Ewa Okoń-Horodyńska
Tomasz Sierotowicz
Rafał Wisła

Measuring Patent Activity of Economic Branches with the Use of Concordance Tables

INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

PATENT OFFICE OF THE REPUBLIC OF POLAND

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Original Title: Pomiar aktywności patentowej gałęzi gospodarki z wykorzystaniem tablic konkordancyjnych

Free copy

Translation, proofreading, editing
and typesetting by Skrivanek Sp. z o.o.

Contents

Introduction

The results of research and development work have lately become particularly desirable assets. The needs and demands of the real economic domain spur enterprises, and partly the world of science as well, to direct their resources towards research which finds applications. This behaviour changes the structure of investment expenditure (with a great shift towards investments in intangible assets), of planned and targeted scientific research (including industrial research) carried out in large and usually interdisciplinary teams, of the expectations for commercial application of the obtained results, etc.

The products of knowledge are often a source of innovation (i.e. the products are economically used, including improved or innovative engineering, processing or organisational solutions); hence they influence the operational effectiveness of businesses and the structural changes in the economy. The strength of this influence varies depending on the nature of innovation.

The theory of economy tries to grasp the logic of the changes by expressing them as general statements, usually deprived of any application value (i.e. of little use to economic policy) or as rules with a local significance. Both are formulated with the use of two methodological categories: induction and deduction. This paper employs methods based on observations and general conclusions derived from the observations. An attempt to identify the presumed rules by using a specific methodology of economic process measurement is a deterministic functional dependence.

This work touches on the current of research into the potential of employing patent statistics in research on development in science, engineering and innovation, as well as on structural changes of economy (see *Science and Engineering...*, 2010; Scheu, Veefkind, Verbandt, Molina, Absalom, Förster, 2006; Magerman, van Looy, Song, 2006; Griliches, 1990, et al.).

This paper formulates two main research goals. The first is to identify the branches of economy which demonstrate the highest and lowest patent activity; the other is to determine a pattern of interrelation between the number of patents obtained in a specific economic branch and changes in the share of that sector in the generated gross value added in the economy.

The aforementioned main goals, as well as other ones defined in the methodology part of the book, are achieved with the use of proprietary concordance tables (see Annex No. 1 and 2). The concept of the proposed research approach is based on the functional dependence $f:IPC \rightarrow NACE$, i.e. assignment of the International Patent Classification (IPC) to the Statistical Classification of Economic Activities in the European Community (NACE).

International comparative studies are frequently carried out using various economic classifications (Triplett, 1993). Regional public statistics organisations and executive agendas of the European

Commission list patent activity in their report according to conventional (in the economic sense) sectors and branches of the economy. The definitions of these sectors and branches are largely simplified and superficial. These traits, however, are also found in other scientific attempts to represent the IPC as NACE.

Thus, despite their cognitive value, the aforementioned main research goals aimed to aid a fragmentary discovery of certain regularities, should be considered as secondary and extra work in this book. Two concordance tables (see Annex No. 1 and 2) which can be applied in various economic research are the basic added value and an important contribution to the development of methods for measuring economic processes. One of the values is examinating interdependence (a fragment) of industrial innovative activity and its relation to the changes in generating gross value added (GVA) in the economy. The map of assigning categories to both classifications, presented in the book, gains proportional value with access to quality raw data; hence it becomes a more useful research tool.

Empirical verification of the proposed approach uses statistics of patents awarded between 1995 and 2009 to entities registered in Poland, Ireland, Spain and Hungary. (Chapter IV explains the criteria for sample selection).

Repositories of patent statistical data made public (public statistics, databases of regional patent offices) fail to ensure precise exploration of their resources (due to the weakness of data exploration tools)[1]. Hence a commercial database was used, i.e. *Thomson Innovation* by Thomson Reuters.

The nature of this work and of the employed research procedure necessitates the use and verification of its feasibility in empirical research. As a result, two research hypotheses were formulated, i.e. assumptions based on a certain probability which stems from the latest knowledge and research experience.

Productivity is among the most important determinants of economic growth, payroll growth and general social prosperity. One of the components of productivity is changes in technology and manufacturing technology (Solow, 1957; Uzawa, 1965; Denison, 1967; Romer, 1990; Barro, Sala-i-Martin, 1995; Francesco, Piantab, 2008). Hence: (1) the changes in the real economy should, to a certain extent, represent patent activity which in turn is the emanation of engineering changes.

In the economic perspective, the development of information and communication technologies is a potent accelerator of production processes. The special role of the ICT in the economy is that IT affects the development of nearly all technologies used in specific economic branches and they also contribute to increasing productivity of all factors engaged in the production process (Wierzbołowski, 2006; Welsum, Vickery, 2005). Hence it is assumed that (2) among all patent classification sections, electricity is the most exploited area in the context of awarded patent protection.

The adopted goals are achieved and research hypotheses verified in the following chapters of this book, which consists of an introduction, four highly interrelated chapters, conclusions and annexes which constitute a necessary complement of this discourse.

The first chapter is an argument for the use of patent statistics in research on innovation. Patent documentation is a rich source of information about the directions of ongoing research programmes, invention activity and the innovative and competitive potential of the economy and its entities. Chapter I stresses the high quality of the data which allows its aggregation at any level: micro-, meso-

1 See: http://worldwide.espacenet.com

and macroeconomic, as well as on an international level. This is why patent activity is an important component of all algorithms for measuring the innovation level of economy and its entities (including various indexes and international rankings).

Chapter II, in its opening part, extends the argument of the previous chapter and shifts to present the significance of statistical classifications in scientific research. The classifications are the basis for the generation and collection of data and information; their use, processing and interpretation followed by inference creates knowledge. The way of conducting scientific research changes with the development in the IT structure of digital repositories[2]. Discovering knowledge with the use of distributed databases and the integration of generally accepted statistical classifications involves searching for distinct patterns and rules which were previously unknown. This study lays the structure of a research process on, for instance, assuming feasibility to integrate two different economic classifications, i.e. the Statistical Classification of Economic Activities in the European Community (NACE) and the International Patent Classification (IPC). Hence Chapter II contains a synthetic description of those classifications solely from the perspective of their subsequent use in the next chapter.

Chapter III, which concentrates on methodology, articulates the main goals and partial research. It also presents the method and the algorithm used in the research on determining the potential presence of an interdependence pattern between the patent activity of economic branches and changes in their share in the generated GVA. Annex No. 1, 2 and 3 correspond to that chapter as integral parts of the presented procedure.

The final section of this book is the empirical verification of the proposed research method. Patent statistics based on approx. 15 thousand records (awarded patents) from the commercial patent database by Thomson Reuters for the years 1995-2009 form the original material (raw data) in the study. During the analysis, apart from the derived general and partial conclusions, questions are formulated which set the directions for further examination by the authors.

2 Present method of scientific research: formulation of hypothesis → research design and performance → analysis of results → evaluation of hypothesis. The new method: formulation of hypothesis → search of data to test the hypothesis → analysis of results → evaluation of hypothesis.

Chapter I
Patent activity in research on innovation

1.1. Patent as a measure of engineering innovations

1.1.1. Patent

A patent is the right for explicit use of a specific invention. Irrespective of the technical field, a patent is granted to inventions which: are new[3], have the inventive step[4], and are fit for industrial application[5]. The patent is considered to be one of the sternest intellectual property rights. It is a formal right officially granted by a national or regional patent office (Ożegalska-Trybalska, 2009).

At the time of creating an invention, its creator – or other entities under special circumstances (i.e. an employer or contracting authority) – acquires the subjective right of the opportunity for applying for legal protection. Based on the granted patent, the patent holder acquires the right of explicit use of the invention. This right is transferable and inheritable.

Inventions are patented in the following categories: (1) method, (2) process, (3) apparatus, (4) use. The creations not eligible for patenting include: (1) discoveries, scientific theories and mathematical methods; (2) aesthetic creations; (3) schemes, rules and methods of performing mental acts, playing games or doing business; (4) creations with an unfeasibility for use which can be demonstrated in light of generally accepted and acknowledged rules of science; (5) computer programmes; (6) presentations of information.

Depending on the territorial jurisdiction in which an invention is to be protected, the patent can be obtained in the following manner:

1) under a domestic procedure by an application for the invention at the Polish Patent Office, followed by a formal inspection of the application correctness and paying applicable administrative fees

3 The novelty of an invention is evaluated on a global level. The new feature of an invention is construed so that an invention (engineering/technological solution) is considered to be new if it is not a part of the state of the art. Everything that has been disclosed to public knowledge before the date, in reference to which priority for the granted patent is determined, and in any form of disclosure, including: by written or oral description, by application, exposure or disclosure in any other manner is the state of the art.

4 An invention has the inventive step if the said invention is not apparent to those skilled in the state of the art.

5 An invention is fit for industrial application if it can be used in any industrial activity, including agriculture.

collected by the PPO; the patent granted by domestic procedure (i.e. national patent) is valid only in the territory under protection (i.e. of a single state only);

2) under a European patent procedure by a single application at the European Patent Office in accordance with the provisions of the European Patent Convention; once granted, the European patent protects the applicable invention in the countries identified in the application (a bundle of nationally enforceable patents);
3) under the Patent Cooperation Treaty (PCT) by a single 'international' application at: the Polish Patent Office, the European Patent Office or directly with the International Bureau of the World Intellectual Property Organization (IB WIPO). Under the two latter circumstances, an application can only be filed provided that a prior application was made under the domestic procedure.

If two persons apply for the protection of the same or similar solution, the patent protection is granted to the applicant whose application came first (i.e. has an earlier date of priority). The date which defines the priority of a solution is the date of filing at a patent office a complete documentation of the invention applied for protection, or the date of the first application of a solution in a foreign patent office in a state under the Paris Convention.

Patents are a result of: research and development; capacities and motivation of R&D teams (creative work, talent, imagination, creativity and invention); continuous search for improved use of limited resources (time, financial and material capital, or the state of the art). If generated by a managing entity, patents are utilised as intangible assets in the process of producing subsequent goods and services. If patents have an innovation capacity, they may contribute to: higher productivity, rate of sales, and the rate of competitive growth, both in the regional and global perspective. The benefit of monopoly which results from the priority in marketing of a new product is intended to return the costs incurred by developing an innovation, and it should also prompt such activity in the future. The risk of quick imitation or copying by competitors definitely requires establishing a system for the protection of intellectual property rights.

An effective system of protecting intellectual rights should favour increased expenditure on research and development, and increase innovation of the economy and its entities on an international scale, fostering an increased competitive position and a higher rate of economic growth. Engineering (industrial) intellectual property is especially important for economic growth and development. Not only does the process of their creation result in new products, but it also expands knowledge in the theory and practice of economic growth, management, and production processing.

By principle, a system for protecting intangible property rights should form a secure and creative space for the civilisation process, including economic growth. If the effectiveness of this system is poor or non-existent, the ownership title for intangible property is only conditioned by economic concerns (i.e. expenditure, risk, and marketing priority) and it becomes ineffective in confrontation with the market. An economic entity with the original (economically substantiated) property right is incapable on its own of stopping other economic entities from succumbing to the temptation of imitation.

Legal protection warranted by specialist organisations favours protection of an idea embodied in an invention; first and foremost it increases the probability of promptly exceeding the threshold of

innovation profitability. Innovation activity is characterised by high fixed costs incurred for R&D, high level of uncertainty and financial risk. The following is expected in exchange:

1) increased effectiveness of the management process (including increased productivity of production factors);
2) increased international competitive advantage (i.e. increased reliability of economic turnover).

Institutional solutions in the form of protection of intangible property, tax incentives for innovative business, and education for pro-innovation behaviour and the intellectual property culture are economic movers and preconditions for increasing competitive capacities of the economy and its entities.

1.1.2. Patent databases

The two main characteristics which are generally used for describing and measuring what is generally construed as innovation are: expenditures for research and development, and patent applications and/or granted patents (*The Community Innovation...*, 2006; *Oslo Manual*…, 2005; Decision (…) No. 1608/2003/EC…, *Frascati Manual*…, 2002; *The Measurement of Scientific*…, 1994, et al.). An important merit of patents and collections of patent information (i.e. databases) is their long-term availability (for even tens of years). This makes them tremendously useful in scientific research. The contents of patent databases and the wide time frames of their description allow for data aggregation on any level. In the case of research on innovation on the micro-, meso- and macroeconomic levels, patent databases enable one to describe the following traits of innovative activity:

1) the level of novelty of the products of research and development activity (R&D);
2) types of developed innovations and technological competencies;
3) sources of innovation;
4) dissemination of knowledge and technology.

The level of novelty of the products of research and development activity. Patent applications have been used in the research process for many years (see Griliches, 1990; Jaffe, Fogarty, Banks, 1998; Lanjouw, Pakes, Putnam, 1998; Johnson, 2002; Popp, 2005). A strict correlation between R&D activity, patents and their effect on stimulating further R&D work is highlighted. Not all patent applications end in one being granted. The difference between applications and granted patents can be used as a measure of R&D effectiveness.

Types of developed innovations and technological competencies of an entity. Each patent provides a detailed description of the invention and is classified in a specific class, group and subgroup of the International Patent Classification (see Chapter II). A hierarchical arrangement of the system favours examinations of patent applications for the criteria of novelty and inventive step; it also allows for precisely researching technological trends, both on the microeconomic (i.e. the innovations developed in specific corporations) and macroeconomic level (i.e. identification of technological advantages of the economy).

Sources of innovation. In 2010, the United States Patent and Trademark Office granted 219,614 patents, with 107,792 patents of US origin and 111,822 from abroad. The structure of granting this category of exclusive rights among U.S. residents was as follows (*Patenting...*, 2011, p. A1-1): corporations (88.3% of grants), private persons (10.8%), U.S. federal government (0.9%); foreign entities: corporations (95.6%), private persons (4.2%), government administration (0.2%). The largest number of patents in 2010 was granted under USPTO's proceedings to:

1) International Business Machines Corporation (5,866 patents);
2) Samsung Electronics Co., Ltd. (4,518);
3) Microsoft Corporation (3,086);
4) Canon Kabushiki Kaisha (2,551);
5) Panasonic Corporation (2,443);
6) Toshiba Corporation (2,212);
7) Sony Corporation (2,130);
8) other: Intel Corporation, LG Electronics INC., Hewlett-Packard Development Company, L.P., Hitachi, LTD, Seiko Epson Corporation, Fujitsu Limited, General Electric Company, Ricoh Company, LTD., Cisco Technology, INC., Fujifilm Corporation (range: 1700 to 1000).

The available data concerning patent applications to the European Patent Office (see *Science, technology...*, 2009, 2010) reveals the following structure of patent activity by the applying entities: enterprise sector (86% of all applications), private persons (6.6%), government administration (1.1%), private non-profit sector (1.7%), university education sector (1.5%), other (3.1%).

