Patent results of men's and women's R&D activities in the enterprise sector in the EU[1]

Abstract

The frequent lack of analytical work in the field of patent statistics is manifested in the insufficient use of one of the most important attributes of patent descriptions – information about the gender of the inventors. The standard patent record allows for multi-layered analysis and reporting of the submitting organizations and inventors in combination with other types of data. Patent information is made available in different forms. No currently available database contains direct information on the gender of the creator of the new solution. Analytical work undertaken so far in this field meets these challenges in a limited way. We are trying to fill this gap, at least partially, in this study and develop *Gender Economics and Innovation*. The study is an overall response to the question about the relationship between the direction and dynamics of changes in expenditure in the enterprise R&D sector, as changes in the participation of women and men in their capacity as researchers and inventors.

Keywords: intellectual property, comparative studies of countries, patent, Innovative Gender

JEL classification: O34, O39, O57

Introduction

One of the most prominent axioms of modern economic development shows that the creation of knowledge and its effective use in manufacturing processes determine the ability and competitive position of economies at all levels and in all areas of impact on the surroundings; and the global knowledge-based economy is a distinctive feature of the contemporary process of internationalization (Thurow, 2000).

The second half of the twentieth century, in particular the turn of 90s, brings a deep reflection, mainly under the influence of dynamic structural changes in the global economy, on the possibilities of the description and inclusion of the issue of knowledge and its use in manufacturing processes to economic theory. An important contribution to the achievements of intellectual inquiry, among others, is manifested by works on: (1) including human capital in the new growth theory (Lucas, 1988, 1990; Baro, Sala-and-Martin, 1991, 2004), (2) recognizing technical progress as an endogenous factor arising from research and development (R&D) activities (Romer, 1990; Grossman, Helpman, 1991; Mankiw, Romer, Weil, 1992), and (3) the introduction of the 'knowledge spill-over' concept in the new growth theory (Tondl, 2001).

Today, the results of this research (the result of the accumulation and knowledge creation process) are becoming particularly sought after goods, and are often a source of significant competitive advantage.

An example of an R&D product that is highly saturated with knowledge, having the potential for commercial exploitation, is a new technology included in a patent description. In a legal sense, a patent is a right to exclusive use of a new solution of a technical nature. It is considered one of the strongest intellectual property rights. In the scientific sense, it is the culmination of R&D activities. In economic terms, this is one of the stages of the innovation

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process. From the point of view of the person who is the owner, it is a resource and a potential market value. It has a relatively high ability to be transformed into a production factor. The properties of the patent description and exclusive rights (patent – understood in the strict sense) mean that the patent information constitutes a bridge between the results of the R&D activities and their potential economic exploitation.

A patent is a set of accumulated industrial knowledge with the ability to influence the course of management processes. It is an economic category ascertained both in normative and positive economics. In the first case, it is considered on the level of institutional solutions (optimal patent policy, the effectiveness of patent systems, external effects); in the second case, as a measure of dynamics and direction of changes in the economy. An important advantage of the time series of patent applications (and patents granted) is the possibility of their use in at least four dimensions simultaneously: time, space, economic sector, and value.

Until the mid-1970s, the average annual number of patent applications (regardless of the mode of application) remained stable. Between 1975 and 2008 there was an increase in patent applications – an average of 3.2% per year; in the period 1995-2008 it had risen to 4.9% per year (World Intellectual ..., 2011, p 19-20). Extending this range to 2013 raises the annual rate of change to more than 5%.

The main factors stimulating this trend include: (1) the multiplicity of applications of patent protection of technological solutions within a single invention, (2) the productivity increase in the R&D activities caused by pressures on the applicability of research results, and (3) the emergence of a new and/or intensively exploited current areas of technological development, (4) heightened awareness of the importance of the formal protection of intellectual capital..

As a result, huge collections of structured data and information (database of facts) are created. In conjunction with the rapid technological development in the field of IT infrastructure, data repositories and new methods and techniques of data mining, they open up new possibilities for: (1) discovering previously unknown dependencies and relationships between data, (2) projection of the course of processes, including those of an economic nature, (3) determination of the accuracy for those processes, and finally (4) attempting to formulate the generalizations for their course, depending on the conditions shaping the environment.

