The Analysis of the Innovation Potential of the Czech Higher Education: An Application of Porter's Model of Competitive Advantage

Anna Vitásková & Josef Jukl

Abstract. A successful knowledge-driven society is based on its ability to produce knowledge and innovation through a maximal utilization of disembodied human capital. In this sense, all major public institutions of higher education are expected to play a key role. Yet, when we examine the extent in which the Czech system of higher education develops and supports a high level of disembodied forms of human capital, several issues raise immediately. First, despite many governmental efforts, the Czech system of higher education still belongs among the so-called post-Soviet model of higher education that tends to be a hindrance to the effective production of knowledge. Second, a little evidence is available on the university research production and its impact on innovation potential of the Czech Republic. Therefore, the purpose of this research paper is to examine the effects of university research on the overall innovation potential of the Czech Republic.

Keywords: bibliometrics, citation impact, Czech system of higher education, disembodied human capital, innovation potential, university-industry collaboration

Introduction

Let us start by stating the obvious: maximal utilization of "disembodied human capital" (Romer, 1994) is one of the major prerequisites for the development of innovation potential of a society (see for example, Lundvall, 1992; OECD, 1999; Rebelo, 1998; Romer, 1994; World Bank, 2002). Innovation potential can be broadly defined as having the ability and capacity "to manage knowledge creatively in response to market-articulated demands and other societal needs" (OECD, 1999, p. 9). Disembodied human capital refers to the stocks of economically and socially useful knowledge that does not reside specifically in trained individuals, but instead exists indepedently of the individuals who created it. In this context, a research-intensive and competitive knowledge society expects its national systems of higher education to produce world-class research leading to the continuous ability of a nation to compete[1] on international markets.

The Czech Republic, which at one point was widely praised in the West for a relatively smooth transition from communism to capitalism, has been considered one of the few post-socialist European countries with the best growth and innovation prospects (OECD, 2000). Yet, according to the renowned Global Competitiveness Report, the Czech Republic's overall growth competitiveness ranking has declined steadily from 31st place in 2000 to 37th place in 2003 (World Economic Forum, 2004). This report also includes the ranking of innovation growth and innovation potential; the Czech Republic ranks on 40th place in the former and on 45th place in the latter (Table 1).

Table 1: Innovation Growth and Innovation Potential Index

Countries	Innovation Growth		Innovation Potential	
	2003	2004	trend	2004
USA	2	2	↔	1

Finland	1	1	↔	3
Estonia	22	20	+	26
Hungary	33	39	-	38
Lithuania	40	36	+	30
Czech Republic	39	40	-	45

Source: The Global Competitiveness Report 2004-2005

The fact that the Czech Republic scores approximately in the middle of the ranking might not seem as alarming unless we put it in the comparative context and discover that countries, which traditionally used to score lower than the Czech Republic, such as Poland, Estonia, Hungary, Lithuania, are now scoring higher than the Czech Republic.

One of the major causes of the decline in the innovation potential of the Czech Republic repeatedly points towards the low productivity and effectivity of higher education system, especially in the arena of research (see for example, Kaderabkova, 2004; Komarek, 2005; Vysoka-Vitaskova, 2004). Having said that, a fundamental question pertaining to the Czech higher education arises immediately: To what extent, this system develops high level of disembodied human capital? Or in other words, what is the impact of research activities of Czech universities on innovation potential?

In order to answer these questions and to analyze the role of the Czech higher education in building innovation potential, we selected Porter's "diamond" model of competitive advantage as our guiding theoretical lens. Thus, in this paper, we first examine Porter's four factors influencing competitive advantage in the sector of Czech higher education. Then, we detail and describe our research methodology as well as sources of data. And finally, we discuss the main empirical findings through the application of the Porter's model.