Dissemination of knowledge and technology can occur with the use of patents, non-patented inventions, licences, shared know-how, trademarks, projects and designs. For at least 20 years there have been attempts at measuring the diffusion of knowledge and technology with the use of patent databases, market transactions, or the search for connections between technical innovation producers and their users (see Jaffe, 1986; Coe, Helpman, 1995; Lanjouw, Pakes, Putnam, 1998; Jones, Williams, 1998; Stoneman, 2002, Verspagen, 2005). The measurement methodologies which have been developed so far put stress on various aspects of the diffusion process; the process of improving measurement of the knowledge and technology dissemination power is still far from completion.

Hence patent databases can be used in various ways. The number of granted patents for an enterprise, sector or regional economic branch and/or a country reflects the technological dynamics. Investigation in the rate of change, and seeking interdependencies within patent classes and groups can help discover the directions and dynamics of technological changes. The study uses patent statistics as an element of the algorithm for searching the interdependence pattern between industrial patent activity and changes in its share in GDP generation.

Flaws of patents as innovation characteristics are well known. Many new or improved solutions are not claimed, whereas others are simultaneously protected by many patents and/or other forms of protection. Many patents have no technological or economic value; while others are very valuable in those terms (cf. *Oslo Manual...*, 2005, p. 25).

The chief international patent databases maintained and made available by various organisations include:

1) *European Patent Register* and *Espacenet* – databases maintained by the European Patent Office;
2) *Patentscope* – database maintained by the World Intellectual Property Organization;
3) *DEPATISnet* – database and a news service of the German patent system;
4) USPTO (USA) – a full-text database of applications and granted patents;
5) *Thomson Innovation* – a commercial database which allows exploring vast structured collections of applications and granted patents.

Other, frequently thematic databases include: Cippix® (chemistry); Delphion (integrates the databases of USPTO, EPO and WIPO); GenomeQuest (biology) and "JP-NETe"; KPA Search In KIPRIS – Free Services; LexisNexis; MicroPatent[6].

1.2. Patent activity in the international innovation rankings

The main characteristics (indexes) used in building international innovation ratings are: the number of doctorate graduates, the number of scientific publications, the number of scientific centres, the amount of expenditure for R&D and the patent activity (claims and granted patents). All of these are generally collected and processed by national and regional organisations of public statistics. They are considered to be traditional forms of innovation measurement.

Patent activity is a significant component of all algorithms for measurement of the innovation level of the economy and its entities. It greatly reflects the capacity of enterprises to transform accumulated knowledge into improved or novel technical solutions. Hence the international indexes of economic effects measurement tend to use the statistics of patent claims and/or granted patents. This is substantiated and reflected by the approach recommended by the Organization for Economic Co-operation and Development and the European Commission in successive editions devoted to methods of gathering and interpreting datasets on innovation (see *Oslo Manual*…, 1992, 2005; *The OECD Innovation Strategy*…, 2010).

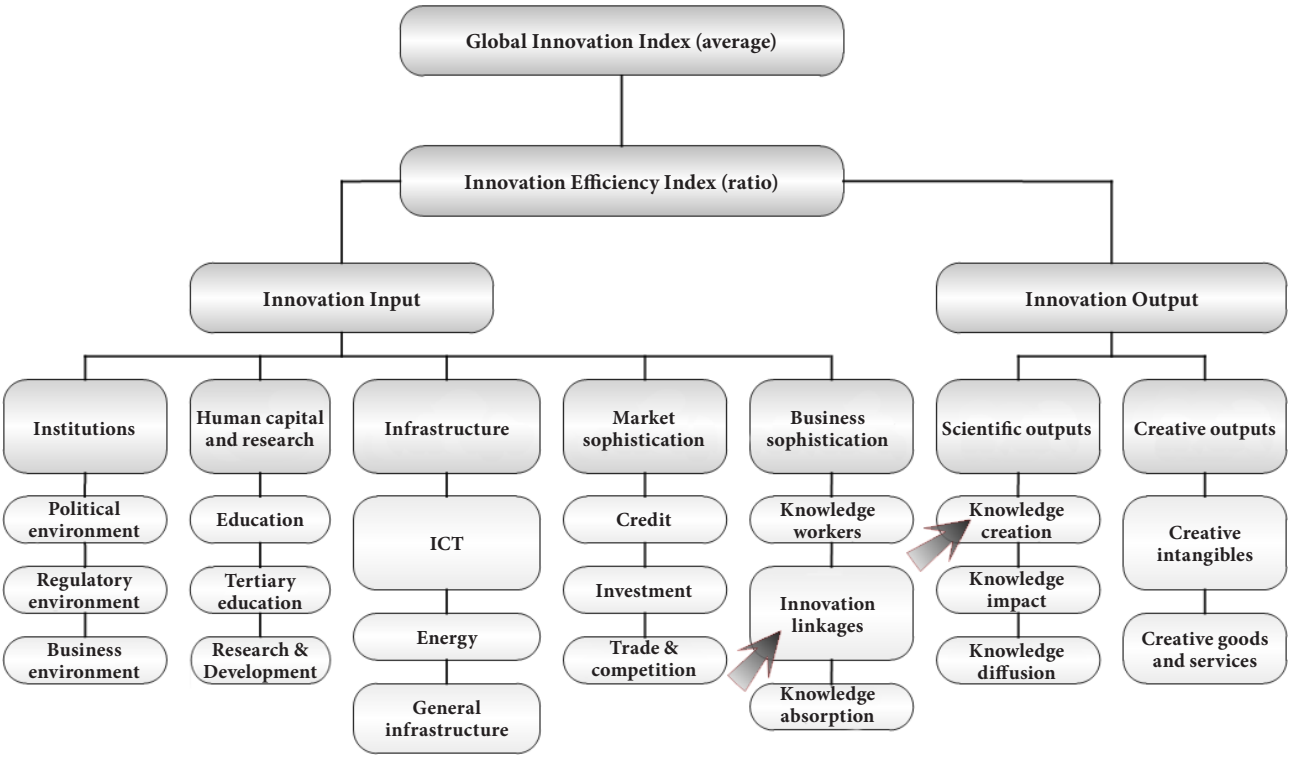
1.2.1. The Global Innovation Index

Since 2007, INSEAD The Business School for the World eLab[7] has been publishing the Global Innovation Index (GII). It consists of two sub-indexes: The Innovation Input Sub-Index and The Innovation Output Sub-Index. Each one is made of several components. The first sub-index includes: (1) institutions, (2) human capital and research, (3) infrastructure, (4) market sophistication, and (5) business sophistication. The other sub-index covers: (6) knowledge and technology outputs and (7) creative outputs. Each component is made of several subcomponents, and the latter in turn are built on the basis of composite indicators (*The Global Innovation Index*…, 2011, p. 8).

The component (5) business sophistication level consists of three subcomponents: (5.1) knowledge workers, (5.2) innovation linkages, and (5.3) knowledge absorption. The section on innovation

6 See more: http://www.piug.org/vendors.php
7 See http://about.insead.edu

Figure 1. Patent activity within the architecture of the Global Innovation Index (GII)



Source: The Global Innovation Index 2011. Accelerating Growth and Development (2011), ed. S. Dutta, INSEAD, p. 9.

linkages includes a composite quantitative indicator within the PCT patent filing proceedings (in total applications) in cooperation with a foreign inventor (partner)[8].

The component (6) scientific outputs comprise three subcomponents: (6.1) knowledge creation, (6.2) knowledge impact and (6.3) knowledge diffusion. The first part which concerns the "production" of knowledge has the following measures introduced based on patent statistics:

1) the number of patent applications by residents under the domestic procedure;
2) the number of patent applications under the international filing procedure.

The 2011 GII Report includes 125 countries which represent 93.2% of the global population and 98% of the global GDP.

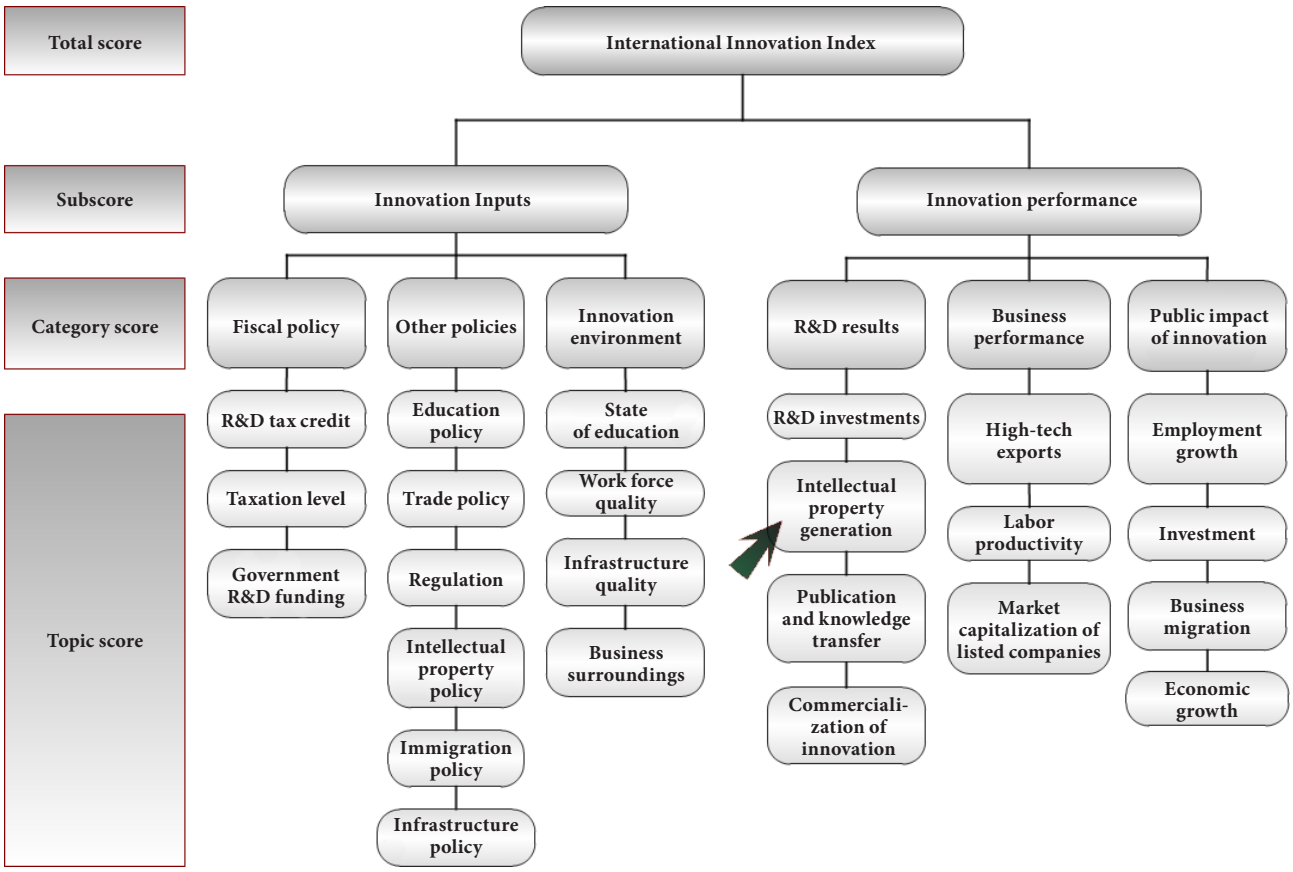
1.2.2. The International Innovation Index

In 2009, the Boston Consulting Group/National Association of Manufacturers published for the first time *The BCG/NAM International Innovation Index*. The index is also a ranking of U.S. regions (states) and a ranking of countries. The index structure is based on two components: innovation inputs and innovation performance. The first component includes: (1) fiscal policy, (2) other policies,

8 The regulations for the PCT procedure are listed e.g. in the publication of the Polish Patent Office of 2007 titled *The Patent Cooperation Treaty (PCT). Consolidated text of the Regulations for the Patent Cooperation Treaty* and in *PCT Administrative Instructions* issued in 2006.

(3) innovation environment. The other index component encompasses: (4) R&D results, (5) business performance and (6) public impact of innovation.

Figure 2. Patent activity within the architecture of the International Innovation Index (The BCG/NAM Index)



Source: The Innovation Imperative in Manufacturing: How the United States Can Restore Its Edge (2009), Boston Consulting Group/National Association of Manufacturers, Boston, p. 9.

The component (4) – R&D results – has four subcomponents: (4.1) R&D investments, (4.2) intellectual property generation, (4.3) publication and knowledge transfer, and (4.4) commercialisation of innovation. The part concerning the creation of intellectual property includes a composite index of the number of patent applications.

1.2.3. The European Community Innovation Index

The ranking has been prepared for nearly 10 years by the Maastricht Economic and social Research and training centre on Innovation and Technology (UNU-MERIT) and with the participation of the European Commission (*Innovation Union Scoreboard…*, 2011).

The structure of the *Innovation Union Scoreboard* (IUS) is based on three main indicator groups which are further developed within 8 topical dimensions and preconditions of innovation. Patent activity is researched in the second group, "Firm activity", under the topic "Intellectual assests".

The detailed indicators here are:

1) the number of PCT (Patent Cooperation Treaty) patent applications received by the European Patent Office;
2) the number of PCT (Patent Cooperation Treaty) patent applications in climate change mitigation and health care received by the European Patent Office (EPO).