The issue of patent statistics and their use in economic studies is not a subject that is widely covered worldwide. The intellectual foundations of purposefulness and the possibility of using collections of patent information in scientific research are the work by the following researchers: Griliches (1990), Pavitt (1984), Jaffe, Trajtenberg (1993, 1996); Schmoch (1993, 1997, 1999, 2008); Guellec and van Pottelsberghe (2000, 2001, 2007), Cohen (2002, 2003) and the OECD manuals (OECD Patent ..., 2009), which harmonize the rules of patents statistics as one of the system elements for measuring technological changes, scientific and innovation activities, as well as the structural changes in the economic environment.

Patent statistics are an important and still underutilized source of information about the current level of development of economies. The main reason for this is the inadequacy of the methods of using patent statistics, which are far from a holistic approach.

One of the frequent absences of analytical work in patent statistics is insufficient use of one of the most important patent attributes – information about the creator of the invention in terms of gender and the resulting specific characteristics, which might significantly determine its importance in creative work. The standard record patent allows for multi-threaded analysis of applications and industrial developers in conjunction with other types of data, for example the organizational and legal form of the applicant entity, address, and field of technology. Patent information is made available in different forms. No currently available database contains direct information on the gender of the creator of the patent. Analytical

work undertaken so far in this field meets these challenges in a limited way. We are trying to fill this gap, at least partially, in this study and develop *Gender Economics and Innovation.*

In the study, the following assumptions are made. First, the patent constitutes an institutionally protected product of creative activity that is not tantamount to its preparation for commercialization. This requires its further development supported by certain institutional and financial support. Second, the patent is the result of creative activity of men and women with different abilities and skills in "absorbing" the streams of expenditure on R&D. The economic potential of the new solution (patent protected monopoly) is dependent on the structure of the research team, the research unit, the company that produces it, etc. Here, too, the question arises of the source of increasing creative activity, e.g. by optimally shaping the structure of research teams. Thirdly, on the basis of the employment of women and men in R&D activity it is possible to evaluate the involvement of these groups in patent activity. So there is a specific triad of relationships in the research process: R&D and its outcome (e.g. patent, patents awarded); R&D activities and the structure of teams; and the structure of teams and their outcome.

The studies are designed to demonstrate the connection between gender and the processes of creativity and innovation. Understanding the relationship between gender and the creativity and innovativeness of men and women and the influence of the state on these relationships may be helpful in promoting progress and may even point to a new source. These studies are not, however, easy to carry out. In the first stage, we should look for information on the activity of men and women in a specific area and their results, although it is not always simple to obtain such information. As mentioned above, patent data collections do not present data disaggregated by gender. The selection of appropriate methods of data mining is therefore important, although it is not the only problem. Gender is a category that shows the relationships and the influence of social institutions on perceptions, but also socialization and the development of femininity and masculinity. The perception of such links is difficult because it requires the researcher's understanding of a relationship of which they themselves are a participant. Social relations, including sociocultural gender, are dynamic and change as a result of the institution (Jaworek, Zachorowska-Mazurkiewicz 2015). In the studies of Innovative Gender as a New Source of Progress, the authors of this paper seek to demonstrate that analysis of the processes of creativity and innovation is of vital importance for national policy, but also for economic growth and development, precisely because of gender relations.

Directions of research

The study of the relationship between scientific and industrial achievements and structural changes in the economy have a long tradition (Schumpeter, 1934; Arrow, 1962; Nelson and Winter, 1982; Freeman, 1982; Lucas, 1988; Grossman and Helpman, 1991; Romer, 1990; Griliches 1990; and their successors).

The relationships between: the size of the available resources, trends and dynamics of streams of expenditure on research and development (R&D), its results, the productivity of production factors, and finally the increase in competitiveness, remain at the centre of the inquiry. The links between these "passes" are to the greatest extent organizational and technological changes. In both cases, the discovery of the strength of the relationships and their impact on the end product is an important challenge for scientific knowledge. The inclusion in these tactile explorations of the relationship between gender and creativity and innovation brings even greater challenges. This paper is part of the response to these new research challenges.

The need for research on the diversity of the participation of women and men in scientific research, technology development, and innovation, is increased significantly in the

Third European Report on science and technology indicators, towards a knowledge based economy (European Commission, 2003, p. 257): Although female participation in science has increased in recent decades, women are still rarely seen in top scientific positions, such as professorships or other high-level research positions. Career opportunities in science are determined by a number of complex factors, which cannot easily be described using simple statistical indicators. 'Internal' factors – those that depend on the organisation, operation, and structuring of the scientific community itself – form an essential part of the explanation. The internal factors interact with 'external' factors, which are determined and shaped by society at large – such as existing gender roles inside and outside the family, the changing status of women with regard to education and the labour market, and the political frameworks that support equal opportunities. The Report attempts to establish new indicators and review the presence of women in science and technology. It should be emphasized that data on the area of science and technology with regard to gender began to be collected for the European Union at the supranational level in 2001.

