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Development of academic entrepreneurship in an innovative economy: factors and motivation

Abstract

Object: Study of issues of entrepreneurial activity motivation among university scientists and identification of factors influencing academic entrepreneurship.

Methods: The study uses the methods of system analysis, comparative analysis, grouping method, content analysis, analysis of literature.

Findings: The article considers the main factors that influence university scientists when they make a decision on academic entrepreneurship. The types of activities that can be attributed to academic entrepreneurship are identified: the implementation of funded projects, the foundation of start-ups, licensing, etc. An analysis of the studies conducted in the field of motivation of academic entrepreneurs made it possible to identify groups of main factors, as well as the strength of their influence on the motivation of scientists. Among the personal motives most often in Western research scientists highlight the desire to continue research, create innovative products, scientific interest in their field of study.

Conclusions: The creation of an innovative infrastructure and legislation in the field of intellectual property protection and technology transfer largely determines the possibilities for the development of academic entrepreneurship in the country. Scientists involved in the commercialization of scientific developments become an example (mentor) for younger colleagues, which makes it possible to involve young, qualified specialists in academic entrepreneurship. The presence of professional connections and the opportunity to communicate with business representatives greatly facilitates the receipt of funding for the implementation of results, makes small innovative enterprises more successful in the market. Despite the small percentage of academic entrepreneurs in universities, most scientists maintain contacts with the business community, which, under favorable conditions, can develop into entrepreneurial activity.

Keywords: academic entrepreneurship, university, commercialization, technology transfer, motivation.

Introduction

Today universities are actively involved in the innovation processes of the region not only by training personnel for the innovation economy, but also by introducing their own research and development at industrial enterprises. The transfer of technologies by the university for further implementation becomes possible due to the development of academic entrepreneurship.

Academic entrepreneurship has been developing in the United States since the 1970s, when public funding for scientific research began to decline, and venture capital infrastructure was actively developed. Entrepreneurial activities of university staff made it possible to attract private funding, the most promising students, as well as to introduce technical developments. The further development of academic entrepreneurship was facilitated by the adoption of the Bayh-Dole Act in 1980, which secured intellectual property rights for scientists and contributed to the accelerated receipt of patents. Commercialization offices at universities became widespread, which contributed to the transfer of technologies to industry.

In mother conditions the importance of developing entrepreneurship in a university is because academic entrepreneurs:

- influence the economic development of the region through the introduction of their own developments;

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- produce new (innovative) products;
- support university research by attracting inventors, private funding;
- contribute to the training of students, increasing their competencies in the field of entrepreneurship and technology (Gianiodis, Meek, 2020; Anjum et al., 2021).

At the same time, various studies (Rippa, Secundo, 2019; Pugh et al., 2021) show that in foreign countries, no more than 17% of all university teachers are involved in academic entrepreneurship, and in most cases, entrepreneurial activity is not related to the direction of scientific research.

Thus, it is relevant to study the factors that influence scientists when they decide to start an entrepreneurial activity based on the results of their scientific research, as well as the creation of spin-off companies.

Literature Review

In the modern literature on the innovative development of the economy, much attention is paid to universities as sources of new innovative ideas and engines of economic growth (Feola et al., 2021). Changes in the US legislation in the 80-90s of the twentieth century, affecting the issues of technology transfer, contributed to the growth of entrepreneurial activity of universities and, accordingly, scientists working in them. The concept of "entrepreneurial university" was developed in the mid-90s in the works of the American scientist B.R. Clark. The essence of the entrepreneurial university concept was that the university not only realizes its socially significant function, but also meets the needs of the government and business. This soon contributed to the fact that the university began to be seen not only as an element of interaction with other participants, but as the core of the attraction of innovative activity.