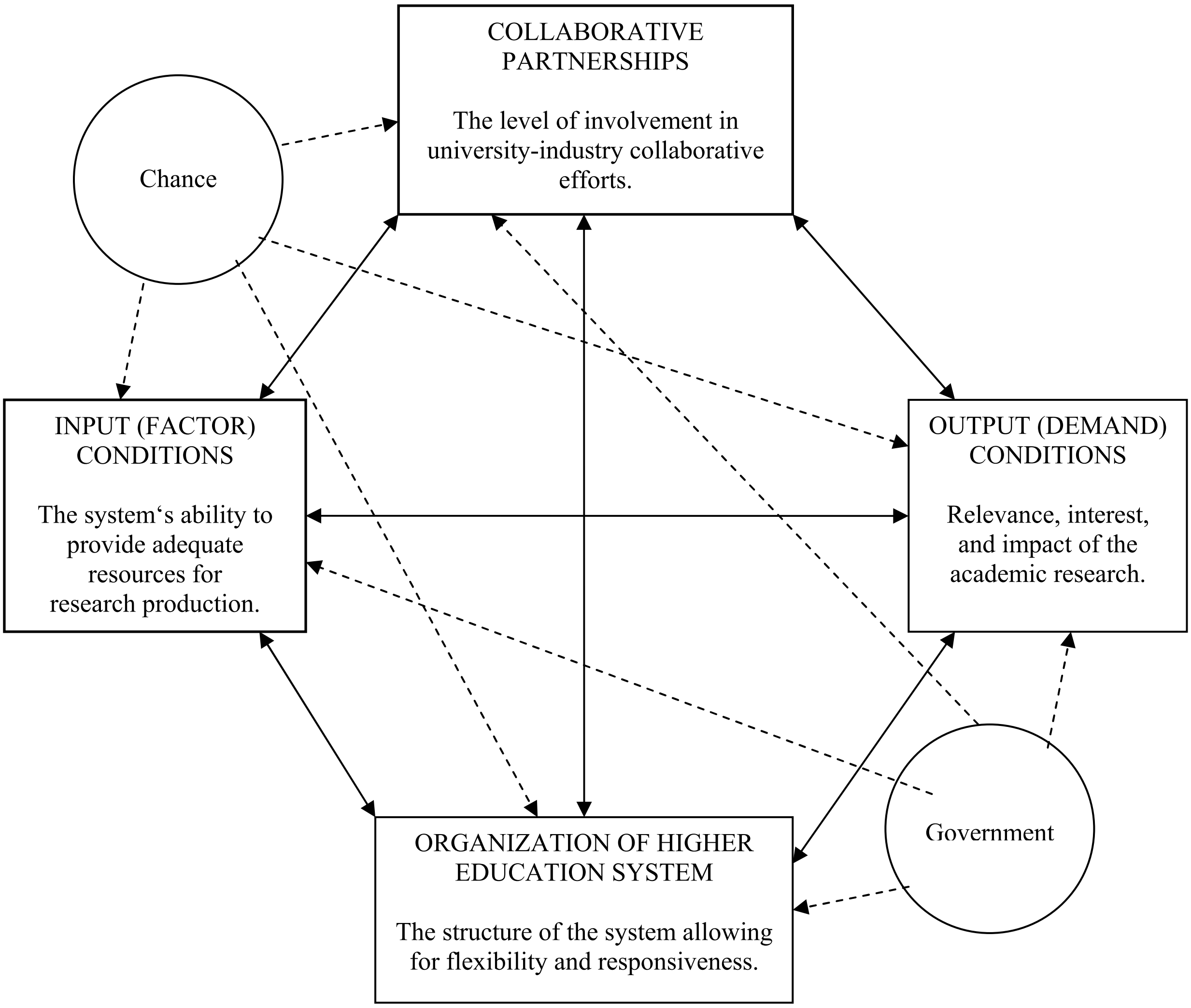
Theoretical Framework: Porter's "Diamond" Model of Competitive Advantage

The theory of competitiveness, generally known as competitive advantage, has dimished the relevance of some basic premises of macreconomic theories. The traditional Kenysian theories do not take into consideration growing influence of microeconomic factors and conditions necessary for creating innovation-driven growth upon which competitiveness is essentially based. A variety of approaches to competitiveness has produced a myriad definitions of the concept, however, an overwhelming majority of these theories focus only on one aspect of competitiveness, for instance, input-output side, organizational processes, competitive performance, which provide very rich, yet somewhat narrow and limited picture often leading to weak understanding of competitiveness and subsequent creation of suboptimal policies (see for example, Buckley et al., 1990; Hamalainen, 2003; Hatzichronoglou, 1996; Nelson, 1992).

Therefore, one of the more complex theories emphasizing non-fiscal dimension of competitiveness that explains why some countries outperform others at economic activities is Porter's "diamond" theory of competitive advantage of "companies in a nation" (Porter, 1990). The theory maintains that while such sound factors of macroeconomic policies as creation of a stable political environment, a trusted legal framework, and improvement of social conditions are indeed necessary to ensure a prosperous economy, they are not sufficient. Competitiveness ultimately depends on continuous improvement of the so-called microeconomic foundations of competition. Porter (1990) defines those as four interrelated and mutually dependent factors: (1) factor (input) conditions; (2) demand (output) conditions; (3) contextual (corporate) strategy and structure; and (4) related and supporting industries. In addition, his framework also includes additional two elements of government and chance which may also influence national competitiveness through the four main factors.

While this model is initially intended to assess the conditions of competitiveness of local industries, it has proven to be useful in the context of higher education as well. Curran (2000), for instance, applied this model to the assessment of research performance in the discipline of geography in the U.K. Hazelkorn (2004), on the other hand, applied the model to illustrate the complex (and often problematic) relationship between government and universities. Based on some of Curran and Hazelkorn's applications, Figure 1 shows our adaptation of Porter's model of competitive advantage to our conceptual framework.

Figure 1: Adaptation of Porter's Model of Competitive Advantage to Higher Education System



Source: Modified from Curran, (2000); Hazelkorn (2004); Porter (1990).

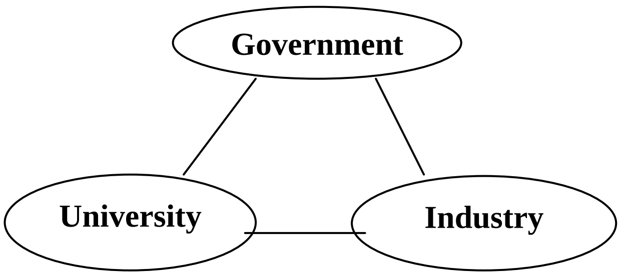
In our context of analyzing the research impact of the Czech universities on innovation potential as a prerequisite for building true competitiveness, input conditions are defined as the system's ability to provide adequate resources conducive to the production of economically and/or socially relevant research. Among these resources belong financial (i.e., research and development funding) and human resources (i.e., research and development personnel). Due to their tangible nature, the assessment of input related factors allows to identify possible gaps between research and development (hereafter R & D) expenditures and the actual sectoral (i.e., higher education system) performance by uncovering inadequate infrastructure and possible weak research competencies (Geisler, 2000).