Jaffé (2006), in mentioning the significant participation of women in the development of science and technology, highlights the insufficient (but also potential) quantification of this participation. However, the last decade has seen an increase in proposals for the methodical measurement of the achievements of science and technology including gender (Bunker-Whittington, Smith-Doerr, 2005; Naldi, Luzi, Valente, Parenti, 2005; Frietsch, Haller Vrohlings, Grupp, 2008; Frietsch, Haller Funken-Vrohlings, Grupp, 2009). The empirical results of international comparative studies show a clear regularity in the lesser involvement of women in the creation of scientific knowledge (Larivière, Ni, Gingras, Cronin, Sugimoto, 2013), and knowledge in industry (Bunker-Whittington, Smith-Doerr, 2005; Frietsch, Haller Vrohlings, Grupp, 2008; Frietsch, Haller Funken-Vrohlings, Grupp, 2009).

'Innovative Gender' as a New Source of Progress (InnoGend) comprises original studies designed to demonstrate the impact of gender on creativity and innovation, and to find answers to what the manifestations of this relationship are and whether the policy of the state in fostering the processes of creativity and innovation actually takes all these manifestations into consideration. If the policy for supporting creativity and innovation is neutral on gender grounds, then is that because gender does not play a role in these processes, or rather because the impact of gender is ignored? Understanding the relationship between gender and the creativity and innovativeness of men and women and the influence of the state on these relationships may be helpful in promoting progress and may even point to a new source.

In order to grasp the gender relationships in the innovation process, we use a simple schematic of the process (Figure 1).

Enter Figure 1 about here

The area of research determines the need for a thorough assessment of the progress and results of the innovation process including a comprehensive catalogue of the attitudes, roles, behaviours, and characteristics of the participants in this process (women and men). This study tackles only one of the stages of the process – patent activity. The identification carried out by the authors of the entity structures of the industrial inventors enables analysis and assessment of the dynamics of changes in the participation of women and men in the research and development process from an international perspective. A general question was formulated about the relationship between the direction and dynamics of changes in expenditure in the enterprise R&D sector with changes in the participation of women and men

in their capacity as researchers in the years 1999-2013.

Research Method

In order to answer to the above question we use the full set of patent information (in European applications from the period 1999-2013) derived from Thomson Reuters' *Thomson Innovation*. The choice of data source was dictated by the uniform procedure for obtaining patent protection in the EPO for all applications irrespective of the country of origin, which enables comparative analyses to be made. The study design is presented in Figure 2.

Enter Figure 2 about here

In addition, data sets were used derived from the European Statistical Office on the structure of employment in research and development by gender and expenditure on R&D activities in the business sector.

Enter Table 1 about here

The dynamics of the changes in the proposed characteristics were determined using the average rate of change over time (Freedman, Pisami, Purves 2007):

$$log\bar{y}_{Cg} = \frac{1}{n-1}\sum_{i=2}^{n} log\frac{y_{cgi}}{y_{cgi-1}} \quad (1)$$

$$Ac_{Cg} = \left(\bar{y}_{Cg} - 1\right) \times 100 \quad (2)$$

where:
$\bar{y}_{cg}$ – the geometric mean of chain indices calculated separately for the specified variables and each EU country throughout the study period.
g – successive listed variables for which calculations were made in each country covered by the study,
n – the number of observations in time series (corresponding to the number of years of the study period),
i – successive observation in the time series,
c – successive European Union country under investigation,
$\frac{y_{cgi}}{y_{cgi-1}}$ – value of successive chain index.
Ac_{cg} – the average rate of change of successive listed variables in each country covered by the study.

The results of the calculations made it possible to conduct a comparative analysis, and draw conclusions and recommendations.

Research results

In countries belonging to the EU in the period covered by the study, 791 959 people were identified in patent documents (in European application) who are recognized as the creators of inventions. Of this number, 58 678 are women. Table 2 shows the percentage of men and women performing the role of industrial inventors analysed from different perspectives.