This understanding of the role of the university was based on the ideas of American scientists Etzkowitz & Leydesdorff, who studied the possibilities of universities to introduce their developments into industry. Through adding a third element – universities – to the traditional government-business model, something new, interesting and creative was obtained (Sitenko, Holienka, 2022). The three-element structure opens up much more opportunities for all participants in the innovation process than the two-element structure does, and this was proved by them in their research.

The development of the Triple Helix concept has contributed to a better understanding of the relationship that can arise between a university and business in technology transfer (Cai, Etzkowitz, 2020; Etzkowitz et al., 2022; Leydesdorff, Smith, 2022).

Another conception, "engaged university", appeared in the literature several years later and was strongly focused on the regional role of university. According to the concept, engaged institution "is committed to direct interaction with external constituencies and communities through the mutually-beneficial exchange, exploration, and application of knowledge, expertise, resources, and information" (Holland, Malone, 2019). But the difference of this conception from Triple Helix was in adaptive responses of university which includes regional emphasis in its traditional functions – teaching and research. In further works university received broader functions – societal transformer and co-creator (Klofsten et al., 2019; Pugh et al., 2021).

Methods

During the study, methods of system analysis, comparative analysis, grouping method, content analysis were used. The methodology of the Triple Helix theory, developed by Western scientists at the beginning of the 21st century, is used, the essence of which is the need for innovative interaction between the three driving forces of the modern economy – the university community, industrial enterprises and public authorities. To analyze the literature on the motivation of academic entrepreneurship, articles were selected for the period from 2006 to 2019, which considered modern problems of motivating academic entrepreneurs. The full-text scientific database ScienceDirect, which includes high-ranking (peer-reviewed) journals, was used as sources for articles.

Results

The concept of academic entrepreneurship arose with the emergence of a demand for a new role and mission of the university in society, the so-called "third mission" (Compagnucci, Spigarelli, 2020; Nicotra et al., 2021). In the context of globalization, universities play an ever-increasing role in the economic life of the region, they become conductors in the introduction of new ideas and technologies into production. Along with research and teaching, the university becomes an "entrepreneurial university", which allows the development of new sources of funding from technology transfer and the commercialization of innovations.

The concept of academic entrepreneurship includes part of the functions of a university teacher and an entrepreneur who promotes his/her ideas to the market. Performing the functions of an entrepreneur, the teacher becomes an intermediary between the university and the socio-economic environment of the region.

Currently, the forms of academic entrepreneurship are different. These include activities from traditional ones like consultations and training till innovative ones – creation of startups (Table 1).

Table 1. Activities related to academic entrepreneurship

Activity	Description
Execution of funded projects	Obtaining funding for major projects through public funding or industry sources
Contract research	Research projects in cooperation with third-party organizations
Consultations	Expert opinion or knowledge to solve a specific problem
Patents/Licenses	Conclusion of license agreements with the business sector for the production of innovative products (services)
Startups	Creation of new innovative companies or organizations to implement the results of university R&D (research and developments)
Training	Short courses for specialists of third-party organizations
Sales	Marketing of innovative products developed at the university
Tests/Laboratory Analyzes	Providing the possibility of using laboratory equipment for external users
Note - compiled by the authors based on Teixeira, Nogueira, 2018; Teixeira, Ferreira, 2019.	

While studying the factors influencing the opportunities for the formation of entrepreneurial skills among university staff, scientists offer various factors for research, which can be divided into certain groups. So, Babak et al. (2019) distinguish 4 groups of factors:

- personal motives;
- motives associated with the availability of various resources for the scientist to create a business;
- motives related to state support for technology transfer;
- motives associated with the professional and social environment.

1. Personal motives. Motives related to the personal expectations and goals of the researcher in the commercialization of their own development. These include such motives as increasing the income of a scientist, developing and deepening scientific knowledge, and recognition from the scientific community.