Second, output (or demand) conditions are measures of relevance and impact of university research on a society (Curran, 2000; Hazelkorn, 2004). Geisler (2000) distinguish between two different kinds of impact: (1) indirect or non-tangible impact, such as improved reputation of universities, impact on student satisfaction, contribution to the public good, etc.; and (2) direct or tangible impact as explicated by the number of publications, citations, patents, etc.

Third, organizational structure is defined as the flexibility and responsiveness of the system to respond to the market and societal needs, thus building the innovation potential. Hence, the critical stimuli for innnovation actually come from the specific nature of the institutional context of each system or country (Dosi, 1988). Gibbons and associates (1994) in their influential analyses of knowledge production describe a new form of institutional structure where transdisciplinary research (as opposed to discipline-specific research) is produced in the context of supply and demand, evaluated by its immediate stakeholders (as opposed by peer review judgments), and from its beginning is intended to be useful to the stakeholders (Gibbons et al., 1994). Organizationally, therefore, such universities - often called entrepreneurial - are becoming more heterarchical (as opposed to hierarchical) with greater flexibility and willingness to disperse research results faster into a society (i.e., socially distributed knowledge) (see for example, Etzkowitz & Leydesdorff, 1997; Gibbons et al., 1994; Slaughter and Leslie; 1997).

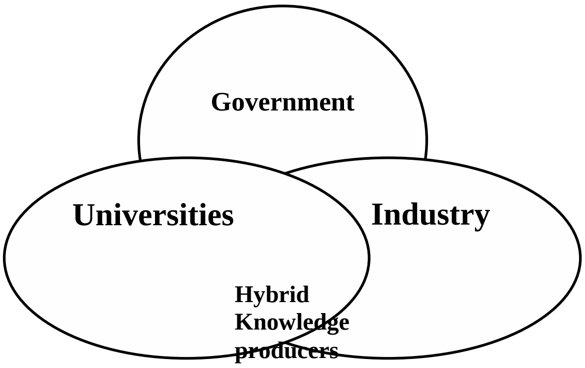
And finally, regional and international relations refer to the level of university involvement in collaborative networks and partnerships with other knowledge-creating public and/or private institutions. Currently, there are two contrasting models of university-industry collaboration in the knowledge production: (1) "knowledge flows"; and (2) "triple helix" (Etzkowitz, 1998). The first model is a linear, one-directional model of "demand pull" or "technology push" based on a relative separation of partners involved (see Figure 2). According to this model, government typically determines the research priorities (i.e., top-down identification) without consulting with smaller organizations, institutions, private enterprises or other relevant stakeholders.

Figure 2. Knowledge Flow Model of University-Industry Collaboration



The second model known as the "triple helix" takes the traditional forms of institutional differentiation among universities, industries, and government as the starting point for institutional interaction in the research production (Etzkowitz & Leydesdorff, 1997) (see Figure 3). The rationale for this cooperation is relatively simple: industry profits by easy access to research results and human resources, and universities have some of their research financed. The role of government in this institutional collaboration is one of support; it puts in place necessary infrastructure for successful cooperation between universities and industry and eliminates barriers that can potential hinder such partnership.

Figure 3. Triple Helix Model of University-Industry-Government Relations



This model, in contrast to the previous one, is characterized by a high level of entrepreneurial activities on the part of university academicians, such as networking, strategic partnering, and requiring academicians to also possess strong leadership skills in managing multidisciplinary projects.

Therefore, by adapting holistic Porter's model of competitive advantage where all the factors are not only equally important to innovation process, but also mutually dependent, we propose to answer the following set of research sub-questions: (1) Does the system of higher educaton provide adequate resources for research? (2) What type of research (basic or applied) the Czech system of higher education predominantly produces? What are the effects university research on an international scholar community? (3) To what extent, the current structure of higher education responds to the increased demand for economically useful research? (4) Is there any collaboration between Czech universities and other research-producing entities? Even though, the empirical focus is on the Czech Republic, we also employ, statistical data pertaining to the closest Czech competitors, such as Poland, Hungary, Slovenia, as well as we use data on Finland and the U.S., which represent the most successful countries in developing their innovation potential; thus are used as benchmarks.

Research Methodology and Data

Our research methodology utilized the most frequently used approach in quantitative innovation studies; the use of indirect proxies for the assessment of university research impact on innovation potential[2]. In order to obtain the most holistic picture, we analyzed macro as well as micro data. Macro data came from EU, OECD statistical databases, and the Institute for Scientific Information Thomson Scientific (hereafter ISI) and the micro data came from the 2005 Survey of Faculty Members of Czech Higher Education Institutions[3] (see Table 2 for summary).

