitude towards patenting research results, but 81% of them are tend to patent their research results. Despite of this positive attitude, only 22% of them plan to patent within 1 year, that could be explained by ineffective encouragement or most of the research results are not patentable according to the respondents.

In previous year 21 semi-structured individual interviews have been conducted in Hungary in order to investigate the potential incentives and barriers of patenting. During the qualitative research we determined some factors that could influence patenting intention. To let researchers to decide whether the investigated factors have a positive or negative direction, the endpoints of the Likert scales represented positive and negative opinions as semantic differential scales (Figure 6).

Although two-third of the researchers believe that patents exert positive influence on their scientific recognition (63%) and patenting is an appropriate form of intellectual property protection (66%), the results of other variables suggest presume difficulties relating to patenting and its successful commercialization. 40% of the researchers do not believe that commercialization of patents can yield significant personal income. About four-fifth of the respondents would need support (financial (81%) and business expertise (77%)) from the university to patent research results while only 9% of them believe that commercialization of university patents is easy. A small proportion of scientists (12%) consider patents more

important than publication, and about half of them (44%) associate patenting with negative influence on their publication performance.

*Figure 6* Distribution of answers relating to potential perceptual barriers




*Source:* own construction

The results suggest that the large proportion of researchers expressed negative opinion about patenting and its impact on publication. Although the researchers are tend to patent research results (as we have seen previously), neither the appropriate business expertise nor the necessary financial resources are available without the support of the university.

### *4.2. Relationships within the model*

In the previous section we have seen the distribution of answers, now our aim is to investigate the relationship of patenting intention with TPB factors and potential perceptual barriers. Following the presumptions of the Theory of Planned Behavior, we will also test the internal consistency of the predefined constructs.

As Appendix 2 shows that all variables of the attitude factor [(1), (2), (3)] have significant relationship with the patenting intention. Among these variables, those researchers are tending to patent, who consider patenting important. Regarding the social norms factor, all groups play important role in encouragement, but university management (6) has less significant relationship with patenting intention, than family and friends (4) and peers (5). While the variables of previous factors have been proven important in this model, the items of perceived behavioral control [(7), (8), (9)] seems insignificant in this context.

We further our investigation and attempt to create the constructs predefined by the Theory of Planned Behavior. According to the reliability statistics attitude (Cronbach's alpha: 0,755), social norms (Cronbach's alpha: 0,779) and perceived behavioral control (Cronbach's alpha: 0,599) can be created from the variables as we supposed earlier. While the attitude (Pearson correlation: 0,558**) and social norms (Pearson correlation: 0,472**) factors are still playing important role in patenting intention, the perceived behavioral control (Pearson correlation: -0,031) does not (Table 2). This result is assumable, because none of those items [(7), (8), (9)] had significant relationship with the patenting intention.

*Table 2* Correlations

| | | Attitude | Social norms | Perceived behavioral control | I plan to patent my research results in the future (within 1 year). |
|---|---|---|---|---|---|
| Attitude | Pearson Correlation | 1 | | | |
| | Sig. (2-tailed) | | | | |
| | N | 121 | | | |
| Social norms | Pearson Correlation | ,661** | 1 | | |
| | Sig. (2-tailed) | ,000 | | | |
| | N | 98 | 104 | | |
| Perceived behavioral control | Pearson Correlation | ,164 | ,322** | 1 | |
| | Sig. (2-tailed) | ,157 | ,006 | | |
| | N | 76 | 72 | 79 | |
| I plan to patent my research results in the future (within 1 year). | Pearson Correlation | ,558** | ,472** | -,031 | 1 |
| | Sig. (2-tailed) | ,000 | ,000 | ,793 | |
| | N | 105 | 94 | 73 | 114 |