Table 1. Comparison of the partial indicators used in the innovation research methodology in *The European Innovation Scoreboard* (up to 2009) and *Innovation Union Scoreboard* (from 2010) in the second main group, "Firm activity"

European Innovation Scoreboard (EIS), 2009 Main type/innovation dimension/indicator	Innovation Union Scoreboard (IUS), 2010 Main type/innovation dimension/indicator	Comments	Data source	Reference year – the last years of use of the Innovation Union Scoreboard 2010
Firm activity				
Firm investments				
2.1.1. Business R&D expenditures (% of GDP)	2.1.1. R&D expenditures in the business sector (as % of GDP)	Identical	Eurostat	2005–2009
2.1.2. IT expenditures (% of GDP)	–	EIS 2009 – currently not used	–	–
2.1.3. Non-R&D innovation expenditures (% of turnover)	2.1.2 Non-R&D innovation expenditures (as % of turnover)	Identical	Eurostat	2004, 2006, 2008
–	Linkages & entrepreneurship			
2.2.1. SMEs innovating in-house (% of SMEs)	2.2.1. SMEs innovating in-house (% of SMEs)	Identical	Eurostat	2004, 2006, 2008
2.2.2. Innovative SMEs collaborating with others (% of SMEs)	2.2.2. Innovative SMEs collaborating with others as % of SMEs	Identical	Eurostat	2004, 2006, 2008
2.2.3. Firm renewal (SME entries plus exits) (% of SMEs)	–	EIS 2009 – currently not used	–	–
2.2.4. Public-private co-publications per million population	2.2.3. Public-private co-publications per million population	Identical	CWTS/ Thomson Reuters	2004–2008
Throughputs	**Intellectual assets**			
2.3.1. EPO patents per million population	–	EIS 2009 – currently not used	–	–
–	2.3.1. PCT patents applications per billion GDP (in PPS€)	New indicator	Eurostat	2003–2007
–	2.3.2. PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigration, health)	New indicator	OECD/ Eurostat	2003–2007
2.3.2. Community trademarks per million population	2.3.3. Community trademarks per billion GDP (in PPS€)	Different denominator	OHIM/ Eurostat	2005–2009
2.3.3. Community designs per million population	2.3.4. Community designs per billion GDP (in PPS€)	Different denominator	OHIM/ Eurostat	2005–2009
2.3.4. Technology Balance of Payments flows (% of GDP)	–	Revenues accounted by IUS 2010, indicator no. 3.2.5	–	–

Source: Hollanders H., Tarantola S. (2011), Innovation Union Scoreboard 2010 – Methodology report, MERIT (Maastricht University) and Joint Research Centre (JRC), Unit G3, p. 5.

A new formula for the aforementioned characteristics was introduced in 2010. Both are cited as the number of patent applications per 1 billion of the Gross Domestic Product in Purchasing Power Parity Euros. OECD and Eurostat datasets are the main source of raw data for calculating the indicators.

Before 2009, the patent applications and granted patents were calculated per 1 million inhabitants. The change in the structure of the aforementioned indicators provides a better representation of the interdependency between patent activity and changes in the real economy activity.

1.2.4. The Global Innovation Index

The innovation ranking made by the Economist Intelligence Unit (*A new ranking...*, 2009) is based on two pillars: *Innovation Output* and *Innovation Input*. The first pillar covers mainly the patent statistics in the portion of the granted patents from the European Patent Office (EPO), the Japanese Patent Office (JPO) and the US Patent and Trademark Office (USPTO).

The value included in the index is an arithmetic mean of the granted patents per 1 million inhabitants in a 4-year period; example: the period covered the years 2002-2005 in the (first) 2007 index, and 2004-2007 in the 2009 index.

The Innovation Input pillar encompasses a very wide economic, social and political context, as well as the direct determinants of innovation, e.g. qualifications of workforce, quality of local research infrastructure and quality of education.

1.3. Patent activity in meso- and microeconomic research

Innovation and innovation capacity of economic systems, domestic economies and enterprises have been one of the main research problems of economic sciences for the last two decades. As the integration processes progress, this package of research is completed with the problem of innovation in the economy of regions[9].

Subsection 1.2 presents the use of patent statistics in the rankings of innovation on the macroeconomic level. This section also focuses on patents and their application in the research of innovation on the meso- and microeconomic levels.

1.3.1. Role of innovation in regional development and measurement of innovation

Innovation as a stimulant of productivity is a component of the paradigm of endogenous development and the contemporary model of regional development policy.

The authors of the endogenous development concept assume that the development processes are based on internal accumulation of capital and knowledge within countries and regions (see Myrdal, 1957; Kaldor, 1966). This assumption strongly corresponds to the neoclassical model of growth developed by Solow and Swan, which proposes an automatic convergence of development processes in specific economies which enter the identical path of growth in the stationary state (Barro,

9 The concept or a region has a very wide set of connotations. This work construes the term 'region' as a territorial unit with a certain autonomy within a country, where decisions are made which affect the course of development processes.

Sala-I-Martin, 1995). Other researchers are sceptical towards the concept of spontaneous decrease of economic disproportions. Krugman (1998) argues that there is a set of forces (negative external effects, immobile factors, and other) which can lead to economic concentration resulting in the centre-peripheries structure.

Endogenous development can progress in accordance with two main scenarios:

1) creation of a new endogenous asset in the region (by: expenditure on education, science, R&D, privatisation of public utility enterprises, opening to external capital);
2) modernisation of regional endogenous assets (by: intensification of promotion activities, improvement of communication and tourism infrastructure, increase in workforce productivity within traditional economic divisions of the region).

Initiation of these processes helps increase the chance for a stable, sustainable and long-term development of regional economy and its entities.

As a formality another important goal of regional policy should be stressed, aside from a productivity increase, i.e. elimination of differences. This goal is achieved by following the paradigm of exogenous (induced or top-down) development which stresses the importance of external factors (e.g. interventions by governments and third-party business investments) in the generation of development movers stimulating the regions, *inter alia* within their innovation. The paradigm emphasises the necessity of inducing the first stimulus which triggers the development process. This approach implies that systematic redistribution of resources towards problem areas is necessary to prevent their marginalisation (see Szul, 2007).

Contemporary policy of regional development uses the output of neoclassical theories and demand theories to a similar extent. A new trend is a strong emphasis on the need for accumulating knowledge resources and its output in the region[10]. A great importance for the process is imparted by:

1) the sector of small and medium enterprises whose prime attributes include flexibility and innovation capacity;
2) regional development policy aimed at development of education and promotion of enterprise innovation activity;
3) the sector of large enterprises which is capable of incurring large expenses on R&D that conditions the creation internationally competitive innovations.

Hence even the best designed exogenous instruments for supporting regional development will fail if the regional endogenous physical and social resources cannot be activated (the endogenous concept of regional development).

The regional differences in the inventive step activity result from the nature of endogenous traits and available resources, the intensity of R&D activities in specific economic branches of the region, and the dimension of applying the regional innovation policy (regional innovation systems and strategies).

The regional perspective of innovation is a new trend in social research. It emerged, for instance, as a response to the demand of the local government administration and regional innovation support organisations also to create and implement regional innovation support programmes. The research in innovation in the European Union is related to the development of the Community policy of

10 As confirmed by the provisions of the regional development strategies in the EU, including Poland.

regional development and the need to measure the effect of the policy on regional economies. In successive years, the research was also determined by the cohesion policy and the Lisbon strategy. The methodological facilities developed so far, e.g. for measuring and assessing the effect of public intervention on regional development potential will certainly be developed and employed in the forthcoming years. The new long-term financial perspective of the EU will bring new R&D challenges and a necessity for continuous control of results in this domain[11].

The research on innovation of regions continuously evolves, both for the number of indexes in use and the number of investigated regions. For example, the Regional Innovation Scoreboard (RIS) of 2002 used 7 indicators and covered 148 regions; in 2003, this increased to 13 indicators (and 173 regions). After the EU expansion in 2004, the number of employed and analysed regional-level indexes was limited to 7 (due to the lack of data concerning new member states). The years after have revealed a clear improvement[12].

Research carried out in 2002 and 2003, for the EU15 group[13], used high-tech sector statistics of patent applications[14] (EPO filings). The research of 2006 temporarily omitted the characteristics for the EU25 group[15] (*Regional Innovation Scoreboard...*, 2009, p. 28).

The current research into regional innovation (of the EU) again uses patent applications. The research considers the number of PCT patent applications received by the European Patent Office[16]. This variable is given the highest importance in the algorithm of the RIS Summary Innovation Index (a 13.8% share in the Index).

Table 2. List of regional statistics in the Eurostat Science and Technology division: patent applications (EPO) on the regional level

Indicators of regional science and technology statistics (part: *Patent applications to the EPO by priority year at the regional level*)	Symbol	Type	Data	
			from	to
Patent applications to the EPO by priority year at the regional level	pat_ep_rtot	dataset	1977	2007
Patent applications to the EPO by priority year at the regional level by IPC section and classes	pat_ep_ripc	dataset	1977	2007
High-tech patent applications to the EPO by priority year at the regional level	pat_ep_rtec	dataset	1977	2007
ICT patent applications to the EPO by priority year at the regional level	pat_ep_rict	dataset	1977	2007
Biotechnology patent applications to the EPO by priority at the regional level	pat_ep_rbio	dataset	1977	2007

Source: Eurostat, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database, 1.10.2011.

11 The new building stage of the European Research Area – a homogenous market for knowledge, research and innovation (see http://ec.europa.eu/research/consultations/era/consultation_en.htm).

12 A result of the harmonisation, standardisation and implementation of the Community law standards in public statistics.

13 EU15 – 15 member states of the European Community before the enlargement of May 2004.

14 As an example, Eurostat includes the following NACE classification division numbers in the high technology sector: 24.4; 30; 32–33; 35.3 (Science, technology…, 2009, p. 186).

15 EU25 – 25 member states of the European Community after the enlargement of May 2004. 27 member states from January 2007 (UE27).

16 See: Eurostat – Data Navigation Tree: Database/General and regional statistics/Regional statistics/Regional science and technology statistics (reg_sct)/European patent applications to EPO (reg_pat)/Patent applications to the EPO by priority year at the regional level (pat_ep_rtot).

The Eurostat data repository for patent statistics contains the following selection criteria:

1) high-tech sector patents (total);
2) computer equipment and other automatic equipment used in business;
3) genetic engineering;
4) aviation;
5) communication technologies;
6) semiconductors;
7) lasers;
8) consumer electronics;
9) business electronics.

Apart from patent statistical data, the European "Science and Technology" regional statistics also includes the following modules: research and development; the Community Innovation Surveys (CIS) database employed in successive years for the European Innovation Scoreboard / Innovation Union Scoreboard; high tech sector with industries which intensely use knowledge and human resources in science and technology (HRST)[17].

The increase in the significance of economies on the regional level and in the significance of the European regional development policy followed by decentralisation within individual states subject the regional statistics to frequent modifications. The modifications involve improvement and implementation of new methods and tools for gathering and processing data from the area. The problems which have been intensely exploited and transposed to the regional level in recent years are:

1) IT and communication technologies (*A Guide for Information Society…*, 2005);
2) biotechnology (*A Framework for Biotechnology…*, 2005);
3) knowledge management (*Measuring Knowledge…*, 2003);
4) impact of global processes (*Handbook on Economic…*, 2005).

The methodological work carried out under the OECD are intended to design and continue the development of a new generation model of indicators which accounts for a systemic approach to the processes of creation, diffusion and implementation of knowledge in economic practice (input, throughput and output indicators). The operators of data repositories meet the new methodological guidelines by, e.g. designing new tools for patent statistics[18].

1.3.2. Patent statistics in the measurement of business innovation

In order to gain knowledge about innovation of industrial enterprises in the European Union, as a part of the international research programme called "Community Innovation Survey" (CIS), national statistical offices assess the innovation level of businesses employing more than 9 persons. The methodological aspect of the research is inspired by the guidelines of the Oslo Manual (2005). The indicators employed in the CIS research are aggregated in 12 thematic groups; one of them being "Innovation activity and expenditure on product and process innovation". The group

17 The innovation statistics is regulated by, e.g. The Commission Regulation (EC) No. 1450/2004 of 13 August 2004 implementing Decision No. 1608/2003/EC of the European Parliament and the Council concerning production and development of the Community statistics on innovation.

18 E.g. the PATSTAT repository (Worldwide Patent Statistical Database, EPO) managed by the European Patent Office (EPO).

includes a survey question about the purchase of licences or patents and other patented inventions (*The Community...*, 2010). The previous *Community Innovation Survey 2006-2008* included a query on patent applications (*Community...*, 2009).

The surveys by the Central Statistical Office in the area of innovation in Poland are carried out within two main programmes:

1) the annual survey of innovation and R&D in science and industry, "Science and Technology"; this research employs patent databases to present the following detailed statistics (CSO, 2011):
   - foreign patent applications filed in Poland and granted patents by countries;
   - patent applications and granted patents by technology sections pursuant to the IPC;
   - patents granted to Polish residents in the United States;
   - patent applications and granted patents in biotechnology;
   - foreign patent applications filed with the Polish Patent Office and granted patents by selected countries;
2) regular survey of enterprise innovation (in industry and services), based on international methodological guidelines by the OECD and Eurostat as applied in the Community Innovation Survey; the research does not employ patent statistics (CSO, 2010).

***

Patent statistics and its use in economic research is not a widely popular subject. The main research areas (apart from research on innovation) which use patent statistics include:

1) comparative studies (Pohulak-Żołędowska, 2009; Liberda, 2008; Cohen, Merrill, 2003, Martinez, Guellec, 2003; Jaffe, Trajtenberg, 1996; Jaffe, Henderson, Trajtenberg, 1993; Pakes, 1985);
2) investigating changes in engineering and technology (Popp, 2005);
3) research methodology (Lanjouw, Pakes, Putnam, 1998; Jaffe, Fogarty, Banks, 1998; Griliches, 1990).

1.4. Selected application examples of patent statistics

Patent documentation is a rich source of information about the directions of ongoing research programmes, invention activity and the innovative and competitive potential of the economy and its entities. The final part of this chapter presents two examples of patent statistics application in socio-economic studies. The first example is related to the proposed use of the IPC to describe the development of an information society; the other one is a case study of a global enterprise, International Business Machines.

1.4.1. Methodology of measuring the information society

Despite numerous controversies related to describing the information society (Bendyk, 1999; Doktorowicz, 2002; Mattelart, 2004; van Welsum, 2005; et al.), the majority of definitions reveal a common theme. That is, information and communication technology (ICT). The OECD manual (2009) highlights very clearly the ICT as a basic element of a quantitative (statistical) model description of the information society. The OECD guidelines (2009) are a result of many years of conceptual work by Schmookler (1966), Scherer (1982), Evenson and Putnam (1988), and Griliches (1990).

The methodology of measuring the information society uses a selection of IPC subclasses and subgroups which define the ICT sector (OECD, 2009). Table 3 lists these subclasses and subgroups.