Table 2: Summary of Indicators and Sources

Factor	Types of Indicators	Source of Data
Input Conditions	R & D expenditure in PPS	Eurostat
	shares of R & D funds	OECD
	R & D personnel (FTE)	Eurostat
Output Conditions	types of research	survey
	number of publications	ISI Thomson
	number of citations	ISI Thomson
	number of patent applications	survey
System Structure	management & leadership of university & department	survey
	information sharing	survey
	academic freedom	survey
Collaboration	number of consultancies	survey

	perceived barriers	survey

To analyze the effects of the input conditions related metrics, we selected two major proxy measures of innovation potential: R & D expenditure expressed in purchasing power standards[4] (hereafter PPS) and R & D personnel (OECD, 1994). In terms of R & D personnel measures, there are two possible approaches: headcount or full-time equivalence (hereafter FTE). The first approach refers to measurement of either the total number of persons employed in R&D on a given date or during the year or the average number of persons employed in R&D during the year (OECD, 1995). The FTE, on the other hand, refers to the proportioned measurement of a researcher[5] and his/her time spent on R&D activities (OECD, 1995). Since headcount is best to use for construction of additional macro-indicators, which was not the aim of this study, we selected FTE measurement as more appropriate for our particular context.

For the measurement of the output conditions, we followed Jaffe's (1998) conceptual framework and assessed the number of patents, the number of publications and citations as our proximal outputs. For this endeavor, we utilized a method known as bibliometrics. Bibliometrics refers to the evaluation of scientific and technical published outputs from science and its related disciplines. It is based on the summation of the count of publications in a selected academic field which serves as a foundation for subsequent calculations of the relative influence of those publications (i.e., citation impact). Data were collected from ISI Social Science Citations Index, Science Citation Index, and Arts and Humanities Citation Index. Due to the unavailability of some data, the time frame of the collected data differs; the comparative bibliometric evaluation of selected countries covers a period between 2000-2005, while the bibliometric evaluation of the Czech universities covers a period from 1990-2005.

Another proxy of the output conditions used in this study was the desegregation of the indicators for basic, applied research, and experimental research[6]. Such distinction serves as a key indicator of innovation potential since applied research tends to indicate immediate economic or social usefulness of research, as well as it illustrates the level of interest in university research by industry.

Finally, patents as “tangible evidence of technological innovation” were used as a measure of technological capability and achievement (Geisler, 2000). Patents most of the time represent outputs of applied and experimental research, however, they can also be linked to basic research (OECD, 1994).

The collaborative partnerships were evaluated according to the level of involvement of Czech faculty members in consulting activities. A number of consultancies is a relevant indicator of so-called cross-sectoral linkages between institutions and industry (Godin et al., 1998). We suspected, however, that the number of consultancies might be relatively low due to de-facto and de-jury barriers existing in the Czech society which prompted us to also utilize data from the 2005 Survey of Faculty Members to examine the impact of frequently cited barriers on the formation of such linkages.

And finally, the assessment of the effectiveness of organizational structure of the Czech higher education system was based on the survey data that measure the concept of entrepreneurial university (indicators: management and leadership of university, management and leadership of department, information sharing, and academic freedom).

Analysis of Input Conditions: The Beginning of Innovation Journey

Financing of university research is one of the key input indicators of potential achievable success in building innovation capacities. The alarming fact is that despite many governmental intentions and stated objectives of increasing financing resources for research, the Czech system of higher education remains chronically underfunded. It is generally known that developed "richer" countries spend on R & D more than the less developed countries, yet the expenditures into research in the Czech Republic tends to be significantly lower than the investments in well-developed countries: 1.3 % in the Czech Republic; 4.6 % in Sweden; 3.6 % in Finlands; 3.1 % in the U.S. (United Nations Development Programme, 2004).

Table 3 compares total intramural R & D expenditures in higher education sector as percentage of GDP in PPS in the Czech Republic, which is 'currency' unit eliminating differences in purchasing power thus allowing for meaningful comparisons among countries, to the innovation leader - Finland - that on average spends three to five times more on higher education than the Czech Republic. A closer examination also points out that Poland's expenditures are almost equal to Finnish ones; that trend will most likely show its positive effects in the near future.

Table 3: Total Intramural R&D Expenditures in Higher Education Sector in PPS between 1995-2005

Country	Year								
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Finland	366.81	398.27	519.59	584.33	680.80	708.82	745.61	809.72	827.30
Czech Republic	97.26	113.55	133.9	154.39	197.80	243.33	276.30	291.97	321.24
Hungary	148.86	137.82	152.42	167.35	160.13	216.80	298.40	336.12	342.51
Poland	447.44	519.24	541.79	596.01	673.04	764.12	781.17	752.4	701.47

Source: Eurostat (2004). Unit: PPS

In the most developed knowledge-based societies (i.e., Finland, U.S.) university research is predominantly funded from private sources as a response to a slowdown in the flow of public resources and to new emerging funding opportunities (Slaughter & Leslie, 1997). It follows that to respond to new financial opportunities, a majority of research universities have shifted their focus from basic research to more applied research. In contrast to this trend, Table 4 shows that in the Czech universities prevailing sources of funding are those coming from public sources [7]. That implicates a low level of involvement of Czech university researchers in applied research, thereby collaboration between universities and private sector[8].

Table 4: Overall Shares of University R & D Funding in 2004

Country	Public Sources (%)	Private Sources (%)
U.S.	31	63
Finland	26	70
EU - 15	34	56
Japan	18	74
Czech Republic	42	51

Source: Authors‘ calculations based on OECD (2004) data. Note: the overall summation of shares of fundings does not always equal to 100% because into the calculations were not taken other sources of funding.