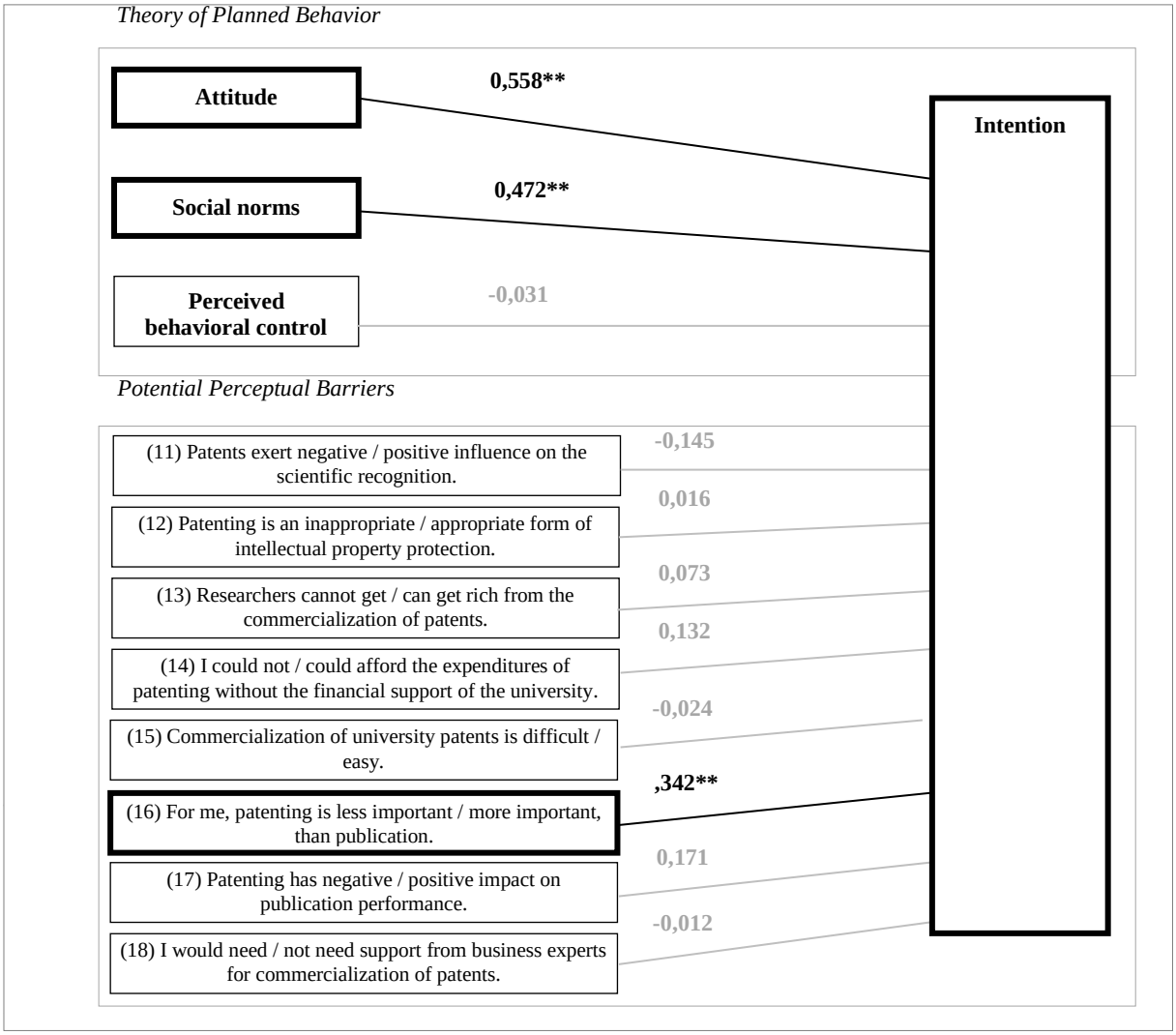
**. Correlation is significant at the 0.01 level (2-tailed).

*Source:* own calculation

We investigated the relationships among the potential perceptual barriers and the patenting intention as well (Figure 7). Unfortunately none of the variables have been proven significant in our model except only one (16). According to the results we can suppose that only those researchers plan to patent their scientific results, who consider patenting more important than publication. These results raise the question of why the other variables do not prove our presumptions. Regarding the effects of patenting on scientific recognition (11) and publication performance (17) may be perceived differently among academics and these beliefs

are not crucial in this context. Whether patenting is an appropriate or inappropriate form of intellectual property (12), it can differ by disciplines but this variable does not seem to be a fundamental factor. There are researchers who do not patent, but think commercialization of patent can provide significant personal income, and vice versa (13). This somehow relating to the motivations as well, so we cannot say that expected financial gain (getting rich) motivate scientists in patenting, there should be other motivations. In addition neither the financial background (14) nor the business expertise (18) possessed by the researcher has significant relationship with patenting intention. Finally, the researchers also not consider the difficulty of commercializing university patents (15) in patenting decision. We can assume that there should be other factors influencing researchers in patenting, because most of the variables specified during our qualitative study have not been proven determining in this quantitative survey.