Table 3. ICT sector mapping with IPC

IPC codes	Description
Telecommunications	
G01S	Radio navigation
G08C	Transmission systems for measured values, control or similar signals
G09C	Ciphering apparatus
H01P, H01Q	Waveguides, resonators, aerials
H01S003–025, H01S003–043, H01S003–06, H01S003–085, H01S003–0915, H01S003–0941, H01S003–103, H01S003–133, H01S003–18, H01S003–19, H01S003–25, H01S005	Laser conductors
H03B–D	Generation of oscillations, modulation, demodulation
H03H	Impedance circuits, resonators
H03M	Coding, decoding
H04B	Transmission
H04J	Multiplex communication
H04K	Secret communication
H04L	Transmission of digital information
H04M	Telephonic communication
H04Q	Selecting, relays
Consumer electronics	
G11B	Information storage based on relative movement between a record carrier and transducer
H03F, H03G	Amplifiers, control of amplification
H03J	Tuning resonant circuits
H04H	Broadcast communication
H04N	Pictorial communication, television
H04R	Acoustic electromechanical transducers
H04S	Stereophonic systems
Computers and office appliances	
B07C	Postal sorting
B41J	Typewriters
B41K	Stamping devices
G02F	Devices for the control of the intensity, colour, or direction of light
G03G	Electrography
G05F	Systems for regulating electric or magnetic variables
G06	Computing, calculating, counting
G07	Checking-devices
G09G	Arrangements or circuits for control of indicating devices using static means to present variable information
G10L	Speech analysis or synthesis
G11C	Static stores
H03K, H03L	Pulse technique, automatic control, synchronisation or stabilisation
Other	
G01B, G01C, G01D, G01F, G01G, G01H, G01J, G01K, G01L, G01M, G01N, G01P, G01R, G01V, G01W	Measurements, testing
G02B006	Optical waveguides
G05B	Control or regulating systems
G08G	Traffic control systems
G09B	Educational or demonstration appliances
H01B	Cables, conductors
H01J011, H01J013, H01J015, H01J017, H01J019, H01J021, H01J023, H01J025, H01J027, H01J029, H01J031, H01J033, H01J040, H01J041, H01J043, H01J045	Electric discharge tubes or discharge lamps
H01L	Semiconductor devices

Source: OECD, (2009), Guide To Measuring The Information Society, 2009, p. 39.

The nature and objectives of this work do not allow extensive side themes, so the reader is encouraged to refer to the indicated sources, and/or to study the following chapters of this book. This will help to thoroughly understand the contents of Table 3.

1.4.2. Patent activity of International Business Machines

IBM is a classic example of a global corporation. It has over 90 subsidiaries. The majority have an international range of operations (covering 170 countries). IBM is not a homogenous corporation and runs several businesses in different sectors. One of them is an extensive patenting business, demonstrated by the highest number of patent applications and granted patents in the world. Apart from this activity, active management of its patent portfolio is equally important to IBM. Table 4 lists the number of patents granted to IBM Corporation between 1998 and 2009.

Table 4. Number of patents granted to IBM Corporation

Year	The total number of patents granted to IBM Corporation (including all subsidiaries, S) and the share of the subsidiaries S in the total number of granted patents					
	USPTO, WIPO and EPO		USPTO		WIPO and EPO	
	total	share of S	total	share of S	total	share of S
1998	2,959	13	2,716	6	243	7
1999	3,120	39	2,820	8	300	31
2000	3,256	57	2,953	9	303	48
2001	3,810	69	3,477	9	333	60
2002	3,929	328	3,348	4	581	324
2003	3,958	346	3,467	9	491	337
2004	3,929	503	3,297	12	632	491
2005	3,549	384	2,998	12	551	372
2006	4,300	371	3,691	26	609	345
2007	3,982	609	3,188	31	794	578
2008	4,369	36	4,219	22	150	14
2009	5,084	21	4,922	13	162	8
Total	46,245	2,776	41,096	161	5,149	2,615

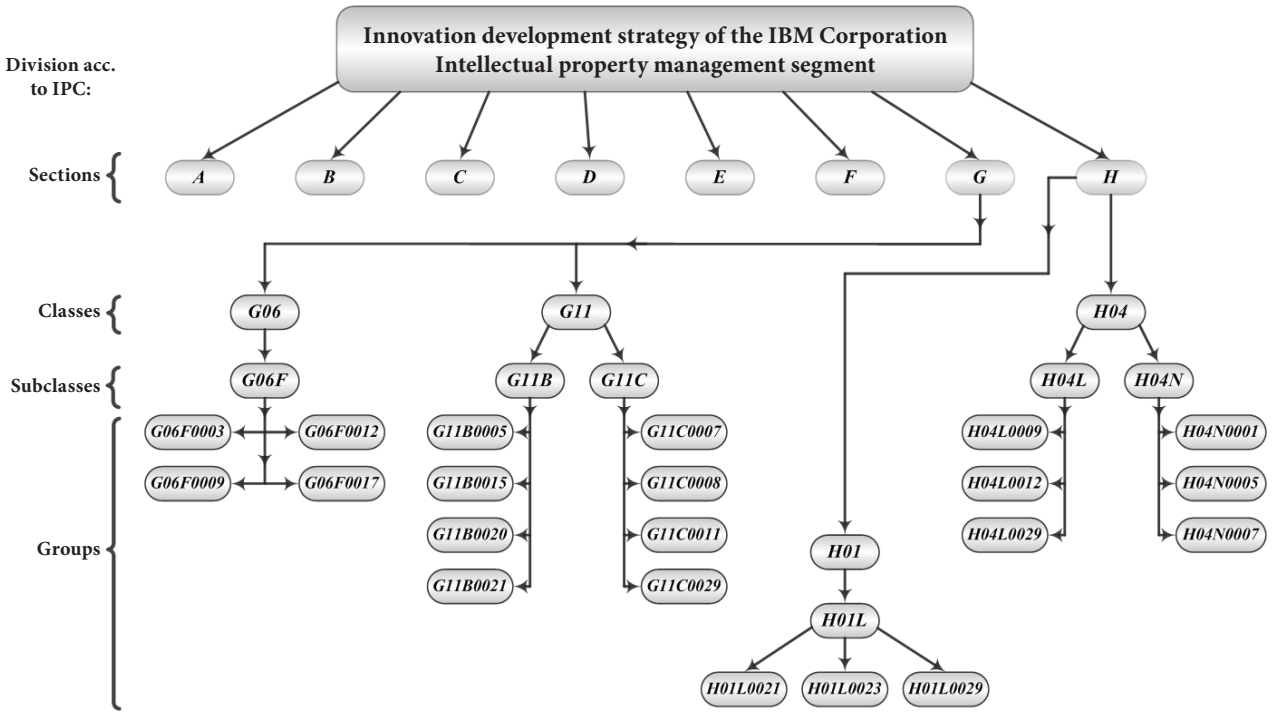
Source: T. Sierotowicz, Wykształcanie wielowymiarowej strategii rozwoju innowacji w korporacji globalnej na przykładzie przedsiębiorstw International Business Machines (Development of a multidimensional innovation development strategy in a global corporation on the example of businesses owned by International Business Machines), unpublished doctoral thesis.

Between 1998 and 2009 46,245 patents were recorded as granted to IBM Corporation, including 2,776 patents granted to its subsidiaries. The number includes 5,149 patents registered by WIPO and EPO, with 2,615 patents granted to the subsidiaries. The presented calculations show that the highest number of granted patents was registered at USPTO - a total of 41,096, including 161 patents by the subsidiaries.

The analysis of all granted patents shows a certain pattern in the patents granted to IBM. There are two leading sections of the IPC in each year of the investigated period: G - Physics and H - Electricity.

The preceding examples are intended to show only some of the possibilities of using the patent classification and statistics in research and scientific description.

Figure 3. Tree of the main intellectual property development areas at IBM Corporation



Source: T. Sierotowicz, Wykształcanie wielowymiarowej strategii rozwoju innowacji w korporacji globalnej na przykładzie przedsiębiorstw International Business Machines (Development of a multidimensional innovation development strategy in a global corporation on the example of businesses owned by International Business Machines), unpublished doctoral thesis.

The remainder of this book continues this dissertation and argumentation, albeit with a different research approach and a different mode of employing the designed measurement tool.

Chapter II
Preconditions for building the methodology for measuring patent activity of economic branches

2.1. International economic classifications, data repositories and their use in scientific research

The research in the course of economic processes, including analyses required for the state economic policy, are preconditioned by, for example, the availability and quality of the sets of certain economic objects (issues)[19]. The modern course of global processes stimulates certain needs with respect to international exchange of socio-economic information. This requires domestic and international organisations to harmonise and standardise economic classification systems to ensure integrity and comparability of global, national and regional data; while the pace of changes in specific domains necessitates regular, periodic revisions of current economic classifications.

Currently the basic catalogue of international economic classification includes:

1) ISIC – International Standard Industrial Classification of all Economic Activities;
2) CPC – Central Product Classification;

both under the supervision of the UN;

and their European counterparts:

3) NACE – Statistical classification of economic activities in the European Community – which forms the basis of the Polish Classification of Activities (PKD – *Polska Klasyfikacja Działalności*);
4) CPA – Classification of Products by Activity – the basis of the Polish Classification of Goods and Services (PKWiU – *Polska Klasyfikacja Wyrobów i Usług*);

other, i.e.:

5) IPC – International Patent Classification;

19 The problems of statistics of science, technology and innovation as an instrument of state policy are synthesised by Jan Kozłowski in the report Statystyka nauki, techniki i innowacji w krajach UE i OECD. Stan i problemy rozwoju (The statistics of science, technology and innovation in EU and OECD countries. The status and problems of development), see: http://dlafirmy.info.pl/articlesFiles/raport__statystyka_nauki_techniki_i_innowacji.pdf, 1.11.2011.

6) International Classification for Industrial Designs (the Locarno Agreement – the Locarno Classification);
7) International Classification of the Figurative Elements of Marks (the Vienna Agreement – the Vienna Classification);

The classifications are the basis for the generation and collection of data[20] and information[21], i.e. factual databases. The use, processing, interpretation, together with inference create knowledge (cf. Brdulak, 2005; Kałuszyńska 2005; Babrowski, Bonner, 2003; Skyrme, 1999).

The technological advancement in the IT infrastructure of data repositories is an important component of social development and increase in the competitiveness of science and the economy. The repositories are strong accelerators of growth in the intensity and effectiveness of scientific research. By accessing diverse objects, frequently extensive collections of sources, and integrating distributed databases, they facilitate access to and productive use of their resources.

Lately, data mining has been one of the most dynamically and intensely developed IT fields in this area. It is defined as the discovery of new and previously unknown, potentially useful, comprehensive and correct patterns in very large data volumes (Fayyad, Piatetsky-Shapiro, 1996; Han, Fu, Wang et al., 1996). This phenomenon is a response to the increasing demand for effective processing of data gathered in various repositories (i.e. databases of public and commercial statistical organisations, databases of research centres and corporate databases).

In the scientific aspect, the purpose of data exploration is to assist in (cf. Witten, Frank, Hall, 2011):

1) the discovery of previously unknown dependencies and relations between data;
2) making generalisations;
3) establishing accuracy;
4) predicting the course of processes, including social and economic processes.

Exploration of data sets uses various models of knowledge creation from the patterns existing in the data. This includes, for example: regular and periodic rules (Ozden, Ramaswamy, Silberschatz, 1998); sequence patterns (Agrawal, Srikant, 1994); cluster analysis (Everitt, Landau, Leese 2001); and temporal courses, singularities and exceptions. The knowledge discovered in the data is an added value. It improves the quality of the data itself and affects the course of the decision process based on the data. Morzy (1999) lists the following examples of classes in the data mining methods:

1) discovery of associations;
2) discovery of sequence patterns;
3) clustering;
4) discovery of similarities in temporal courses;
5) detection of changes and deviations.

Discovery of associations involves searching for associations between the occurrence of groups of elements in specific data sets (i.e. the potential of combining singular objects into units and the dependencies in databases). The general mathematic notation of the method is:

20 Data (raw, unprocessed) – is the simplest object outside of a specific context.
21 Information – data within a context; has content and meaning.

Data:

- $I=\{i_1, i_2, ..., i_n\}$ – the set of objects;
- Transaction T: a set of objects where $T \subseteq I$
- Database D: the set of transactions
- Transaction T includes X, where $X \subseteq I$, if $X \subseteq T$
- The rule of association: the implication of $X \Rightarrow Y$, where $X, Y \subseteq I$
- The rule $X \Rightarrow Y$ has a confidence c% in the database D if c% of the transactions which belong to D and contain X also contains Y
- The rule $X \Rightarrow Y$ has the support s in the database D if s% of the transactions in D contains $X \cup Y$

Discovery of the temporal patterns of behaviours, e.g. searching for sequences of stock quotations, behaviour of customers of insurance companies or patent applications. The general mathematic notation of the method can be:

Data:

- $I=\{i_1, i_2, ..., i_n\}$ – the set of objects;
- Transaction T: a set of objects where $T \subseteq I$
- Sequence: the list of transactions of a single entity
- Sequence database D: the set of sequences.

The purpose of this class of methods is to find a finite set of object classes (clusters) in databases with similar characteristics. The objects can be separate, complete, and can also form hierarchical and overlapping structures. The clustering process can follow two cycles: the external cycle follows the number of possible clusters and the internal cycle tries to find an optimum division of objects into clusters.

Discovery of similarities in temporal courses is a search for similarities in the temporal courses which describe certain processes.

Detection of changes and deviations is generally applied in the analysis of large volumes of multidimensional data. The purpose of such analysis is to identify the nature and directions of trends, and to identify the changes in processes which generate the data. The complementary goal here is to find differences between actual and expected data values.

Discovery of knowledge with the use of distributed databases and the integration of generally accepted statistical classifications (public statistics) involves searching for distinct patterns and rules which were previously unknown and which are potentially useful for supporting the decision-making process in economic policy and for a better description and interpretation of hidden contents of a database. However, the raw data stored in databases with complex models of data processing cannot be accepted as scientific knowledge. It only becomes such knowledge if a completed analysis of data sets is a coherent stage of the entire complex research process. The mental construct and its resulting research approach still remain the most important stage of the process. This work lays the structure of the research process on, *inter alia*, the assumption of the feasibility to integrate two different economic classifications:

1) **Statistical Classification of Economic Activities in the European Community, NACE;**
2) **International Patent Classification, IPC.**

2.2. Statistical Classification of Economic Activities in the European Community

The processes of deepening economic integration within the European Communities, including the ongoing creation of the community market, required unified statistical standards applicable for collection, transmission and publishing of domestic and community statistics. The information was (is) necessary in the following areas of the community policy: structural, competition, industry, agriculture or monetary policy. The response to this demand was the Council Regulation passed in 1990 on the statistical classification of economic activities in the European Community (*Council Regulation...*, No. 3037/90).

The Regulation formed a unified basis for statistical classification of economic activities, ensuring comparability between classifications and the domestic and Community statistics. The classification was hierarchical and included the following levels:

1) level one – items defined by an alphabetical code (sections);
2) intermediate level – the items defined by a two-character alphabetical code (subsections);
3) level two – the items defined by a two-digit numerical code (divisions);
4) level three – the items defined by a three-digit numerical code (groups);
5) level four – the items defined by a four-digit numerical code (classes).

In subsequent years, technological and structural changes in the European economy necessitated revisions, updates and adaptations of the NACE to new economic conditions (*Commission Regulation...*, No. 973/2007).