In terms of allocating these funds to individual academic disciplines, social sciences and humanities receive the highest level of support from public sources in the Czech Republic. The justification for public financing is that the nature of research in these fields does not lend itself to applied research. This is in contrast with hard sciences receiving most of their funds from private sources[9]. Such allocation of funds in itself should not be suprising since it mirrors global trends of private financing those fields (i.e., medicine and technology) that produce the most lucrative forms of innovations.

What should be of our interest, however, are the 2002 total intramural R & D expenditures by individual academic fields in the Czech Republic in comparison with other countries. Without a doubt, Poland, Hungary, and Finland's expenditures are higher in all academic fields than those in the Czech Republic (see Table 5). Moreover, Finland's expenditures in all academic fields, except for agricultural science, are on average two to seven times higher than expenditures in any other of the selected countries (see Table 5). Interestingly enough, Finland devotes five times more of its resources to social sciences; the field where most of organizational and/or societal innovations and development takes place, whereas the expenditure in the same field in the Czech Republic are three times less. One of the plausible explanations may be that due to the transition from communism to capitalism accompanied by a strong emphasis on immediate financial returns, which non-technological innovations cannot guarantee, the production of organizational and/or societal innovations have not been preferrred or perceived as needed.

Table 5: Total Intramural R&D Expenditures in Higher Education Sector by Academic Field in 2002 (in PPS)

Country	Academic Fields					
	Engineering and Technology	Natural Sciences	Medical Science	Agricultural Science	Social Sciences	Humanities
Finland	160.44	207.51	203.31	19.33	153.53	65.52
Czech Republic	115.72	81.75	32.41	22.47	30.41	8.21
Poland	241.84	197.15	96.49	56.61	69.46	90.80
Hungary	57.26	74.70	44.67	36.00	58.99	64.61

Source: Authors‘ calculations are based on Eurostat data (2004). Unit: PPS.

The number of university researchers (FTE) mirrors almost precisely the financial expenditures in individual academic fields. The greatest number of researchers can be observed in engineering and technology; the fields where Czech university researchers traditionally have succeeded in the past (see Table 6). Somewhat surprisingly, medical science tends to be underfunded and understafffed when compared with other selected countries (see Table 6).

Table 6: FTE Researchers in Higher Education by Academic Field in 2002

Country	Academic Fields					
	Engineering and Technology	Natural Sciences	Medical Science	Agricultural Science	Social Sciences	Humanities
Finland	NA	NA	NA	NA	NA	NA
Czech Republic	1,491	1,084	423	287	799	199
Poland	7,936	7,637	5,698	2,909	4,118	8,978
Hungary	843	1,057	810	429	1,218	1,642

Source: Eurostat data (2004). Data for Finland were not available.

It can be summed up, therefore, that the intial determinants of building innovation potential are not as favorable as in other selected countries. Someone might argue, however, that it is not the amount of allocated financial resources or quantity of researchers that constitute a high-class research, but the quality and relevance of their research outcomes. Let us then examine this objection and analyze the output conditions.

Analysis of Output Conditions: The "End" of Innovation Journey

To our best knowledge, there are no evaluations of economic and/or social effects of university research in the Czech Republic[10]. One of the most frequently used methods of evaluating university research is through the analysis of number of publications and patent applications (Jaffe, 1998)[11]. While publications and patent applications tend to point out the overall level of productivity of universities, they do not effectively address the issue of quality and content relevance of a particular publication or patent application. Therefore, the number of citations per publication (i.e., citation impact) was calculated to assess the international impact of published articles.

Based on ISI bibliometric indicators, Table 7 summarizes university publication activities and citation rates for the selected European countries in 2000-2005. It becomes apparent that the impact of Czech university publications is not as high as it would be necessary; only less than half of them is cited (see Table 7 & 8). The average citation rate per Czech publication is 2.47, while in Finland it is almost twice as much.

Table 7: Cumulative Summary of Publication Activities of Universities (2000-2005)

Country	Number of Publications	Number of Cited Publications	% Cited	Citation Rate per One Publication
Finland	38,439	23,583	61.4	5.10
Poland	43,601	21,808	50.0	2.46
Hungary	17,049	9,077	53.2	3.26
Czech Republic	14,526	6,947	47.8	2.47

Source: Authors‘ calculations are based on Thomson ISI bibliometric data (2005).

Table 8: Cumulative Cross-Country Comparison of Average Citation Rate Per One Publication (2000-2005)

Academic Fields	Countries

	Finland	Czech Republic	Hungary	Poland	Estonia
Natural	5.49	2.78	3.80	2.97	3.39
Technical	2.47	1.75	1.73	1.48	1.98
Agricultural	3.97	1.30	1.26	1.29	2.76
Medical	6.19	2.68	3.36	2.35	3.65
Economics	1.63	0.45	1.48	1.29	1.33
Humanities & Social Sciences	1.77	0.74	1.02	1.02	1.51
Law	3.11	0.71	1.20	1.78	2.00
Education	1.21	0.27	0.71	0.48	0.00