*Figure 7* Model of the patenting intentions




*Source:* own calculation

## 5. Conclusions

We conducted this survey to determine the influencing factors of patenting intention. Building on Ajzen's (1991) theory, we can conclude that the most important factors of patenting are the patenting attitude and social norms. These factors have the strongest relationship with patenting intention[11]. In this study peers encouragement has been proven important in patenting intention. This result is also supported by Novotny (2013) who found relationship between the entrepreneurial spirit of the department and technology transfer activity. Other studies found university's role determining in patenting (Baldini 2007) which is supported by our study as well, but in our model the role of university is lower than the other groups. Regarding the third factor of the TPB model, the perceived behavioral control did not have relationship with the patenting intention. This result can be explained by that researchers are usually not aware of that in what conditions they can patent their scientific results. This can vary among academics because some of them think that patenting decision is entirely up to the inventor. But this is partly true, at most universities technology transfer offices (or similar subunits with same functions) make final decision after disclosure whether to patent or not. This can be confusing and probably not all of the respondents were aware of the regulations.

In our survey we investigated potential perceptual barriers which could determine in patenting intention. Firstly, we assumed that if the patenting activity has positive impact on scientific activity (scientific recognition, publication performance), the scientists are tend to patent their research results. It also means that researchers could gain reputational rewards through patenting which is consistent with recent studies (Baldini 2007; Lam 2011), but negative impact of patenting could pull back scientists if scientific career progress play more important role in their motivation. Secondly, the easier the commercialization of university patents and getting rich, the higher the propensity of patenting intention. In this case the higher commercial potential of university patents can trigger academics' motivation to patent. The relevance of the commercial potential has gained attention in the science to business marketing as well (Prónay − Buzás 2013). However the academics do not believe in commercial potential of patents, they can have less motivation in patenting according to recent studies on faculty motivation (D'Este – Perkmann 2011, Lach – Schankerman 2008, Nilsson et al. 2010). Finally, we assumed that researcher's capability (including financial and

[11] Due to the time constraints, unfortunately we could not conduct the survey on the behavior. In this study we suppose the strong relationship between the intention and behavior.

business expertise) can influence patenting activity positively. In parallel, Buzás (2004) also found the lack of competence as a barrier for entrepreneurship in Hungary. Despite of the results of previous studies, we did not find significant relationship of the above mentioned potential perceptual barriers with patenting intention.

In this study we did not investigated control variables, but the academics' beliefs may differ by positions, institutions and/or disciplines. We should also investigate the effect of patenting experience, because those scientists who have already gained experience, they may have different opinion, moreover the inventors of successfully commercialized patents evaluate differently patenting as those inventors whose patents were not attractive to industrial partners. These possibly explanations are still presumptions; we still have to investigate their effect in more detail.

*Acknowledgement*

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*Appendix 1* Frequencies of answers