In the further part of this work NACE (Revision 1.1)[22] becomes the first part of the algorithm of analysis and inference concerning changes in patent activity of specific industrial branches and interdependencies between the changes and the share of the produced added value. The following shall be adopted from NACE:

1) level one:
   section "Agriculture, hunting and forestry, fishing";
   section "Mining and quarrying";
   section "Manufacturing";
   section "Construction"
   included in sector I and II of the theory of three sectors (Noga, 2000);
2) intermediate level:
   - agriculture, hunting and forestry;
   - fishing;
   - mining and quarrying of energy producing materials;
   - mining and quarrying, except of energy producing materials;
   - manufacture of food products, beverages and tobacco;
   - manufacture of textiles and textile products;
   - manufacture of leather and leather products;

22 The European Patent Office continues presenting data acc. to NACE Revision 1.1.

- manufacture of wood and wood products;
- manufacture of pulp, paper and paper products; publishing and printing;
- manufacture of coke, refined petroleum products and nuclear fuel;
- manufacture of chemicals, chemical products and man-made fibres;
- manufacture of rubber and plastic products;
- manufacture of other non-metallic mineral products;
- manufacture of basic metals and fabricated metal products;
- manufacture of machinery and equipment n.e.c.;
- manufacture of electrical and optical equipment;
- manufacture of transport equipment;
- manufacturing n.e.c.;
- construction;

(a full list of adopted subsections is in Annex No. 2);

3) level two:

divisions with the codes: 1, 2, 5, 10–11, 13–37, 45 (a full list of adopted divisions is presented in Annex No. 1).

The databases of the European Statistical Office have data sets for sections, subsections and divisions. The lower levels, i.e. groups and classes of NACE, are not visible in the public domain. The empirical verification of the proposed measurement approach as discussed in detail in the following chapter shall be carried out on NACE Rev. 1.1 level two, which is conditioned by the availability of data in Eurostat databases (e.g. concerning the share of subsections in the generated GVA of the economy).

2.3. International Patent Classification

The International Patent Classification (IPC) is a hierarchical system for the classification of inventions. The main purposes of this classification include (*Międzynarodowa… (International…)*, 2006):

1) unified systematisation of patent documents on the international level to facilitate access to their legal and technical contents;
2) selective distribution of information to all users of patent information;
3) creation of an effective means of searching for patent documents by intellectual property authorities and other users when examining innovations and assessing their inventive step;
4) assistance in the preparation of statistical statements concerning protection of industrial property, which in turn enables defining the tendency of engineering development in various fields.

The IPC is periodically revised to update and improve the classification system as the technological progress continues. The classification is hierarchical and includes the following levels:

1) level one, which includes items identified according to an alphabetic code (sections);
2) each section includes information titles without classification symbols (subsections);
3) classes make up the hierarchical level two;
4) the classes feature the level of subclasses;
5) groups are the lowest hierarchical items.

Sections are the highest level of hierarchy in the IPC. Each section is marked with a capital letter of the Latin alphabet, from A to H (the section symbol) and contains its title, which is a very general guideline on the subject matter of the section. Individual sections have the following titles:

1) A – Human necessities;
2) B – Performing operations; Transporting;
3) C – Chemistry; Metallurgy;
4) D – Textiles; Paper;
5) E – Fixed constructions;
6) F – Mechanical engineering; Lighting; Heating; Weapons; Blasting;
7) G – Physics;
8) H – Electricity.

Classes are the second level of hierarchy in the IPC. Each class is marked with a symbol which includes the section symbol followed by a two-digit number. Each class has a title which explains the contents and scope of the class; each class covers at least one subclass, which is the third hierarchical level of the IPC. Annex No. 3 presents the full list of adopted classes and subclasses.

The titles of sections, subsections and classes only indicatively state the contents and do not precisely define the topics covered. The titles of sections/subsections are a very superficial identification of the nature and scope of topics within a section/subsection, while the class title only generally indicates the scope of topics covered by subclasses. However, references, definitions or notes have been added to the subclass titles in order to make them more precise and to define the scope of covered topics as precisely as possible. Similarly, the titles of main groups and subgroups with their references, definitions and notes precisely define their topic ranges (*International...*, 2006).

Groups are the lowest hierarchical level of the IPC. Each group is identified by the group symbol which includes the subclass symbol followed by two sets of digits separated by a slash. The groups are broken down into main groups (i.e. the fourth hierarchical level of classification) and subgroups (i.e. lower hierarchical levels dependent on the level of main classification groups)[23].

The structure of sections, classes and subclasses has been unchanged for many years; however, the IPC groups and subgroups have been frequently modified and continue to be so as new patent applications are developed in the previously unclassified areas. An example is class B82 – Nano-technology, introduced in 2009, where two subclasses were set up:

1) B82B – Nano-structures formed by manipulation of individual atoms, molecules, or limited collections of atoms or molecules as discrete units; their manufacture or treatment;
2) B82Y – Specific uses or applications of nano-structures; measurement or analysis of nano-structures; manufacture or treatment of nano-structures.

The detailed level of describing specific areas of science and technology in the IPC is reflected by the number of classes, subclasses, groups and subgroups in individual sections.

23 The complete list of adopted groups and subgroups – see, e.g. http://ipu.uprp.pl/ipcpub/

Table 5. Number of classes, subclasses, groups and subgroups in individual sections of the IPC (in numbers)

IPC	A	B	C	D	E	F	G	H	Total
Classes	16	37	21	9	8	18	14	6	129
Subclasses	84	168	88	39	31	97	80	50	637
Groups	1,106	1,993	1,329	350	318	1,058	694	538	7,386
Subgroups	7,363	14,667	13,141	2,611	2,900	7,381	6,918	7,519	62,500
Total	8,569	16,865	14,579	3,009	3,257	8,554	7,706	8,113	70,652

Source: proprietary study.

The IPC has 129 classes divided into 637 subclasses, the latter being divided into 7,386 groups. The last and most precise level includes 62,500 subgroups.

Table 6. Share of classes, subclasses, groups and subgroups in the IPC sections (%)

IPC	A	B	C	D	E	F	G	H	Total
Classes	12.40	28.68	16.28	6.98	6.20	13.95	10.85	4.65	100
Subclasses	13.19	26.37	13.81	6.12	4.87	15.23	12.56	7.85	100
Groups	14.97	26.98	17.99	4.74	4.31	14.32	9.40	7.28	100
Subgroups	11.78	23.47	21.03	4.18	4.64	11.81	11.07	12.03	100
Total	12.13	23.87	20.63	4.26	4.61	12.11	10.91	11.48	100

Source: proprietary study.

Out of a total of 129 classes, the majority is covered by section B – Performing operations; Transporting (28.68%). The smallest share of classes is covered by section H – Electricity (4.65%). Next, respectively, out of the total number of subclasses, the majority is covered by section B (26.37%), the smallest share by section D – Textiles, Paper (6.12%); in the total number of groups the majority is covered by section B (26.98%), the smallest share by section D (4.74%); out of the total number of subgroups, the majority is covered by section B (23.47%), and the smallest share is included in section D (4.18%).

Patent documentation is a specific object and an economic issue. It is a rich source of engineering information, information on current trends in research and invention activity, and the innovation and competitive potential of the economy and its entities. Its hierarchical structure combined with a great number of documentations (objects) form a foundation of applying specific methods intended to discover known dependencies, schemes and rules. In the further part of this work the IPC becomes the second part of the algorithm of analysis and inference concerning changes in patent activity of specific industrial branches and interdependencies between the changes and the share of the produced added value.

Chapter III
Methodology for measurement of the economic branches patent activity

3.1. Subject matter of the methodology

This chapter presents the detailed procedure, including a set of rules for achieving the main purpose of this book: measurement of the patent activity in selected economic branches (mainly the industrial sector), and an attempt at discovering patterns between patent activity of the branches and changes in their share in the generated added value of the economy. The methodology includes:

1) definition of the objectives and scope of research;
2) description of the research performance concept, especially arguments for contamination of NACE and the IPC, as well as the selection of specific sectors and branches to be researched;
3) identification of the data sources required for comparative analyses and inference;
4) empirical verification of the proposed research method.

3.2. Objectives and scope of research

3.2.1. Primary objectives

The primary research objectives are:

1) to identify economic branches with the highest and lowest patent activity in the selected time interval (1995-2009), both in domestic and international systems;
2) to determine a pattern of interrelations between the number of patents obtained in a branch (i.e. its entities) and the changes in the share of that branch in the generated value added in the economy in the selected time interval (1995-2009), both in domestic and international systems.

3.2.2. Secondary objectives

The secondary research objectives are:

1) to select the key development directions for technical innovations between 1995 and 2009;
2) to attempt to identify the dependencies between an industrial branch, its patent activity and the changes in valuation of the companies representative of that branch on a regulated stock exchange market.

3.2.3. Scope of research

The scope of research includes:

1) patent activity in sectors I and II, covering 19 branches of the economy;
2) statistics of patents granted to entities registered in Spain, Hungary, Ireland and Poland under the international application procedure (widely available repositories of patent statistics i.e. public statistics and databases of regional patent offices fail to enable precise exploration of their resources, hence a commercial patent database was used: *Thomson Innovation*);
3) structural changes in some selected economies in relation to patent activity with the presumption of *ceteris paribus* for other preconditions;
4) market valuation.

3.3. Mapping of economic branches with the use of patent classes and groups

International comparative studies are frequently carried out using various statistical economic classifications. For a few years now, regional patent offices have listed patent activity in their annual reports by sectors of economy. While informing that they use, e.g. NACE or the IPC for that purpose, they present lists for conventional (in the economic sense) sectors without any deeper thought given to the attribution of specific sections/subsections/division of NACE to those conventional sectors/branches (*Science, technology...*, 2009). Gross simplification and superficiality are evident in the attempts to represent the IPC in NACE (Schmoch, 2008; Verspagen, van Moergastel, Slabbers, 1994).

Hence one of the main methodological goals of this work is to map the IPC in NACE as precisely as possible, with the clear reservation of some selected economic sections/subsections/divisions. The mapping was done on the following sections:

1) agriculture, hunting and forestry; fishing;
2) mining and quarrying;
3) manufacturing;
4) construction.

The identified sections of NACE form sector I (Agriculture, forestry and fishing) and sector II (manufacturing and construction) of economy (Noga, 2000), while sector III covers services. Sectors I and II are the material basis of the economy and its processes, as well as a back-up facility for the service sector.

By employing the apparatus of notions and NACE[24], the following productions are qualified in the manufacturing sector as effected in the following subsections (economic branches) of NACE:

1) manufacture of food products, beverages and tobacco;
2) manufacture of textiles and textile products;
3) manufacture of leather and leather products;
4) manufacture of wood and wood products;
5) manufacture of pulp, paper and paper products; publishing and printing;
6) manufacture of coke, refined petroleum products and nuclear fuel;
7) manufacture of chemicals, chemical products and man-made fibres;
8) manufacture of rubber and plastic products;
9) manufacture of other non-metallic mineral products;
10) manufacture of basic metals and fabricated metal products;
11) manufacture of machinery and equipment n.e.c.;
12) manufacture of electrical and optical equipment;
13) manufacture of transport equipment;
14) manufacturing n.e.c.;
15) mining and quarrying of energy producing materials;
16) mining and quarrying, except of energy producing materials;

and sector II includes:

17) construction.

Sector I includes:

18) agriculture, hunting and forestry;
19) fishing.

Both classification systems (NACE and IPC) have different goals and uses; hence the areas described on specific levels of these classifications are different (see subsections 2.2 and 2.3, and Annex No. 1 and 2). This applies both to specific levels of NACE and IPC, as well as to the two classifications as a whole. As a result, the task of mapping individual IPC codes into NACE required considering the most detailed division in both classification systems, i.e. operation on their lowest levels.

Attribution to NACE on the fifth and the most detailed level required an insight into the complete spectrum of IPC codes (ca. 70,650 codes). For each NACE level and code[25] on the fifth level the entire IPC spectrum was analysed horizontally, i.e. in each section, as well as vertically, from IPC classes to IPC subgroups. The purpose was to identify the classification codes which most precisely represent the area defined by a NACE code. It is judged that such an analysis warrants the most precise representation of a given NACE code by relevant IPC codes. A consequence of the work method described here is a list of IPC codes derived from various sections and the levels of this classification which most truly represent the given NACE code. The IPC to NACE mapping table has been carried out in the following stages:

24 The complete NACE Rev. 1.1 is available at: http://www.fifoost.org/database/nace/nace-en_2002c.php, 3.10.11.

25 See http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_1_1&StrLanguageCode=PL&IntPcKey=&StrLayoutCode=HIERARCHIC&IntCurrentPage=1; the sections were expanded into subsections, subsections into divisions, divisions into groups and groups into classes.

1) on the first stage, the IPC codes corresponding to specific codes on the NACE fifth level were identified;
2) on the second stage, the mapping was shifted to the fourth level of NACE, i.e. the IPC codes attributed to NACE on the fifth level were grouped or 'collapsed' into adequate NACE codes on the fourth level;
3) on the third stage, an analogical shift was made from the NACE fourth level to the NACE third level (another 'collapse');
4) on the fourth stage, all IPC codes attributed to each NACE group on the third level were verified to:
    - eliminate duplicated IPC codes in every division and in the entire spectrum of the NACE third level;
    - to eliminate the IPC codes which represent adjacent (common) divisions on the third level; eliminating the overlapping IPC codes ranges on NACE groups was done by decomposing individual IPC codes down to a level which enables the most complete representation of NACE groups;
5) repeating the procedure carried out on the fourth and third level of NACE on the second level of that classification, i.e. the subsection level.

Two premises rationalise selection of the third and second level of NACE as the basic levels for IPC mapping and the most suitable levels for the analysis:

1) the fifth and the fourth level are characterised by overt refinement, so their suitability for a macroeconomic analysis is poor; the third level corresponds to divisions, while the second level corresponds to branches of economy;
2) the first level (sections) over-simplifies the IPC to NACE mapping.

To recapitulate, each NACE subsection is attributed with specific classes, subclasses, groups and subgroups of the IPC. Mapping was carried out with an assumption that only one of the following: class and/or subclass and/or group and/or subgroup can be assigned to a given subsection (industrial branch) of NACE. This approach is the result of the assumption on the creation of new or improved technical solutions by enterprises operating in the field which coincides with the branch (subsection) to which the enterprises belong according to NACE and their domestic counterparts (e.g. the Polish Classification of Activities or PKD in Poland).