Enter Table 2 about here

From Table 2, the following general findings can be concluded:

1. Of the nearly 800 thousand people appearing in the patent documentation (in European application) and recognized as inventors, 52.5% come from Germany. Next in order are: French (15.6%), British (11.8%), Italians (5.4%), Swedes (4.2%), Dutch (2.2%) and Finns (2.05). The share of the other EU-28 countries in this list is below 2.0%.
2. Taking into account the demographic factor and recalculating the number of inventors per 1 million inhabitants of the country the order is as follows: Germany (20.6%), Sweden (14.7%), Finland (12.5%), Denmark (9.5%), France (8.0%), Austria (6.4%), United Kingdom (6.3%), Luxembourg (5.6%), the Netherlands (4.4%), Italy (3.0%), and Ireland (2.1%). The share of other EU-28 countries is less than 2.0%.
3. Of the nearly 58.7 thousand women appearing in the patent documentation (in European applications) and recognized as inventors, 37.2% come from Germany. Next in order are: French (21.5%), British (14.0%), Italians (9.8%), Swedes (4.4%), Danes (2.6%), Finns (2.4%) and Spanish (2.2%). The share of other EU-28 countries is less than 2.0%.
4. Taking into account the number of women in a given country and recalculating the number of female inventors per 1 million female inhabitants of a given country, the order is as follows: Sweden (14.0%), Denmark (13.8%), Germany (13.0%), Finland (12.9%), France (9.7%), United Kingdom (6.6%) Italy (4.8%), Austria (3.5%), and the Netherlands (3.2%). The share of other EU-28 countries is less than 3.0%.
5. Of the nearly 733.3 thousand men appearing in the patent documentation (in European application) and recognized as inventors, 53.8% come from Germany. Next in order are: French (15.2%), British (11.7%), Italians (5.1%), Swedes (4.1%), Dutch (2.3%), and Finns (2.0%). The share of other EU-28 countries is less than 2.0%.
6. Taking into account the male population of the country and recalculating the number of male creators of inventions per 1 million men living in the country, the order is as follows: Germany (21.3%), Sweden (14.6%), Finland (12.5%), Denmark (9.1%), France (7.9%), Austria (6.7%), United Kingdom (6.2%), Luxembourg (5.8%), and the Netherlands (4.4%). The share of other EU-28 countries is less than 3.0%.

From the perspective of the 11 countries in economic transition, which joined the EU after 2003, the European patent application procedure is still a relatively exclusive path, both in terms of costs and quality (condition of technology, legal status, and patentability or patent purity). The number of barriers to overcome in the EPO procedure by the countries of the central and eastern part of the EU, who are building the foundations of a stable market economy, still requires relatively large expenditures (financial or competency) compared with countries with mature market economies. (a USPTO submission is a test of even higher rank). From Table 2 successive general findings result for this group of countries:

7. Of the 11 countries in economic transition (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) 1% of the total number of inventors of new solutions are protected by patent monopolies.
8. Taking into account the demographic factor and recalculating the number of inventors per 1 million inhabitants of a given country, the economic transition countries represent 4% of the EU's creators, the while female inventors represent 10% of EU women inventors and men inventors account for 4%.

These general findings allow for the emergence of the leading EU countries in terms of women's and/or men’s participation in inventive activity in the EU in total. The leading countries include: Germany, France, the UK, Italy, Sweden, Finland, Denmark, Austria, the Netherlands, and Spain. Among these countries, dynamics of changes in the average share of intramural expenditure on R&D in the business sector in relation to other institutional sectors in leading EU countries were drawn up (Figure 3).

Enter Figure 3 about here

The years 1999-2013 have seen a continuous increase in intramural expenditure on R&D in the business sector in relation to other institutional sectors in the following countries: Italy (0.65%), the Netherlands (0.22%), France (0.18%) Spain (0.17%), Finland (0.07%), and Denmark (0.06%). In the case of Germany and the UK a relatively small decline is visible in the share of enterprises (average decrease of approximately 0.20 – 0.24%). The declines for the Swedish (0.62%) and Austrian (1.35%) enterprise sectors are relatively clear. From graph 3 we can draw out Figure 4, which presents the dynamics of changes in the participation of women researchers employed in the business sector in relation to all researchers in all institutional sectors in leading EU countries.

Enter Figure 4 about here

The years 1999-2013 have seen a continuous increase in the share of women researchers employed in the business sector in relation to all researchers in all institutional sectors in almost all countries covered by the analysis. The exception is Finland, with a small – 0.26% – negative dynamic of changes in the parameter in question. The high growth of women's participation in the R&D teams of business sector entities in Spain (7.69%) and Denmark (3.3%) should be emphasized. Comparing charts 3 and 4 we can derive the careful, very general conclusion that the increase in the share of expenditure on R&D in the enterprise sector does not entail any increase in the share of women employed in the role of R&D unit employees. This process is significantly influenced by other factors.