The study by Grudzinsky, Petrova (2012) researched the influence of 12 factors on the decision of the teaching staff of the university (Russia Federation) to engage in entrepreneurial activities in the field of their scientific interests. The leading trio of motivation factors were a) the need for high earnings, material rewards and material benefits, b) the need for initially interesting and useful work for society, and c) the need for recognition of merit and the acquisition of social significance. The three least significant motivators were the need for social contact, stable long-term relationships, the need for influence, and the need to control others. Thus, the study not only revealed the factors most influencing teaching staff, but also showed the priority of personal motives over other factors.

The research by Teixeira, Nogueira (2018) examined the influence of a scientist's personal characteristics, such as age, gender, and career position, on entrepreneurial readiness. The researchers considered 2 hypotheses previously encountered in the literature:

- the older the scientist, the more likely he/she is an entrepreneur;
- women are less entrepreneurial because they have less access to resources early in their careers.

However, based on the data set under consideration, it is not possible to draw a relevant conclusion that there is a relationship between these variables and academic entrepreneurship. As for the career position, this variable only affected the number of patents received: the higher the position or title of a scientist, the more patents he registered. However, this variable did not affect other aspects of academic entrepreneurship.

2. Motives associated with the availability of various resources for a scientist to create a business. With the resources necessary to create and develop a company, a scientist is most likely to decide about entrepreneurial activity. Such resources include knowledge and scientific results in a certain area, financial resources, social capital, rights to registered intellectual property objects.

Stuart, Ding (2006) in the research on the factors influencing moving of scientist into commercial science (academic entrepreneurship) studied the influence of such a factor as the creation of an innovation infrastructure at the university, namely, a technology transfer office. The study found that this variable has a positive impact on the decision of scientists to engage in academic entrepreneurship. It also confirmed the

hypothesis that scientists are more likely to move to entrepreneurship when they work in institutions with other scientists who are already engaged in the commercialization of projects.

To determine the influence of famous scientists on their colleagues, the authors used such an indicator as reputation (expressed in the number of citations). As a result, a positive correlation was found between the citation rates of those scientists who are already engaged in entrepreneurial activities and the likelihood that lesser-known scientists from the same institution will also implement commercial projects.

3. Motives related to state support for technology transfer. This group includes factors related to the adoption of laws regulating the commercialization of scientific research and creating conditions for academic entrepreneurship.

Today, the state has developed legislative measures to support scientists in the commercialization of research and development. Kazakhstan adopted the Law of the Republic of Kazakhstan "On state support of industrial and innovative activity" dated January 9, 2012. For the first time, the concept of commercialization, including the commercialization of innovative technologies, was defined in the legislation. Currently, intellectual property rights obtained by researchers or research organizations for the R&D financed from the state budget belong to scientific organizations, unless otherwise provided by an agreement between them and the author (authors) of intellectual property. The similar legislation was adopted in the United States in the early 80s. (Stevenson-Wydler Technology Innovation Act) and contributed to the growth of research and, in general, innovative activity in the country.

Economic systems and the legislation developed within them can have a serious impact on the development of academic entrepreneurship, as shown by Audretsch et al. (2015). The authors consider the role of the university in various models of economic systems: 1) the Anglo-Saxon system based on market mechanisms, 2) the centralized and regulated system in most Asian countries, 3) the European democratic model. The authors note that academic entrepreneurship was most developed in the Anglo-Saxon system, which was able to create favorable conditions for the commercialization of university research. This is confirmed by the high rankings of US and UK universities. Asian countries are in second place in terms of the development of academic entrepreneurship, while the European model is still the least competitive. Thus, existing laws and the degree of state support for academic entrepreneurship have a great influence on the commercialization of scientific research. In the context of globalization, it becomes important that the system of protection of intellectual rights, technology transfer can stimulate innovative development and cooperation.

4. Motives related to the professional and social environment. Professional ties can positively influence the decision of creating and developing a company, attracting innovative staff and obtaining financial resources.