Table 7. Mapping of IPC codes on the third level of NACE (economic divisions)

Designation	Description	IPC representation
1	Agriculture, hunting and related service activities	yes
2	Forestry, logging and related service activities	yes
5	Fishing, fishery and related service activities	yes
10	Mining of hard coal and lignite; extraction of peat	yes
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying	yes
12	Mining of uranium and thorium ores	no
13	Mining of metal ores	yes
14	Other mining and quarrying	yes
15	Manufacture of food products and beverages	yes
16	Manufacture of tobacco products	yes
17	Manufacture of textiles	yes
18	Manufacture of wearing apparel; dressing and dyeing of fur	yes
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	yes
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	yes
21	Manufacture of pulp, paper and paper products	yes
22	Publishing, printing and reproduction of recorded media	yes
23	Manufacture of coke, refined petroleum products and nuclear fuel	yes
24	Manufacture of chemicals and chemical products	yes
25	Manufacture of rubber and plastic products	yes
26	Manufacture of other non-metallic mineral products	yes
27	Manufacture of basic metals	yes
28	Manufacture of fabricated metal products, except machinery and equipment	yes
29	Manufacture of machinery and equipment n.e.c.	yes
30	Manufacture of office machinery and computers	yes
31	Manufacture of electrical machinery and apparatus n.e.c.	yes
32	Manufacture of radio, television and communication equipment and apparatus	yes
33	Manufacture of medical, precision and optical instruments, watches and clocks	yes
34	Manufacture of motor vehicles, trailers and semi-trailers	yes
35	Manufacture of other transport equipment	
36	Manufacture of furniture; manufacturing n.e.c.	yes
37	Recycling	yes
40	Electricity, gas, steam and hot water supply	no
41	Collection, purification and distribution of water	no
45	Construction	yes
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	no
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	no
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	no
55	Hotels and restaurants	no
60	Land transport; transport via pipelines	no
61	Water transport	no
62	Air transport	no
63	Supporting and auxiliary transport activities; activities of travel agencies	no
64	Post and telecommunications	no
65	Financial intermediation, except insurance and pension funding	no

Designation	Description	IPC representation
66	Insurance and pension funding, except compulsory social security	no
67	Activities auxiliary to financial intermediation	no
70	Real estate activities	no
71	Renting of machinery and equipment without operator and of personal and household goods	no
72	Computer and related activities	no
73	Research and development	no
74	Other business activities	no
75	Public administration and defence; compulsory social security	no
80	Education	no
85	Health and social work	no
90	Sewage and refuse disposal, sanitation and similar activities	no
91	Activities of membership organizations n.e.c.	no
92	Recreational, cultural and sporting activities	no
93	Other service activities	no
95	Activities of households as employers of domestic staff	no
96	Undifferentiated goods producing activities of private households for own use	no
97	Undifferentiated services producing activities of private households for own use	no
99	Extra-territorial organisations and bodies	no

Source: proprietary study.

Table 8. Mapping of IPC codes on the second level of NACE (economic subsections)

NACE code	Description	IPC representation
AA	Agriculture, hunting and forestry	yes
BA	Fishing	yes
CA	Mining and quarrying of energy producing materials	yes
CB	Mining and quarrying, except of energy producing materials	yes
DA	Manufacture of food products, beverages and tobacco	yes
DB	Manufacture of textiles and textile products	yes
DC	Manufacture of leather and leather products	yes
DD	Manufacture of wood and wood products	yes
DE	Manufacture of pulp, paper and paper products; publishing and printing	yes
DF	Manufacture of coke, refined petroleum products and nuclear fuel	yes
DG	Manufacture of chemicals, chemical products and man-made fibres	yes
DH	Manufacture of rubber and plastic products	yes
DI	Manufacture of other non-metallic mineral products	yes
DJ	Manufacture of basic metals and fabricated metal products	yes
DK	Manufacture of machinery and equipment n.e.c.	yes
DL	Manufacture of electrical and optical equipment	yes
DM	Manufacture of transport equipment	yes
DN	Manufacturing n.e.c.	yes
EA	Electricity, gas and water supply	no
FA	Construction	yes
GA	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	no
HA	Hotels and restaurants	no
IA	Transport, storage and communication	no
JA	Financial intermediation	no
KA	Real estate, renting and business activities	no

NACE code	Description	IPC representation
LA	Public administration and defence; compulsory social security	no
MA	Education	no
NA	Health and social work	no
OA	Other community, social and personal service activities	no
PA	Activities of households	no
QA	Extra-territorial organisations and bodies	no

Source: proprietary study.

The detailed representation of the IPC in NACE on the level of divisions and subsections is presented in Annex No. 1 and 2. Annex No. 1, *Representation of the IPC in NACE (on the division level)* and *Annex No. 2, Representation of the IPC in NACE (on the subsection level)* are an integral part of this chapter. Editorial concerns and care for legibility of this deliberation have necessitated publication of the aforementioned concordance tables in annexes.

As an effect of the applied procedure, a map of IPC was developed and superimposed on the third and second level of NACE. After completion of work it occurred that the IPC is almost completely represented in NACE groups which represent the following sectors: agriculture, manufacturing, processing, industry and construction. It results from the fact that an invention must be fit for industrial use to grant its legal protection. Hence every invention filed for protection (and patent) should be suitable for industrial use, which first relates to manufacturing, processing and industrial branches. However, the broader service sector (e.g. education, medical services, commerce, gastronomy, etc.) employs products manufactured based on patents, and in this sense, its mechanism is secondary to the primary area of research, i.e. the innovation potential of economic sectors I and II. It must be added that the purpose of this book is not to verify hypotheses or to accomplish research objectives in all sectors, but to do so only in sector I and sector II of the economy.

All IPC classes were used in the mapping procedure (i.e. construction of concordance tables). Table 9 lists the applied IPC codes on the class level.

Table 9. List of IPC classes applied in the NACE representation procedure on various levels of detail

Section A	Section B	Section C	Section D	Section E	Section F	Section G	Section H
A01	B01	C01	D01	E01	F01	G01	H01
A21	B02	C02	D02	E02	F02	G02	H02
A22	B03	C03	D03	E03	F03	G03	H03
A23	B04	C04	D04	E04	F04	G04	H04
A24	B05	C05	D05	E05	F15	G05	H05
A41	B06	C06	D06	E06	F16	G06	
A42	B07	C07	D07	E21	F17	G07	
A43	B08	C08	D21		F21	G08	
A44	B09	C09			F22	G10	
A45	B21	C10			F23	G11	
A46	B22	C11			F24	G12	
A47	B23	C12			F25	G21	
A61	B24	C13			F26		
A62	B25	C14			F27		
A63	B26	C21			F28		
	B27	C22			F41		
	B28	C23			F42		
	B29	C25					
	B30	C30					
	B31	C40					
	B32						
	B41						
	B42						
	B43						
	B44 (without B44D, F)						
	B60						
	B61						
	B62						
	B63						
	B64						
	B65						
	B66						
	B67						
	B68						
	B81						
	B82						

Source: proprietary study.

The following IPC codes were not used in the concordance tables:

1) B44D – painting or artistic drawing, not otherwise provided for; preserving paintings; surface treatment to obtain special artistic surface effects or finishes;
2) B44F – special designs or pictures;
3) G09 – educating; cryptography; display; advertising; seals.

Subclass B44D was not used for mapping in NACE due to the selection of manufacturing, processing and industrial branches of economy.

Class G09 includes: (1) educational or demonstration appliances; appliances for teaching, or communicating with the blind, deaf or mute; models; planetaria; globes; maps; diagrams; (2) ciphering or deciphering apparatus for cryptographic or other purposes involving the need for secrecy; (3) railway or timetables or fare tables; perpetual calendars; (4) displaying; advertising; signs; labels or name-plates; stamps; (5) arrangements or circuits for the control of indicating devices using static means to present variable information. What needs to be stressed is the particular complexity and insufficient adequacy of the discussed class for its attribution to the 19 selected branches of economy. Hence this class was omitted in the proposed algorithm. Those and other intentional omissions (B44F) shall be further analysed and included or explicitly excluded (with an extensive argument) in future versions of concordance tables. An analogous procedure will be applied to all codes (mainly on the levels of groups and subgroups) which contain a "topic not elsewhere classified": A01J0099, A99Z, A99Z0099, B29D0099, B99Z, B99Z0099, C99, C99Z, C10G0099, C99Z0099, D01G0099, D99, D99Z, D99Z0099, E99, E99Z, E99Z0099, F99, F99Z, F99Z0099, G99, G99Z, G99Z0099, H01J0099, H99, H99Z and H99Z0099.

Nevertheless, the specified codes do not significantly affect the result of the empirical analysis as they constitute merely 0.045% of all IPC subgroups. It is also confirmed by the distribution of patents granted in the examined countries.

Chapter IV
Use of patent activity for measuring development potential of economic branches

4.1. Introductory notes

The purpose of Chapter IV is a wide exemplification of the designed research procedure and verification of research hypotheses presented in the introduction. The presented tables and figures do not feature the names of individual subsections (economic branches) which are the subject of research; only their symbols are used. Table 10 contains a list of full names of the studied branches of economy, along with their symbolic designations.

Table 10. List of researched economic branches

AA	Agriculture, hunting and forestry
BA	Fishing
CA	Mining and quarrying of energy producing materials
CB	Mining and quarrying, except of energy producing materials
DA	Manufacture of food products, beverages and tobacco
DB	Manufacture of textiles and textile products
DC	Manufacture of leather and leather products
DD	Manufacture of wood and wood products
DE	Manufacture of pulp, paper and paper products; publishing and printing
DF	Manufacture of coke, refined petroleum products and nuclear fuel
DG	Manufacture of chemicals, chemical products and man-made fibres
DH	Manufacture of rubber and plastic products
DI	Manufacture of other non-metallic mineral products
DJ	Manufacture of basic metals and fabricated metal products
DK	Manufacture of machinery and equipment n.e.c.
DL	Manufacture of electrical and optical equipment
DM	Manufacture of transport equipment
DN	Manufacturing n.e.c.
FA	Construction

Source: NACE Rev. 1.1, http://www.fifoost.org/database/nace/nace-en_2002c.php, 3.10.11.

The original (raw) data containing approx. 15 thousand records (granted patents) are sourced from the commercial patent database by Thomson Reuters. The data covers patents granted under the international procedure (PCT) in the period 1995-2009.

It is specifically stressed that the proposed mapping of IPC in NACE is a universal tool. The main obstacles in its application are only the limitations of the computing power and the financial constraints (the need to purchase suitable data formats).

4.2. Changes in patent activity of some selected EU states' economic branches

The following sections of Chapter IV feature a comparative analysis of economic branches, which employs statistics of granted patents obtained by entities in the following European countries:

1) Spain – an example of a country with numerous characteristics shared by Poland, resulting both from historical similarities and factors of a cultural, political, social and demographic nature;
2) Ireland – an example of a country which, over a relatively short time, built a highly competitive economy and achieved one of the highest per capita indicator values;
3) Hungary – an example of a country which began its political and economic transformation at a significantly higher general prosperity when compared to Poland;
4) Poland.

The algorithm presented in Annex No. 2 is employed further to list the granted patents for Spain, Ireland, Hungary and Poland, respectively.

The distribution of granted patents in specific economic branches of Spain under the PCT procedure for the years 1995-2009 is presented in Table 11.

Table 11. Number of granted patents in individual NACE subsections for Spain

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
AA	3	1	6	3	7	3	8	17	11	12	17	13	7	16	7	131
BA	1	0	0	0	1	1	2	4	4	8	7	6	4	6	4	48
CA	0	0	0	0	0	0	0	0	0	0	0	4	2	1	1	8
CB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA	9	13	20	20	20	23	27	50	65	51	46	57	83	89	110	683
DB	5	4	4	19	11	5	12	9	15	21	20	34	11	23	29	222
DC	1	7	5	4	6	3	4	4	13	13	11	7	19	13	8	118
DD	0	3	0	3	0	2	3	1	3	2	4	2	8	3	3	37
DE	4	9	7	10	16	13	19	9	15	21	19	21	12	14	16	205
DF	2	0	0	0	2	4	0	0	0	2	4	1	4	2	5	26
DG	21	35	42	43	67	71	89	101	116	118	120	136	166	166	202	1493
DH	2	1	5	3	4	3	5	9	7	7	3	9	11	8	8	85
DI	2	7	14	6	16	15	11	18	18	17	21	27	20	28	16	236
DJ	6	12	9	18	15	19	24	25	31	43	40	52	61	86	72	513
DK	20	35	46	46	68	62	77	68	86	85	115	125	143	167	161	1304
DL	29	20	50	52	60	84	102	123	133	138	165	184	228	295	309	1972
DM	9	18	16	34	22	44	60	52	58	65	81	66	68	78	74	745
DN	13	21	19	16	19	13	25	24	27	34	34	42	50	45	48	430
FA	6	8	14	15	11	31	30	40	41	35	55	81	73	105	80	625
Total	133	194	257	292	345	396	498	554	643	672	762	867	970	1145	1153	8881

Source: proprietary study.

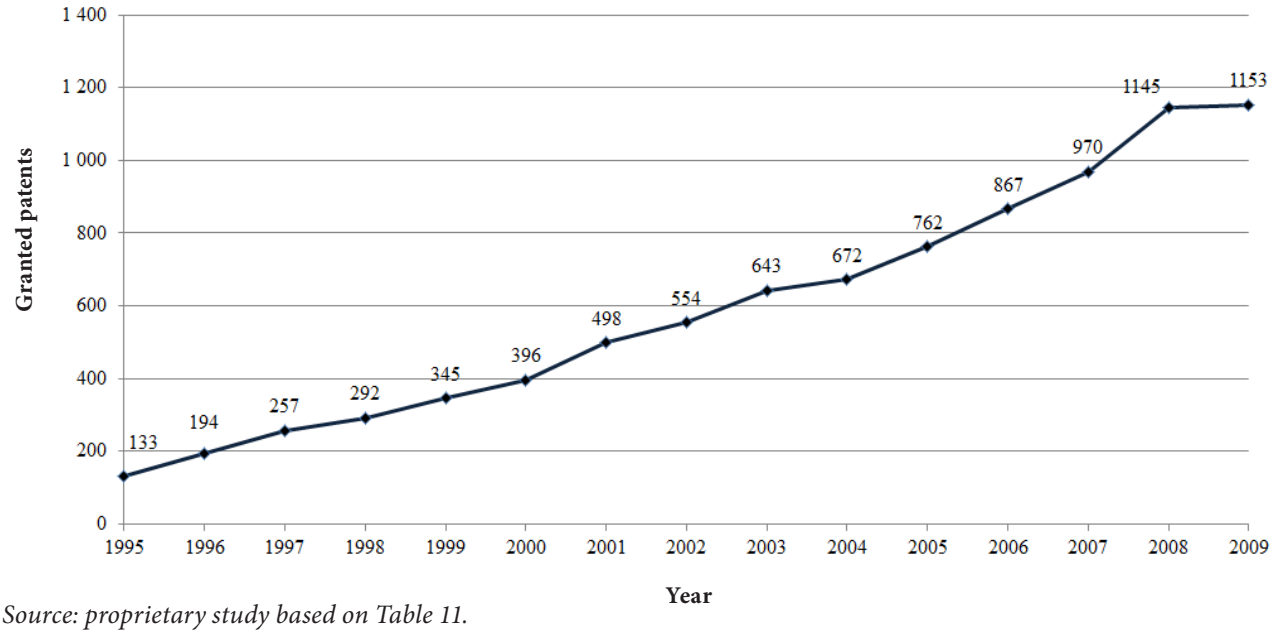
Under the international filing procedure in the years 1995-2009, Spanish residents were granted 8,881 patents. The most active were:

1) manufacture of electrical and optical equipment (1,972 patents);
2) manufacture of chemicals, chemical products and man-made fibres (1,493);
3) manufacture of machinery and equipment (1,304), followed by:
4) manufacture of transport equipment (745);
5) manufacture of food products, beverages and tobacco (683);
6) construction (625);
7) manufacture of basic metals and fabricated metal products (513);

the remaining branches were granted less than 500 patents each in the researched period of 15 years.