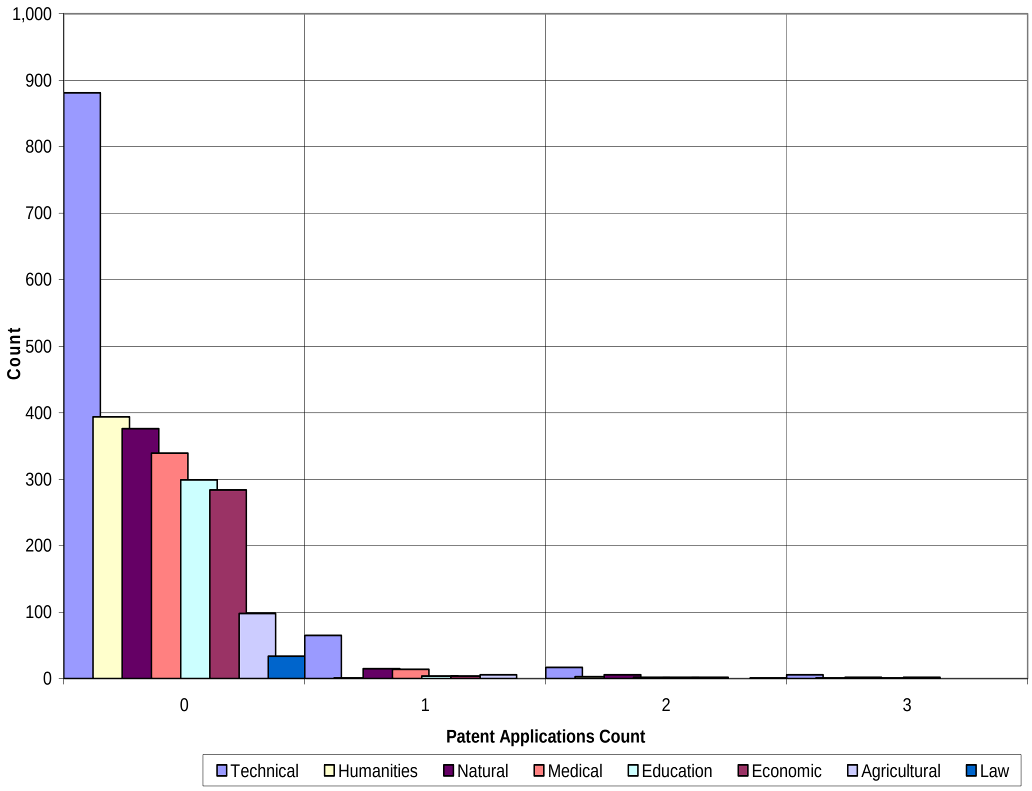
Source: Authors' calculations are based on ISI bibliometric data (2005).

A cross-country comparison of average citation rate per one publication by academic fields immediately points out the highest level of citations of the Czech publications occurs in hard sciences while the lowest level of citations in soft sciences, specifically the lowest level is in the field of education. There are many potential explanations as to why Czech educational research remains on the periphery among its international colleaugues. Some of them are chronic lack of adequate financial resources, language skills among researchers, and human capital. It is also important to add at this point that the Czech public prefers to support research activities in traditionally successfull disciplines (i.e.., natural, technical sciences) which adds additional pressure on allocation of public financial resources.

The most obvious mismatching between the input and output conditions can be found in the field of medicine. Despite the relative low expenditures and FTE researchers, the citation rate in this field is the highest after natural sciences (see Graf 1).

Second major indicator of innovation potential is the metric of patents[12]. As suggested by OECD (1994), patent indicators should not be used in solitude; rather they should emerge within the wider context as of the input-output model. Using the 2005 Survey of Faculty Members self-reported data, a majority of respondents indicate they have submitted a zero patent application in the past three years. One to three patent applications have been predominantly submitted from hard science researchers (see Graf 1).

Graf 1: Self-Reported Number of Patent Applications by University Researchers (2002-2005)



As already mentioned, since patent applications are associated predominantly with applied and experimental research, we used the same survey to compare the self-reported patent applications with its corresponding research type. Approximately 13 % of all Czech faculty members reported to conduct applied research, 44 % of faculty members is involved predominantly in basic research, and experimental research is carried out by 28% (the remaining 15 % of faculty members carries out a combination of these three kinds of research). However, out of those 13 % involved in applied research and 28 % involved in experimental research come 76 % of all patent applications. These 2/3 patent applications, therefore, are submitted by a relatively small group of researchers who participate in increasing innovation potential of the Czech Republic. That finding begs an immediate question: Is there more Czech university researchers who wish to participate more actively in innovation process but are prevented from it by the actual or perceived existence of institutional deficiencies?

…And All That in Between

Since management and organization of higher education system influence the level of involvement of universities in collaborative partnerships, these two “in between” factors are discussed jointly. Changes in funding patterns of university research have affected the effectiveness of these organizational structures. Those universities functioning under hierarchical and autocratic models tend to operate in a relatively inflexible, if not stagnat, environment, lacking the capacity to respond to the market and societal needs in an innovative manner.

Using data from the 2005 Survey of Faculty Members, we attempted to uncover how key organizational actors perceive their institutions. We selected these three major indicators of entrepreneurial university: (1) leadership and management; (2) information sharing; and (3) academic freedom to assess the organizations‘ openess. Table 9 shows that aapproximately half of Czech university researchers believed their university, as well as department, is led in a professional manner. In addition, they expressed their consent with being well-informed about the organizational processes at the university and departmental level. However, the second half of the faculty members reported the exact opposite. Such a clear division in their opinions indicates huge differences in leadership and management styles across the Czech university landscape.