Similar correlations (or their absence) can be sought for male researchers employed in R&D in the business sector (Figure 5).

Enter Figure 5 about here

The analysis shows that in the case of Spain, France, the Netherlands, Denmark, Sweden and

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Italy men's participation in the research group employed in the corporate sector increased in relation to researchers in all sectors of the economy. The biggest increase was recorded, as in the case of women, in Spain (average annual growth of 3.56%).

The graphs 3 and 5 indicate the following general findings:

1. In the group of 6 countries with a higher proportion of male researchers, there are 5 countries for which there was an increase in expenditures on R&D in the business sector.
2. For the four countries which reported a decline in the share of expenditure on R&D in the business enterprise sector, three countries also show a decline in the share of men who are researchers in this sector. The countries for which this rule was not confirmed are Sweden and Finland.

The next step of the analysis is to present the dynamics of the participation of female inventors of industrial employment in the business sector in comparison with inventors of industrial property from all institutional sectors in the EU countries analysed (Figure 6).

Enter Figure 6 about here

Regardless of the dynamics of expenditures on R&D, the dynamic of the growth of employment of women in the business sector there is a regularity that there is a general increase in the proportion of women who are the inventors of industrial property in the business sector in relation to all the other inventors working in the remaining institutional sectors of the countries surveyed. The greatest rate of growth is noted in: Spain (average annual increase women's participation in invention activities completed by obtaining a patent monopoly is 4.8%), Denmark and the United Kingdom (3.7%), Italy (3.6%), and Germany (3.5%). The results of a similar analysis conducted for men are presented in Figure 7.

Enter Figure 7 about here

The results show that in only three of the EU countries included in the analysis (Sweden, Austria and Denmark) did the share of men who are the inventors of industrial property in the corporate sector increase in relation to all inventors in the other institutional sectors in these countries. And in this case it is difficult to find any relationship between the dynamics of changes in the patent activity of men (inventors of industrial property in the corporate sector) and the dynamics of changes in expenditure on R&D and dynamics of changes in employment in the enterprise sector.

As indicated in the comments and conclusions derived from the analysis of Table 2, the 11 countries in economic transition, which joined the EU after 2003, must be considered separately.

The leading post-communist countries, in terms of patent activity, belonging to the EU include Hungary (42.6% of the total industrial inventors of this group), Poland (17.7%) and the Czech Republic (16.8%). A total of 77.1% of inventors come from these three countries.

Figure 8 presents the dynamics of the share of intramural expenditure on the R&D sector in companies in relation to all other institutional sectors in the leading economies of the former communist countries.

Enter Figure 8 about here

In the years 1999-2013 there was a steady, high (nearly 4%) average annual growth of spending on R&D in the Hungarian corporate sector in relation to other institutional sectors. In the case of Poland 10 times weaker growth (just 0.4%) is visible, and there is a negative growth rate in the Czech Republic (-1.06%).

With Figure 8 we have Figure 9, which presents the dynamics of changes in the participation of women researchers employed in the business sector in relation to all researchers in all institutional sectors in the three leading EU countries.

Enter Figure 9 about here

In the years 1999-2013 there has been a continuous increase in the share of female researchers employed in the business sector in relation to all researchers in all institutional sectors in Hungary (close to 5% annual growth rate) and the Czech Republic (0.5% annually). In the case of Hungary, you can observe the relationship between the rate of increase in the share of expenditure on R&D activities in the enterprise sector and the growth rate of the participation of women employed in R&D units. For Poland the slight increase in expenditure on R&D corresponds to a slight decrease (0.53%) in the participation of women as researchers in the business sector. A similar analysis was performed for men (Figure 10).

Enter Figure 10 about here

In the given study period in the group of 3 countries of Central Europe there is increased participation of men in the group of researchers employed in the corporate sector in relation to researchers in all other sectors of the economy. The greatest growth was, as in the case of women, in Hungary (6.9%). Positive changes also took place in the Polish and Czech business sectors. With all due caution, you can generally find a clear positive relationship between expenditures on R&D in the enterprise sector in Hungary and the increasing employment of both women and men in research and development units in this sector. This phenomenon may be symptomatic of a future promotion of Hungary in EU innovation rankings, in which changes in the business enterprise sector determine the level of innovation in macroeconomic terms.