The statistical distribution of granted patents in individual branches (subsections) of the economy is quite differentiated, which can be attributed to very complex reasons. The nature and defined objectives of this work impose limitations on this discourse; hence the issue of patent activity preconditions in individual branches is not elaborated on in this book.

Chart 1. Total number of granted patents per year in 19 economic branches of Spain

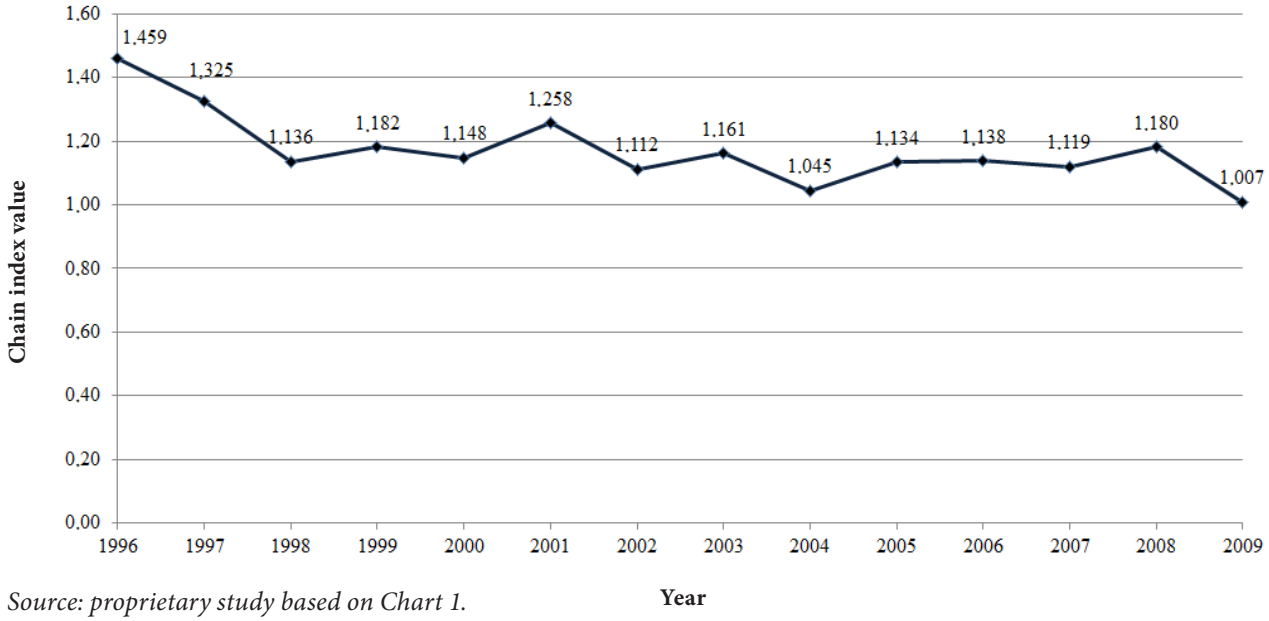


Source: proprietary study based on Table 11.

Chart 1 presents a very interesting phenomenon: a constant growth in the 'production' of patents for the total of 19 examined economic branches of Spain. Where is the main determinant of this pattern? This is another important research question.

In order to obtain a better picture of the constant growth dynamics in granted patents, below we present the distribution of values of chain indexes; the value of the average (annual) rate of distribution change was determined by employing the geometric mean value of individual chain indexes (i.e. successive values of dynamics indicators).

Chart 2. Values of chain indexes based on the total number of granted patents in the successive years (1995-2009) in Spain



Source: proprietary study based on Chart 1.

The geometric mean of the chain indexes of granted patents is calculated based on the following formula:

$$\bar{y}_p = \sqrt[N_p-1]{\frac{P_{p(2)}}{P_{p(1)}} \times \frac{P_{p(3)}}{P_{p(2)}} \ldots \times \frac{P_{p(i-1)}}{P_{p(i-2)}} \times \frac{P_{p(i)}}{P_{p(i-1)}}} = \sqrt[N_p-1]{\prod_{i=2}^{N_p} \frac{P_{p(i)}}{P_{p(i-1)}}}$$

where:

$\bar{y}_p$ – geometric mean of the chain indexes of granted patents in the entire research period;

$P_{p(i)}$ – number of patents granted in all 19 economic branches in successive years;

$\frac{P_{p(i)}}{P_{p(i-1)}}$ – partial value of the chain index;

i – successive annual total number of patents in 19 economic branches;

N_p – number of observations.

Hence the average (annual) rate of change in granted patents is:

$$\bar{T}_p = (\bar{y}_p - 1) \times 100\%$$

where:

$\overline{T}_p$ – the average rate of change in granted patents in the entire research period;

$\overline{y}_p$ – the geometric mean of the chain indexes in the entire research period.

Thus, the value of the geometric mean for Spain is 1.167, which means that a continuous growth in granted patents is observed at the average rate of 16.7% per annum.

Ireland is the next country under examination. The distribution of granted patents in specific economic branches of Ireland under the PCT procedure for the years 1995-2009 is presented in Table 12.

Table 12. Number of granted patents in individual NACE subsections for Ireland

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
AA	3	1	0	3	1	4	0	1	3	2	3	1	1	1	0	24
BA	0	0	0	0	2	1	1	0	0	1	1	2	1	0	0	9
CA	0	0	0	0	0	2	1	0	0	1	0	2	3	0	0	9
CB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA	4	8	5	6	8	6	3	3	6	4	9	8	9	18	9	106
DB	0	1	1	2	1	0	0	1	2	1	2	1	0	1	0	13
DC	0	1	0	0	0	0	4	1	1	0	0	0	1	0	2	10
DD	1	0	0	0	0	0	0	0	1	1	0	0	3	0	0	6
DE	1	4	5	3	1	4	6	3	3	4	4	2	3	1	3	47
DF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DG	14	16	26	29	30	43	27	34	18	33	26	24	40	51	21	432
DH	1	0	2	2	1	3	0	0	1	2	3	0	3	0	0	18
DI	0	3	0	3	1	3	2	2	8	4	6	4	4	7	4	51
DJ	4	2	1	1	3	4	6	7	3	5	4	5	3	4	11	63
DK	9	11	14	14	17	9	17	18	20	26	9	12	14	9	3	202
DL	20	11	35	25	47	70	92	95	133	127	85	84	69	77	68	1038
DM	4	1	3	4	4	1	4	11	4	5	5	2	4	0	0	52
DN	1	4	9	6	4	5	3	4	7	16	4	4	6	4	2	79
FA	3	2	2	5	6	3	5	8	12	11	13	11	15	10	7	113
Total	65	65	103	103	126	158	171	188	222	243	174	162	179	183	130	2272

Source: proprietary study.

Under the international filing procedure in the years 1995-2009, Irish residents were granted 2,272 patents. The most active were:

1) manufacture of electrical and optical equipment (1,038 patents);
2) manufacture of chemicals, chemical products and man-made fibres (432);
3) manufacture of machinery and equipment (202);
4) construction (113);
5) manufacture of food products, beverages and tobacco (106);

the remaining branches were granted less than 100 patents each in the researched period of 15 years.

Chart 3 shows a different graphical presentation of the granted patents statistics for all examined economic branches of Ireland.

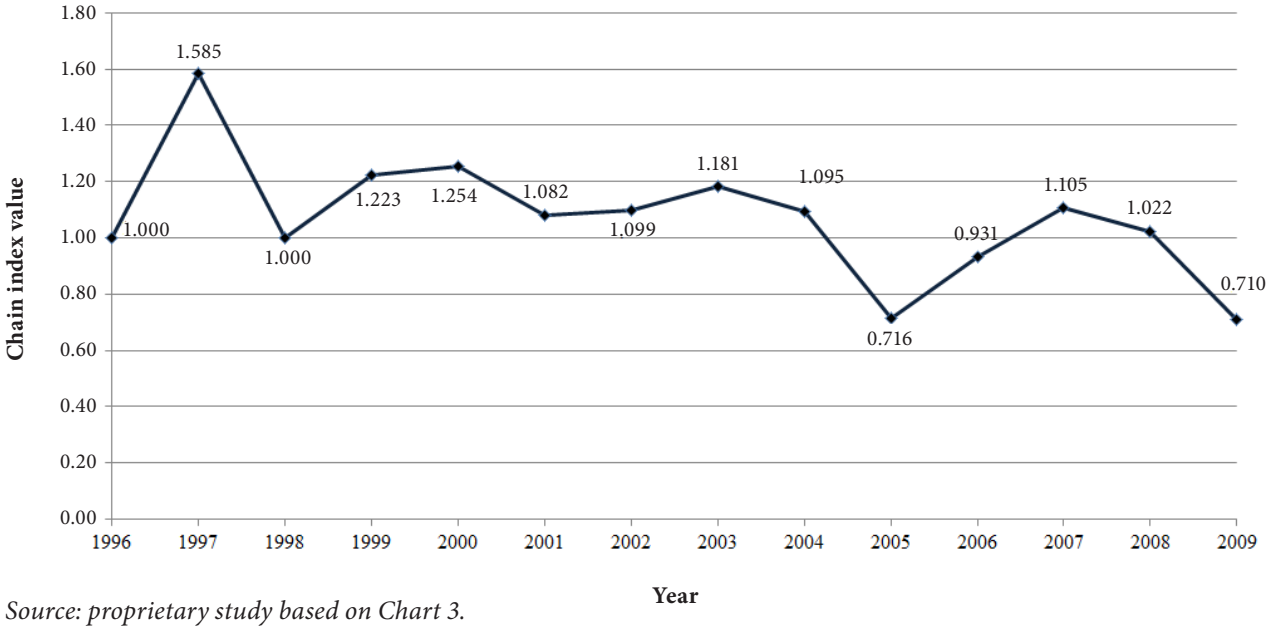
Chart 3. Total number of granted patents per year in 19 economic branches of Ireland

Source: proprietary study based on Table 12.

Chart 3 demonstrates the number of granted patents in all 19 examined economic branches of Ireland; its graphical analysis prompts another significant question, just as in the case of Spain: To what extent can patent activity be used as an indicator in the index of indicators ahead of the economic situation?

In order to obtain a better picture of the constant growth dynamics in granted patents, below we present the distribution of values of chain indexes; the value of the average (annual) rate of distribution change was determined by employing the geometric mean value of individual chain indexes (i.e. successive values of dynamics indicators).

Chart 4. Values of chain indexes based on the total number of granted patents in the successive years (1995-2009) in Ireland



Source: proprietary study based on Chart 3.

By utilising the algorithm for determining the geometric mean (see Spain), the value of the average rate of changes in patents was established for Ireland. The average annual dynamics in the entire period of research is 5.1%.

The next country under examination is Hungary. The distribution of granted patents in specific economic branches of Hungary under the PCT procedure for the years 1995-2009 is presented in Table 13.

Table 13. Number of granted patents in individual NACE subsections for Hungary

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
AA	0	0	0	0	0	3	2	2	3	2	3	0	1	3	0	19
BA	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	3
CA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA	6	3	3	4	3	6	9	5	8	7	5	5	7	10	9	90
DB	0	1	0	2	2	1	2	0	1	0	3	2	3	1	0	18
DC	1	0	1	2	0	2	1	0	0	0	2	3	2	1	1	16
DD	0	0	0	0	0	1	0	0	1	1	0	1	1	0	1	6
DE	1	2	4	1	4	1	4	3	6	3	2	4	2	1	1	39
DF	0	0	0	1	0	1	2	2	6	3	2	1	2	5	3	28
DG	25	23	35	54	34	33	59	35	63	44	57	60	71	67	81	741
DH	0	0	1	2	2	0	2	1	0	1	1	0	3	0	0	13
DI	0	0	1	0	2	2	2	3	2	1	1	2	4	5	4	29
DJ	2	4	4	7	4	6	9	8	9	5	8	0	4	7	5	82
DK	11	3	7	14	15	9	13	11	13	26	9	14	15	19	22	201
DL	25	14	8	17	24	19	43	53	45	39	39	30	33	44	37	470
DM	7	1	8	4	10	4	6	1	10	3	10	8	2	8	6	88
DN	2	4	4	3	5	11	8	3	10	10	6	4	5	7	8	90
FA	3	0	4	1	4	4	5	10	9	11	4	9	9	8	12	93
Total	83	55	80	112	109	103	168	138	187	156	152	143	164	186	190	2026

Source: proprietary study.