Yet, interestingly enough, 80 % of all Czech faculty members pointed out that not only their university but also their department support academic freedom (see Table 9). This indicates that in spite of different leadership and managemetn styles, an overwhelming majority of Czech faculty members enjoyes academic freedom which may serve as a foundation for initiating changes conducive to the development of collaboration between universities and industry; thus develop the connection between academic entrepreneurship and innovation.

Table 9. The Indicated Level of Agreement Among Czech Faculty Members with Statements about Management (in %)

Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
My university is managed in a professional and managerial way.	6.8	45.4	39.8	7.9
My department is managed in a professional and managerial way.	10.3	44.0	34.5	11.2
I feel well informed about the processes at the university.	8.9	50.8	35.9	4.4
Communication between the university management and the faculty is very good	5.2	41.4	46.9	6.5
My university's management often acts autocratically.	11.4	41.0	44.3	3.3
My department's management often acts autocratically.	10.7	32.2	49.0	8.2
Insufficient involvement of faculty members in management is a serious problem.	14.0	52.4	31.9	1.8

This university management supports academic freedom.	11.4	68.8	18.0	1.8
This department management supports academic freedom.	17.0	64.8	15.8	2.4

Source: Data from the 2005 Survey of Faculty Members.

As already mentioned above, triple helix is a necessary precondition for forming strategic partnerships and alliances in building innovation potential through the production of disembodied human capital. Yet, the current model of university-industry collaboration in the Czech Republic still follows the one-directional and less flexible model of knowledge flow (see Figure 2). As our data show, only 11 % of all Czech faculty members estimated the collaboration with experts from private sector over the past three years. In terms of providing occasional expert opinions and reviews for private sector, 19 % of Czech faculty members reported to do so.

Since the current structure of the system of higher education in the Czech Republic is lacking supportive infrastructure for forming partnerships between industry and university, we asked the following question: What are some of the major barriers that tend to hinder this collaboration?

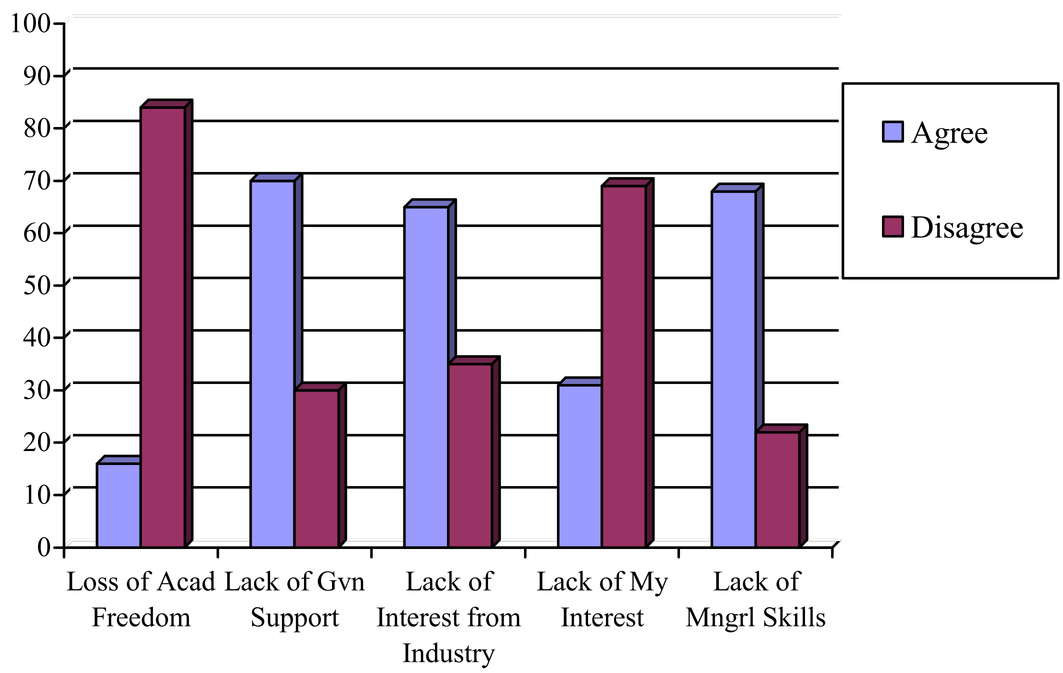
First, the most commonly used argument, among some academicians, against such collaboration is “cultural” incompatibilities between industry and the university (i.e., private vs. public good; or full-profit vs. non-profit). This argument is often supported by the notion of a losing traditional academic values and norms of behavior (i.e., freedom, autonomy, prestige). Quite surprisingly, in the context of Czech university researchers, we found these concerns unfounded, since the survey data show approximately 85 % of faculty members do not consider this form of cooperation restricting their academic freedom (see Graf 2).

Further, roughly 70 % of university researchers expressed their personal interest in collaborating with industry and would welcome such cooperation (see Graf 2). That finding reinforces the notion that university researchers connect entrepreneurial activity with innovation building and are willing to participate more actively.

In addition, Graf 2 shows that university researchers considered a lack of governmental support in setting up the necessary conditions (i.e., incentives) as the greatest obstacle (70 %) (see Graf 2).