Discussions

The influence of personal and professional connections of university scientists on the possibility of engaging in academic entrepreneurship was considered in the study by Fernandez-Perez V. et al. (2015). The study showed that, according to scientists, social ties increase mutual understanding between scientists, as well as increase the ability to use the accumulated scientific results in entrepreneurial activities. Professional connections allow you to find new business opportunities and organize your own enterprise. At the same time, the role of institutions is to maintain the social interaction of scientists, creating a favorable environment for stimulating cooperation (Table 2).

Table 2. Summary of research on the factors of academic entrepreneurship

Authors	Research method	Research questions	Results
Grudzinsky & Petrova (2012)	Questionnaire, 485 scientific and pedagogical staff of the Lobachevsky University (Russian Federation)	The influence of factors on the motivation for academic entrepreneurship of the university staff, depending on the profile (natural science or socio-economic and humanitarian)	For both profiles, the leading factors of labor motivation are: - the need for high earnings, material rewards - the need for initially interesting, grateful and useful for society work; - the need for recognition of merits and positive feedback (reviews)
Teixeira & Nogueira (2018)	Questionnaire, 247 university researchers in Portugal	To identify determinants of academic entrepreneurship of scientists in the field of life sciences	The number of established contacts with industry acts as a key determinant of academic entrepreneurship

Stuart & Ding (2006)	Case-cohort study of biotech entrepreneurs, PhD scientists; publication analysis (USA)	Identification of social and structural factors that contribute to the transformation of scientists into entrepreneurs.	Academic entrepreneurship is more developed in elite universities (the first 20 universities in the country). The leading factors in the development of academic entrepreneurship among teaching staff are the availability of a specialized infrastructure at the university (commercialization office), the number of colleagues involved in commercialization, and cooperation with researchers in industry.
Audretsch et al. (2015)	Publication analysis	Analysis of the influence of three models of political and economic systems on the development of academic entrepreneurship	Academic entrepreneurship is most developed in the United States and Great Britain, where legal and organizational conditions for technology transfer have been created. The development of academic entrepreneurship in Asia is in the second place. In the final positions are European countries that can use the experience of advanced countries to increase efficiency in the field of technology transfer.
Fernandez-Perez V. et al. (2015)	Questionnaire, 630 Spanish university researchers	Influence of personal and professional connections of scientists to engage in entrepreneurial activities in the academic environment	Social connections promote entrepreneurship in academia, improve attitudes toward new business ventures, and increase transfer opportunities. Personal and professional connections are important to start an academic entrepreneurship. More experienced colleagues can be motivators for young specialists.
Note - compiled by the authors			

Exploring the convergence of boundaries between academia and entrepreneurship, Lam (2010) identified several types of scientists in relation to academic entrepreneurship. The first type is “traditionalists”, i.e. scientists who believe that science and industry should be considered separately. Such scientists strive for a career only in an academic environment, do not approve of academic entrepreneurship. In the study, such scientists accounted for 17% (Table 3).

Scientists of the fourth type believe in the transparency of the boundaries between science and industry, that cooperation between these two areas can lead to positive effects for all parties involved. Such scientists according to the study amounted to 11%, most of them are engaged in the commercialization of technologies, the management of spin-off companies (Audretsch & Belitski, 2019). Scientists believe in the practical application of their own scientific developments, positively evaluate commercial activities.

Table 3. Types of scientists depending on the attitude towards academic entrepreneurship

Type	Perceptions about academia-industry interaction	Ways to interact with the business sector	Main motivating factors	Attitudes towards academic entrepreneurship
Traditional	Clearly distinguishes between academia and industry, builds a career only in a university environment.	Infrequent contacts	Mainly to obtain funding for own research	Resistance Attack on academic spirit and autonomy
Traditional Hybrid	Considers science and industry to be different areas, but understands the importance of cooperation	Mostly collaborative ties with occasional involvement in commercial activity.	Funding research is important	Considered undesirable but inevitable
Entrepreneurial hybrid	Believes in cooperation between science and business, but recognizes the need to maintain boundaries	Participation on regular base in various joint and commercial activities	Funding of research is important, but its further application is demanded too	Partial acceptance and participation in technology transfer processes