| | -2 | -1 | 0 | 1 | 2 | N (valid) | Missing |
|---|---|---|---|---|---|---|---|
| ***Items of Theory of Planned Behavior*** | | | | | | | |
| Patenting of research results play important role in my scientific field. | 45 | 18 | 30 | 22 | 18 | 133 | 21 |
| Patenting my research results is important for me. | 33 | 11 | 36 | 29 | 17 | 126 | 28 |
| If I got possession of patentable research results, I would patent it. | 7 | 4 | 14 | 52 | 54 | 131 | 23 |
| My family and my friends encourage me to patent my research results. | 25 | 9 | 42 | 17 | 17 | 110 | 44 |
| Those researchers, whose opinion is important for me, engcourage me to patent my research results. | 25 | 7 | 41 | 26 | 18 | 117 | 37 |
| The university management encourages me to patent my research results. | 29 | 20 | 41 | 21 | 9 | 120 | 34 |
| If I got possession of patentable research results, I can freely patent it at the university. | 18 | 9 | 20 | 27 | 27 | 101 | 53 |
| Whether I patent my research results or not is entirely up to me. | 33 | 21 | 30 | 14 | 15 | 113 | 41 |
| There are barriers outside my control which makes patenting difficult. | 14 | 12 | 33 | 10 | 19 | 88 | 66 |
| I plan to patent my research results in the future (within 1 year). | 64 | 10 | 15 | 10 | 15 | 114 | 40 |
| ***Potential perceptual barriers*** | | | | | | | |
| Patents exert *negative* / *positive* influence on the scientific recognition. | 2 | 5 | 42 | 41 | 43 | 133 | 21 |
| Patenting is an *inappropriate* / *appropriate* form of intellectual property protection. | 11 | 9 | 22 | 32 | 50 | 124 | 30 |
| Researchers *cannot get* / *can get* rich from the commercialization of patents. | 28 | 16 | 28 | 28 | 9 | 109 | 45 |
| I *could not* / *could* afford the expenditures of patenting without the financial support of the university. | 77 | 15 | 9 | 7 | 5 | 113 | 41 |
| Commercialization of university patents is *difficult* / *easy*. | 43 | 25 | 18 | 7 | 2 | 95 | 59 |
| For me, patenting is *less important* / *more important*, than publication. | 68 | 28 | 19 | 11 | 5 | 131 | 23 |
| Patenting have *negative* / *positive* impact on publication performance. | 26 | 24 | 41 | 12 | 10 | 113 | 41 |
| I would *need* / *not need* support from business experts for commercialization of patents. | 70 | 20 | 8 | 13 | 6 | 117 | 37 |

*Source:* own construction

*Appendix 2* Correlations in the TPB model

| | | (01) | (02) | (03) | (04) | (05) | (06) | (07) | (08) | (09) | (10) Patenting intention |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (01) Patenting of research results play important role in my scientific field. | Pearson Correlation | 1 | | | | | | | | | |
| | Sig. (2-tailed) | | | | | | | | | | |
| | N | 133 | | | | | | | | | |
| (02) Patenting my research results is important for me. | Pearson Correlation | ,741** | 1 | | | | | | | | |
| | Sig. (2-tailed) | ,000 | | | | | | | | | |
| | N | 124 | 126 | | | | | | | | |
| (03) If I got possession of patentable research results, I would patent it. | Pearson Correlation | ,338** | ,424** | 1 | | | | | | | |
| | Sig. (2-tailed) | ,000 | ,000 | | | | | | | | |
| | N | 129 | 122 | 131 | | | | | | | |
| (04) My family and my friends encourage me to patent my research results. | Pearson Correlation | ,438** | ,561** | ,492** | 1 | | | | | | |
| | Sig. (2-tailed) | ,000 | ,000 | ,000 | | | | | | | |
| | N | 108 | 106 | 109 | 110 | | | | | | |
| (05) Those researchers, whose opinion is important for me, engcourage me to patent my research results. | Pearson Correlation | ,438** | ,585** | ,406** | ,796** | 1 | | | | | |
| | Sig. (2-tailed) | ,000 | ,000 | ,000 | ,000 | | | | | | |
| | N | 114 | 112 | 115 | 108 | 117 | | | | | |
| (06) The university management encourages me to patent my research results. | Pearson Correlation | ,381** | ,319** | ,223* | ,306** | ,481** | 1 | | | | |
| | Sig. (2-tailed) | ,000 | ,001 | ,015 | ,001 | ,000 | | | | | |
| | N | 117 | 113 | 118 | 105 | 113 | 120 | | | | |
| (07) If I got possession of patentable research results, I can freely patent it at the university. | Pearson Correlation | ,236* | ,248* | ,308** | ,147 | ,315** | ,654** | 1 | | | |
| | Sig. (2-tailed) | ,019 | ,015 | ,002 | ,167 | ,002 | ,000 | | | | |
| | N | 98 | 96 | 100 | 90 | 95 | 98 | 101 | | | |
| (08) Whether I patent my research results or not is entirely up to me. | Pearson Correlation | ,053 | -,030 | -,152 | -,116 | -,116 | ,098 | ,272** | 1 | | |
| | Sig. (2-tailed) | ,585 | ,755 | ,114 | ,251 | ,233 | ,316 | ,007 | | | |
| | N | 110 | 109 | 110 | 99 | 107 | 107 | 96 | 113 | | |
| (09) There are barriers outside my control which makes patenting difficult. | Pearson Correlation | -,051 | -,010 | -,052 | ,033 | ,113 | ,249* | ,298** | ,343** | 1 | |
| | Sig. (2-tailed) | ,640 | ,929 | ,634 | ,774 | ,309 | ,022 | ,008 | ,001 | | |
| | N | 86 | 86 | 85 | 80 | 83 | 84 | 79 | 87 | 88 | |
| (10) Patenting intention (I plan to patent my research results in the future (within 1 year).) | Pearson Correlation | ,475** | ,581** | ,321** | ,477** | ,417** | ,206* | ,079 | -,094 | -,099 | 1 |
| | Sig. (2-tailed) | ,000 | ,000 | ,001 | ,000 | ,000 | ,034 | ,458 | ,349 | ,384 | |
| | N | 111 | 108 | 111 | 98 | 104 | 106 | 90 | 102 | 80 | 114 |