As it has been already mentioned elsewhere, current university researchers, apart from possessing a high level of expertise in a particular field, also need to possess a set of leadership skills to successfully manage teams of experts with a diverse professional background. That, of course, requires a great deal of practice; the fact our respondents found problematic: 68 % cited the lack of managerial skills in leading multidisciplinary projects as a barrier (see Graf 2).

Graf 2. Perceived Barriers in Cooperation with Private Sector



Among the remaining often cited barriers, which tend to be fairly typical, were mentioned a lack of technical equipment for university-industry projects (49 %), lack of support from their university management (34 %), lack of well-qualified partners in a private sector (20 %), and lack of economic stability of some corporations (37 %).

All in all, the "black box" of innovation building processes provided us with more questions, to which we will turn our attention in the near future, than answers. What has surfaced is the notion that Czech university researchers deem to utilize a great deal of academic freedom, despite some of the outlined institutional deficiencies and problems, and are relatively unified in articulating their interest and willingness to collaborate with industry.

Conclusion

Indeed, all national systems of higher education are now expected to contribute to the economic growth of their country; the Czech Republic is no exception. The Porter's "diamond" model of competitive advantage proved to be a useful tool in uncovering major insufficiencies in microeconomic foundations of Czech system of higher education. Our findings illustrate the incomparability of input conditions to those in Finland or other selected Eastern European countries; incomparability resulting in inadequate quality and low productivity of Czech universities in terms of their research outcomes. Similarly, the "black box" of building innovation potential further continues to negatively affect the "innovation journey".

The Czech system of higher education is characterized by a great disparity in its leadership and management which may negatively affect as well as discourage any entrepreneurial activity. A fast elimination of the major barriers mentioned by the faculty members may have the potential to increase the participation of researchers in innovation proces. In turn, these measures can bring changes in input and output conditions since all of these factors mutually affect each other. Only by doing so, the Czech system of higher education can develop a true innovation potential and thus compete successfully on international market(s).

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Notes

[1] Currently, businesses practitioners, organizational management scholars, and public policy makers are more interested in the issue of competitiveness than economists. For the most comprehensive opposing view to the theory of competitiveness, see for example Paul Krugman (1994) and his theory of absolute productivity

[2] Our major referents guiding the methodology sections were OECD methodological manuals: Frascati Manual (2002), Oslo Manual (1997), Canberra Manual (1995), and Patent Manual (1994).

[3] The data were taken from research conducted in Spring 2005 by the department of Social Stratification, Institute of Sociology in the Academy of Sciences of the Czech Republic in collaboration with the Board of the Council of Universities. The questionnaire contains data pertaining to satisfaction, collaboration with public and private sector, barriers in collaboration with public and private sector, consulting activities, and institutional climate in terms of teaching and research

[4] Purchasing Power Standards (PPS) are a fictive 'currency' unit eliminating differences in purchasing power, i.e. different price levels, between countries. Thus, the same nominal aggregate in two countries with different price levels may result in different amounts of purchasing power. For more information on calculating PPS go to http://europa.eu.int/estatref/info/sdds/en/strind/ecobac_gdp_sm.htm

[5] In our context, a researcher refers to a person who has a doctorate degree (or higher), has already published scientific work, and is employed by a university.

[6] Frascati manual provides the following definitions. Basic research is defined as experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts without any particular application or use in view. Applied research, on the other hand, is also original investigation undertaken in order to acquire new knowledge, it is directed primarily towards a specific practical aim or objective. Finally, experimental development refers to the systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed (OECD, 2002, p. 30).

[7] Based on this data, it can be now expected that not many member countries of the EU, neither the EU as a whole, will reach the target for 2010 determined on the 2002 spring session of the European Council in Barcelona, namely the expenditures of 3 % of GDP, of this 1 % from public sources and 2 % from corporate sources.

[8] In addition, lack of funding from private sources also indicastes a shortage of pre-seed, seed, and start-up capital; in other words, inadequate availability of capital for innovation.

[9] This preference in financing research in so-called hard sciences not only mirrors the world trends, but in the context of the Czech Republic is a “spillover” from the Soviet era under which these technical fields were promoted by the regime. Their technical nature did not allow for much controversy and possible doubting of socialist ideology as research in social sciences or humanities allowed.

[10] We believe that the lack of such evaluation implicates one major trend still present in the Czech society. The outdated notion that universities are „Ivory Towers“ is still prevailent among the Czech public and other stakeholders who do not demand any evaluations of the university research results (i.e., their economic and social usefullness and relevance).

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[11] The development of new or improvement of existing services is additional proxy for measuring the outcomes of university research. However, due to the methodological problems associated with collecting such data, we decided not to include it in our paper.

[12] There are several major problems associated with analyzing patenting activities as pertaining to innovation potential. First, the relationship between the level of patenting and outcomes of R & D, such as increased performance, and the link between R&D inputs (expenditures, personnel), and patenting is not theoretically established. Relationships are frequently based on empirical findings and covariation methodology. In addition, patentable inventions have become more difficult to discover. Third, innovation activities do not necessarily lead to patenting, differences among national patent systems arising from legal, geographic, economic, and cultural factors often result in different patenting behavior of institutions in given countries. Diversity thus emerges not only between countries, but also among sectors and disciplines, leading to many possible distortions in the measurement.

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