Entrepreneurial	Believes in the fundamental importance of collaboration between science and business	Ongoing participation in a range of collaborative and commercial activities Strong university-industry linkages	Application of research is most important, funding for research sharing and networking is also important	Full acceptance of commercialization processes, collaboration with firms built into academic activities
Note - adopted by authors from Lam (2010)				

Thus, the extreme types Traditional and Entrepreneurial make up a minority of the studied population of researchers. Most researchers are located between these two poles. These scientists to some extent share the conviction in the importance and benefits of scientific and industrial cooperation with business, while they adhere to basic scientific values and aim at a career in the academic environment.

Since academic entrepreneurship develops unevenly depending on the areas of research, the authors have identified the number of different types of entrepreneurial activity in various fields of science. Traditionalist types of scientists (I and II) are more present in the physical sciences (55%) than in applied disciplines such as engineering and computer science (38%). This is explained by the fact that the applied nature of research makes it easier to bring scientific development to practical application. Entrepreneurial types (III and IV) are more represented in engineering and information sciences (62%) than in natural sciences (45%). In general, applied IT solutions have the shortest path from development to implementation.

Conclusions

Academic entrepreneurship is increasingly developing in universities worldwide, with the greatest development now in the US and the UK. Within the framework of academic entrepreneurship, a university scientist can implement the results of his scientific activity at industrial enterprises or create his own enterprise. Thus, it becomes an intermediary between the university and the socio-economic environment of the region.

Even though the boundaries between academia and entrepreneurship have begun to blur, not all scientists are ready for entrepreneurial activity. As an analysis of studies in the field of academic entrepreneurship has shown, only 11 to 17% of researchers understand the importance of entrepreneurship for transferring their scientific developments to production and have entrepreneurial experience. The rest of the scientists are at various stages of their attitude towards academic entrepreneurship: from complete resistance to partial participation in joint projects with the business sector.

An analysis of the studies of scientists from various countries made it possible to identify the following patterns in the motivations of scientists to engage in academic entrepreneurship. The hypothesis that scientists seek more additional income has not been confirmed in Western studies, and may be relevant for countries with low incomes of scientists. Factors such as age and gender do not have much influence on academic entrepreneurship. The age of a scientist is decisive in such indicators as the number of published works, received patents, which can only indirectly affect his motivation for doing business. The most important personal motives of a scientist are the desire to continue research in further applied developments, interest in the introduction of innovative products, activities useful for society.

The presence of an innovative infrastructure in the university, as well as legislation in the field of commercialization, largely contribute to the development of academic entrepreneurship, which was noted by the researchers. The universities that form commercialization offices and other structures as part of the innovation infrastructure that facilitate the search for funding, have the largest percentage of scientists who are engaged in entrepreneurship. The adoption of laws in the field of technology transfer allowed the United States to take a leading position in academic entrepreneurship, which remains today.

Motives related to the professional and social environment are identified as significant in many studies. A scientist is most likely to engage in academic entrepreneurship if it is already practiced in his/her professional environment. The presence of many social connections allows the scientist to quickly find qualified personnel for his/her own enterprise, expands the possibilities of obtaining funding, cooperation with other scientists and businessmen. The combination of these factors can increase the likelihood of business success.

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Инновациялық экономикадағы академиялық кәсіпкерлікті дамыту: факторлар мен мотивация

Аңдатпа:

Мақсаты: Жоғары оқу орындары ғалымдарының кәсіпкерлік қызметті ынталандыру мәселелерін зерттеу және академиялық кәсіпкерлікке әсер ететін факторларды анықтау.

Әдістер: Зерттеуде жүйелік талдау, салыстырмалы талдау, топтастыру әдісі, мазмұнды талдау, әдебиеттік талдау әдістері қолданылды.