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

*Source:* own calculation

*Appendix 3* Correlations among the perceptual barriers

| | | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (10) Patenting intention |
|---|---|---|---|---|---|---|---|---|---|---|
| (11) Patents exert ***negative*** / ***positive*** influence on the scientific recognition. | Pearson Correlation | 1 | | | | | | | | |
| | Sig. (2-tailed) | | | | | | | | | |
| | N | 133 | | | | | | | | |
| (12) Patenting is an ***inapropriate*** / ***appropriate*** form of intellectual property protection. | Pearson Correlation | ,284** | 1 | | | | | | | |
| | Sig. (2-tailed) | ,002 | | | | | | | | |
| | N | 118 | 124 | | | | | | | |
| (13) Researchers ***cannot get*** / ***can get*** rich from the commercialization of patents. | Pearson Correlation | ,173 | ,285** | 1 | | | | | | |
| | Sig. (2-tailed) | ,075 | ,004 | | | | | | | |
| | N | 107 | 103 | 109 | | | | | | |
| (14) I ***could not*** / ***could*** afford the expenditures of patenting without the financial support of the university. | Pearson Correlation | -,015 | ,034 | ,318** | 1 | | | | | |
| | Sig. (2-tailed) | ,875 | ,731 | ,001 | | | | | | |
| | N | 109 | 103 | 98 | 113 | | | | | |
| (15) Commercialization of university patents is ***difficult*** / ***easy***. | Pearson Correlation | ,179 | ,214* | ,497** | ,494** | 1 | | | | |
| | Sig. (2-tailed) | ,085 | ,044 | ,000 | ,000 | | | | | |
| | N | 94 | 89 | 89 | 90 | 95 | | | | |
| (16) For me, patenting is ***less important*** / ***more important***, than publication. | Pearson Correlation | ,098 | ,104 | ,266** | ,173 | ,217* | 1 | | | |
| | Sig. (2-tailed) | ,278 | ,264 | ,006 | ,069 | ,038 | | | | |
| | N | 125 | 118 | 105 | 111 | 92 | 131 | | | |
| (17) Patenting have ***negative*** / ***positive*** impact on publication performance. | Pearson Correlation | ,313** | ,249* | ,081 | ,071 | ,177 | ,418** | 1 | | |
| | Sig. (2-tailed) | ,001 | ,011 | ,429 | ,480 | ,100 | ,000 | | | |
| | N | 111 | 104 | 98 | 100 | 87 | 110 | 113 | | |
| (18) I would ***need*** / ***not need*** support from business experts for commercialization of patents. | Pearson Correlation | ,105 | ,105 | ,086 | ,250** | ,286** | ,114 | ,139 | 1 | |
| | Sig. (2-tailed) | ,269 | ,286 | ,397 | ,010 | ,007 | ,229 | ,164 | | |
| | N | 113 | 106 | 100 | 105 | 89 | 114 | 102 | 117 | |
| (10) Patenting intention (I plan to patent my research results in the future (within 1 year)) | Pearson Correlation | -,145 | ,016 | ,073 | ,132 | -,024 | ,342** | ,171 | -,012 | 1 |
| | Sig. (2-tailed) | ,132 | ,878 | ,490 | ,202 | ,831 | ,000 | ,100 | ,910 | |
| | N | 109 | 99 | 91 | 95 | 81 | 106 | 94 | 97 | 114 |

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

*Source*: own calculation.