The last two figures (11 and 12) present the dynamics of inventive activity for men and women ending in the granting of patent protection.

Enter Figure 11 about here

The increase in expenditure on R&D, and employment growth correspond with an increase in the proportion of female inventors of industrial property in the business sector in relation to other sectors. This share, in the entire study period, from year to year grew in Hungary on

average by 4.55%. At the same time, Poland and the Czech Republic noted a significant decline in the share of women who are inventors of industrial property in the business enterprise sector. This share, in the entire study period, from year to year, decreased by an average of 7.91% for Poland and 14.69% for the Czech Republic.

Enter Figure 12 about here

The results presented in Figure 12 show the positive dynamics of the share of men who are inventors of industrial property in the business sector in relation to all inventors in all other sectors of the Polish (6.2%) and Hungarian (0.4%) economies.

Considering all the presented results of analyses for post-communist countries, only in Hungary can an explicitly clear positive correlation between all the parameters studied be noted. For the other post-communist countries it is hard to find such links.

Discussion and Conclusion

The study was aimed at seeking a general relationship between R&D activity and its results with regard to gender. The macroeconomic research perspective adopted allows the derivation of the following general findings:

1. Of the nearly 800 thousand people (citizens of EU countries) appearing in patent documentation (in European applications) and recognized as inventors, 52.5% come from Germany. In the group of men, it is nearly 54%. In the group of women, 37.2%.
2. Taking into account the demographic factors and recalculating the number of inventors (separately for men and women) per 1 million inhabitants of a given country the order is as follows: In men: Germany (21.3%), Sweden (14.6%), Finland (12.5%), Denmark (9.1%), France (7.9%), Austria (6.7%), United Kingdom (6.2%), Luxembourg (5.8%), and the Netherlands (4.4%). The share of other EU-28 countries is less than 3.0%. In women: Sweden (14.0%), Denmark (13.8%), Germany (13.0%), Finland (12.9%), France (9.7%), United Kingdom (6.6%) Italy (4.8%), Austria (3.5%), and the Netherlands (3.2%). The share of other EU-28 countries is less than 3.0%.
3. A total of 1% of inventors of new solutions protected by patent monopolies come from the 11 countries undergoing economic transformation and analysed. Taking into account demographic factors and recalculating the number of inventors per 1 million inhabitants of a given country, the economic transition countries represent 4% of the EU's creators, the while female inventors represent 10% of EU women inventors and men inventors account for 4%.
4. The years 1999-2013 have seen a continuous increase in the share of women researchers employed in the business sector in relation to all researchers in all institutional sectors in almost all countries covered by the analysis; the exception is Finland. The high growth of women's participation in the R&D teams of business sector entities in Spain (7.69%) and Denmark (3.3%) should be emphasized. There is increased participation of men in the group of researchers employed in the business enterprise sector in relation to researchers in all other sectors of the economy. Spain, France, the Netherlands, Denmark, Sweden, and Italy. A decline is observed, however, in the case of the UK, Germany, Finland, and Austria.
5. Regardless of the dynamics of expenditures on R&D, the dynamic of the growth of employment of women in the corporate sector there is a regularity that there is a

general increase in the proportion of women inventors in the business sector in relation to all the other inventors working in the remaining institutional sectors of the countries surveyed. The greatest rate of growth is noted in: Spain (average annual increase women's participation in invention activities completed by obtaining a patent monopoly is 4.8%), Denmark and the United Kingdom (3.7%), Italy (3.6%), and Germany (3.5%). Only in three of the EU countries included in the analysis (Sweden, Austria and Denmark) did the share of men who are the inventors of industrial property in the corporate sector increase in relation to all inventors in the other institutional sectors in these countries.

6. In terms of patent activity, the leading post-communist countries belonging to the EU include Hungary, Poland, and the Czech Republic. A total of 77.1% of inventors come from these three countries.
7. The increase in expenditure on R&D, and employment growth correspond with an increase in the proportion of female inventors of industrial property in the business enterprise sector in relation to other sectors. This share, in the entire study period, from year to year grew in Hungary on average by 4.55%. At the same time, Poland and the Czech Republic noted a significant decline in the share of women who are inventors of industrial property in the business sector. This share, in the entire study period, from year to year, decreased by an average of 7.91% for Poland and 14.69% for the Czech Republic. Only in Hungary can an explicitly clear positive correlation between all the parameters studied be noted. For the other post-communist countries it is hard to find such links.

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Patent results of men's and women's R&D activities

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