Қорытынды: Мақалада академиялық кәсіпкерлік туралы шешім қабылдау кезінде жоғары оқу орындарының ғалымдарына әсер ететін негізгі факторлар қарастырылған. Ең алдымен, академиялық кәсіпкерлікке жатқызуға болатын қызмет түрлері анықталды: қаржыландырылатын жобаларды орындау, стартаптардың негізі, лицензиялау және т.б. Академиялық кәсіпкерлерді ынталандыру саласында жүргізілген зерттеулерді талдау негізгі факторлардың топтарын, сондай-ақ олардың ғалымдарды ынталандыруға әсер ету күшін анықтауға мүмкіндік берді. Батыстық зерттеулерде көбінесе жеке мотивтердің ішінде ғалымдар зерттеуді жалғастыруға, инновациялық өнімдер жасауға ұмтылуды және өз зерттеу саласына ғылыми қызығушылықты анықтайды.

Тұжырымдама: Инновациялық инфрақұрылымды және зияткерлік меншікті қорғау және технологиялар трансферті саласындағы заңнаманы құру негізінен елдегі академиялық кәсіпкерлікті дамыту мүмкіндіктерін анықтайды. Ғылыми әзірлемелерді коммерцияландырумен айналысатын ғалымдар жас әріптестеріне үлгі болып, жас білікті мамандарды академиялық кәсіпкерлікке тартуға мүмкіндік береді. Кәсіби байланыстардың болуы және бизнес өкілдерімен тіл табыса білу нәтижелерді жүзеге асыру үшін қаржы алуды айтарлықтай жеңілдетеді және шағын инновациялық кәсіпорындарды нарықта табысты етеді. Университеттердегі академиялық кәсіпкерлердің шағын пайызына қарамастан, ғалымдардың көпшілігі қолайлы жағдайларда кәсіпкерлік қызметке дами алатын бизнес-қоғамдастықпен байланысып отырады.

Кілт сөздер: академиялық кәсіпкерлік, университет, коммерцияландыру, технологиялар трансферті, мотивация.

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Развитие академического предпринимательства в инновационной экономике: факторы и мотивация

Аннотация:

Цель: Исследование вопросов мотивации предпринимательской деятельности среди ученых вузов и определение факторов, оказывающих влияние на занятие академическим предпринимательством.

Методы: Использованы методы систематического анализа, сравнительного анализа, метод группировки, содержательный анализ и анализ литературных источников.

Результаты: В статье рассмотрены основные факторы, которые оказывают влияние на ученых вузов при принятии решения об академическом предпринимательстве. Прежде всего, определены виды деятельности, которые можно отнести к академическому предпринимательству: выполнение финансируемых проектов, основание стартапов, лицензирование и др. Анализ проведенных исследований в сфере мотиваций академических предпринимателей позволил выявить группы основных факторов, а также силу их влияния на мотивацию ученых. Среди личных мотивов наиболее часто в западных исследованиях ученые выделяют желание продолжать исследование, создавать инновационные продукты, научный интерес в своей области исследования.

Выводы: Создание инновационной инфраструктуры и законодательства в сфере защиты интеллектуальной собственности, трансфера технологий во многом определяют возможности развития академического предпринимательства в стране. Ученые, занимающиеся коммерциализацией научных разработок, становятся примером для более молодых коллег, что позволяет вовлекать в академическое предпринимательство молодых квалифицированных специалистов. Наличие профессиональных связей и возможности общения с представителями бизнеса значительно облегчает получение финансирования на внедрение результатов, делает малые инновационные предприятия более успешными на рынке. Несмотря на небольшой процент академических предпринимателей в вузах, большинство ученых поддерживают контакты с бизнес-сообществом, которые при благоприятных условиях могут перерасти в предпринимательскую деятельность.

Ключевые слова: академическое предпринимательство, университет, коммерциализация, трансфер технологий, мотивация.

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