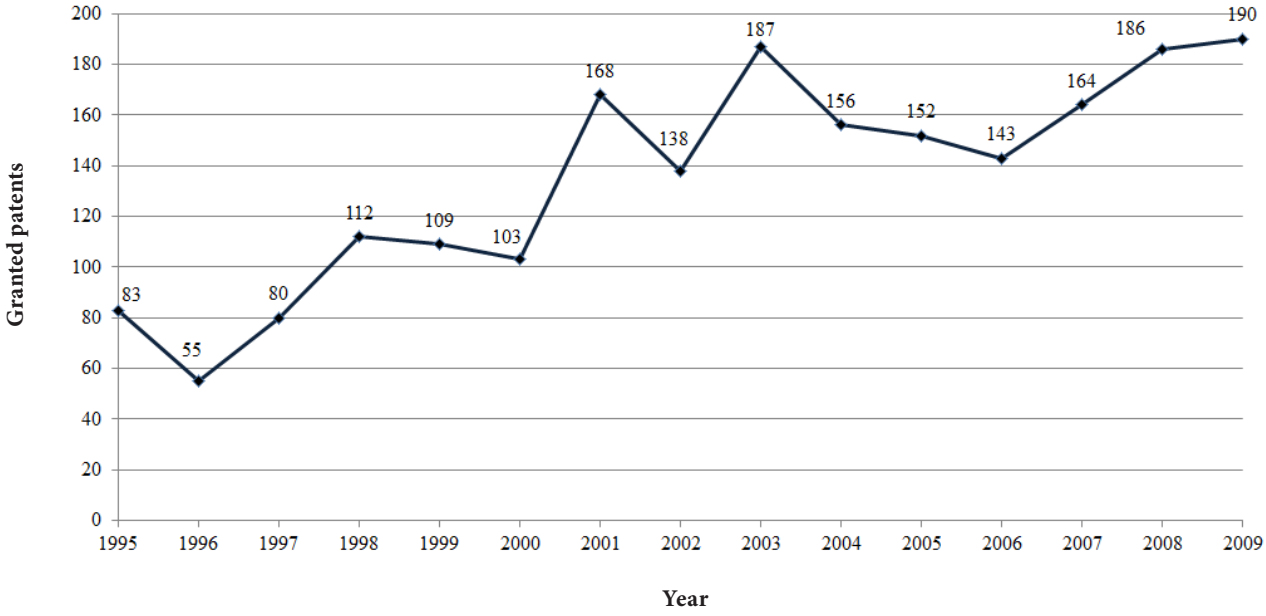
Under the international filing procedure in the years 1995-2009, Hungarian residents were granted 2,026 patents, which is slightly less than in the case of Ireland's economy. The most active were:

1) manufacture of chemicals, chemical products and man-made fibres (741 patents);
2) manufacture of electrical and optical equipment (470);
3) manufacture of machinery and equipment (201);

the remaining branches were granted less than 100 patents each in the researched period of 15 years.

Chart 5 shows a different graphical presentation of the granted patents statistics for all examined economic branches of Hungary.

Chart 5. Total number of granted patents per year in 19 economic branches of Hungary

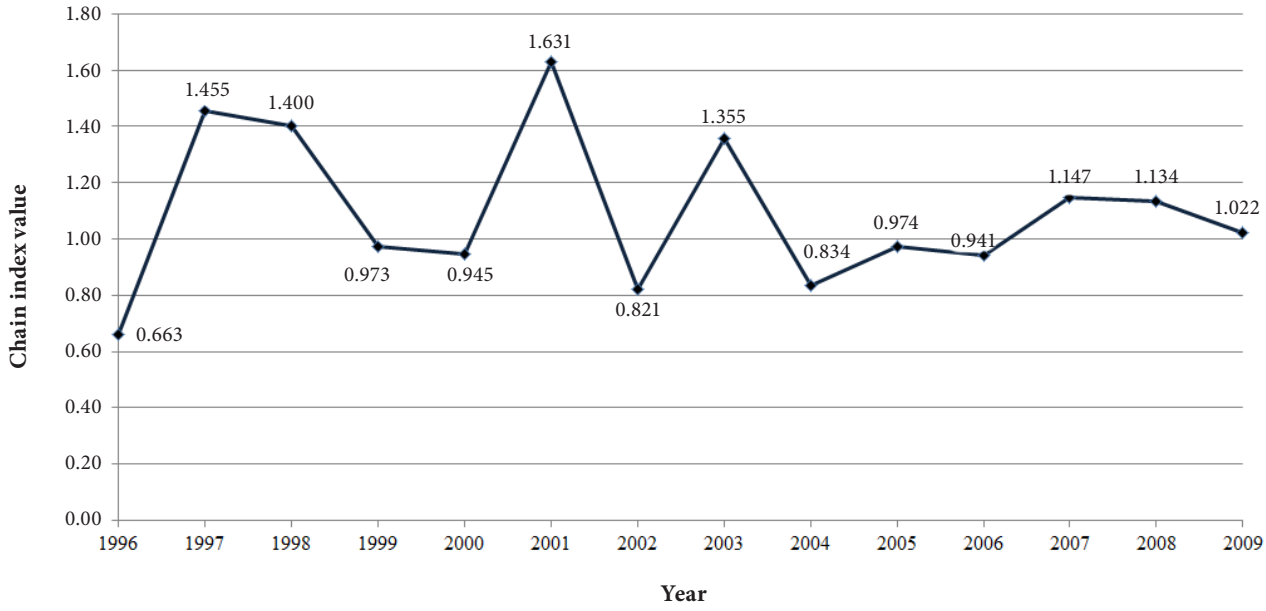


Source: proprietary study based on Table 13.

Chart 5 presents the number of patents granted in all 19 Hungarian economic branches. When compared to Spain and Ireland, a large variation of the analysed statistics is observed in this case. However, it is difficult to easily find the answer to the causes of this relatively high variation in the activity. The problem is beyond the assumed objectives of this work and sets out new research areas for the authors.

In order to obtain a better picture of the constant growth dynamics in granted patents, Chart 6 presents the distribution of values of chain indexes; the value of the average (annual) rate of distribution change was determined by employing the geometric mean value of individual chain indexes (i.e. the successive values of dynamics indicators).

Chart 6. Values of chain indexes based on the total number of granted patents in successive years (1995-2009) in Hungary



Source: proprietary study based on Chart 5.

By utilising the algorithm for determining the geometric mean (see above), the value of the average rate of changes in patents was established for the Hungarian economy. The average growth rate in patent 'production' in the entire research period is 6.1%.

The last country studied here is Poland. The distribution of granted patents in specific economic branches of Poland under the PCT procedure for the years 1995-2009 is presented in Table 14.

Table 14. Number of granted patents in individual NACE subsections for Poland

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
AA	0	1	0	0	0	1	1	0	1	4	1	1	0	0	0	10
BA	0	0	0	0	0	0	0	0	0	2	4	0	0	1	0	7
CA	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	4
CB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DA	2	1	1	1	2	1	1	3	7	10	8	8	9	8	20	82
DB	0	0	0	0	0	3	0	1	0	2	1	0	0	2	2	11
DC	0	0	0	1	0	0	0	0	1	1	0	0	0	1	1	5
DD	0	0	0	0	0	0	1	1	0	3	0	0	0	0	0	5
DE	0	1	0	0	0	1	3	1	4	2	5	1	1	3	0	22
DF	0	1	0	0	0	0	0	2	4	3	3	0	1	0	2	16
DG	4	6	3	7	10	7	18	14	18	40	35	33	29	41	46	311
DH	0	0	1	1	2	3	3	1	3	0	1	1	0	1	1	18
DI	4	2	1	3	0	2	2	2	5	10	2	1	2	5	5	46
DJ	2	0	0	1	1	7	6	6	10	10	7	5	13	13	10	91
DK	1	8	1	4	13	10	12	19	13	13	12	11	16	15	17	165
DL	2	5	6	7	4	5	19	20	34	52	35	28	29	28	28	302
DM	2	2	1	9	6	6	29	13	6	12	8	1	5	14	7	121
DN	0	0	2	0	1	6	7	5	7	8	5	5	6	3	6	61
FA	1	0	2	9	3	2	9	11	20	11	8	7	9	8	11	111
Total	18	27	18	43	42	55	111	99	133	183	136	102	120	144	157	1388

Source: proprietary study.

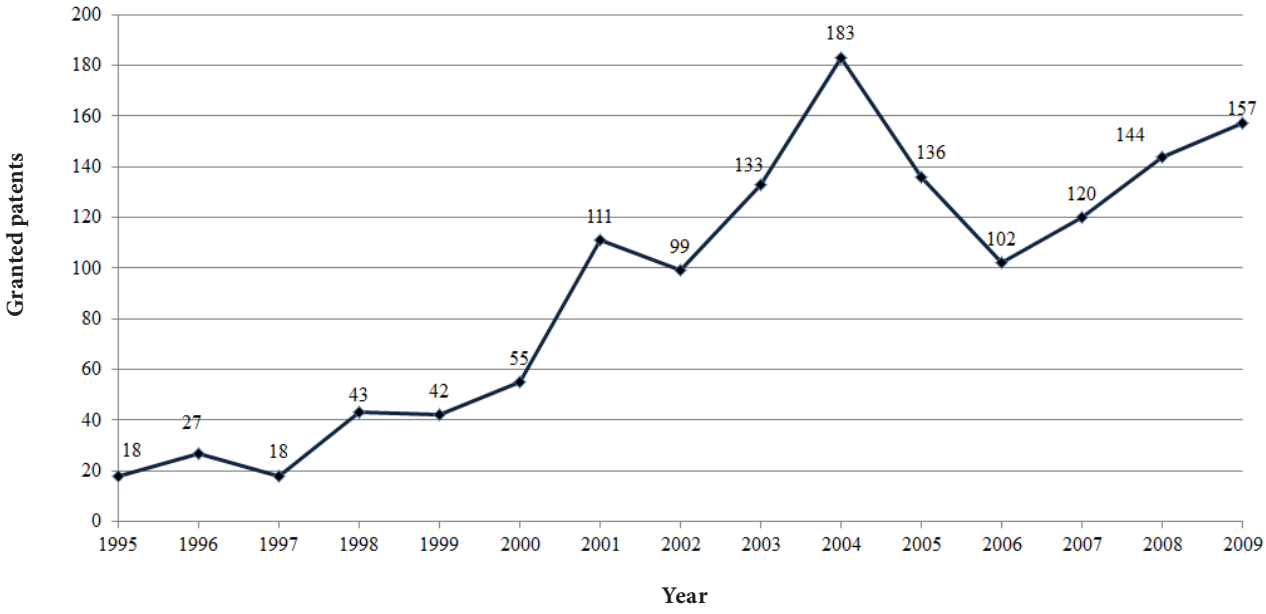
Under the international filing procedure in the examined period, Polish residents were granted 1,388 patents, which is the least of all countries under this research. The most active were:

1) manufacture of chemicals, chemical products and man-made fibres (311 patents);
2) manufacture of electrical and optical equipment (302);
3) manufacture of machinery and equipment (165);
4) manufacture of transport equipment (121);
5) construction (111);

the remaining branches were granted less than 100 patents each in the researched period of 15 years.

Chart 7 shows a different graphical presentation of the granted patents statistics for all examined economic branches of Poland.

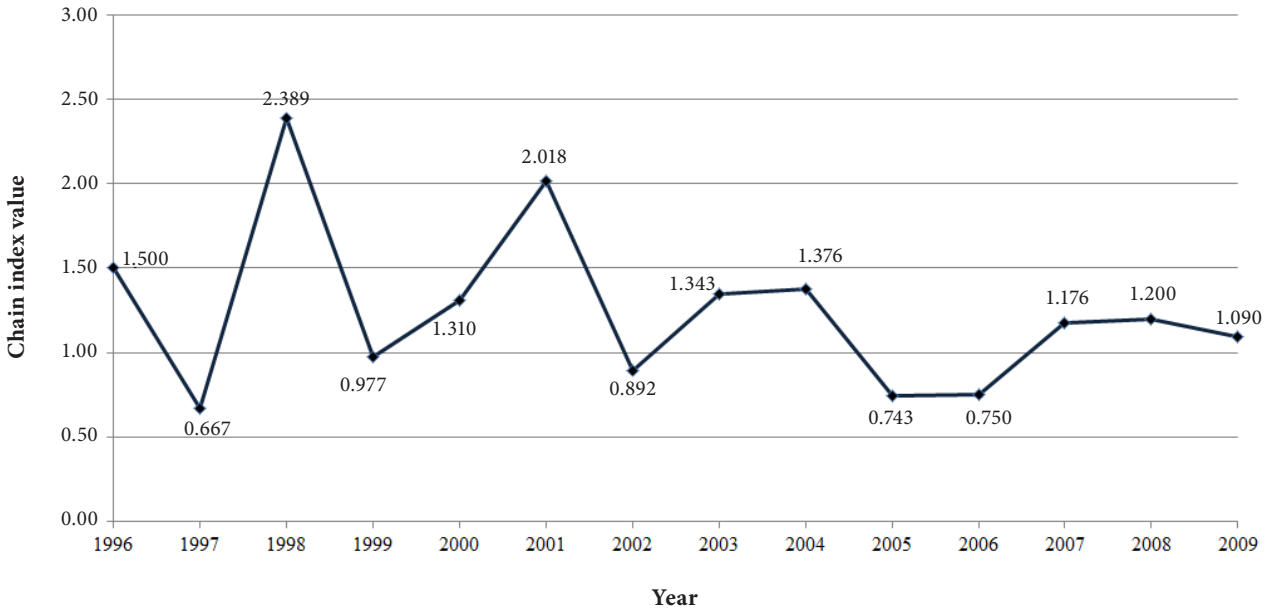
Chart 7. Total number of granted patents per year in 19 economic branches of Poland



Source: proprietary study based on Table 14.

Chart 7 shows the number of granted patents in all 19 examined branches of the Polish economy; its graphical analysis prompts formulating the question concerning the effect of the EU financial support instruments on the intensity of patent filings, and as a result, on the number of granted patents. In order to obtain a better image of the constant growth dynamics in granted patents, Chart 8 presents the distribution of values of chain indexes; the value of the average (annual) rate of distribution change was determined by employing the geometric mean value of individual chain indexes (i.e. the successive values of dynamics indicators).

Chart 8. Values of chain indexes based on the total number of granted patents in successive years (1995-2009) in Poland



Source: proprietary study based on Chart 7.

The geometric mean value for Poland is 1.167, which means that a continuous growth in granted patents is observed at the average rate of 16.7% per annum – similar to Spain, yet with a greater variation of the entire process.

Tables 11-14 presented in this subsection show the distribution of the attribute value (i.e. the number of granted patents) between the elements of the test targets (branches). For a description of the structure of the studied phenomenon, a measurement of distribution concentration was also employed. To that end, one of the measures for flattening the distribution of features, called kurtosis, was applied.

The value of the kurtosis unbiased estimator was calculated according to following relation (cf. Sobczyk, 2002, pp. 51–63; or: Zeliaś, PWE, 2000; Zając, 1994):

$$K = \frac{m_4}{s^4} = \left\{ \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum_{i=1}^{n} \left(\frac{x_i - \bar{x}}{\sqrt{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n}}} \right)^4 \right\} - \frac{3(n-1)^2}{(n-2)(n-3)}$$

where:

K – value of the kurtosis concentration coefficient;

m_4 – fourth central moment in the total of granted patents of NACE subsections for the specific country in the years 1995–2009;

s – standard deviation in the total of granted patents of NACE subsections for the specific country in the years 1995–2009;

n – number of observations, which is the number of NACE subsections for the specific country;

x_i – successive observation value which is the sum of granted patents for the specific NACE subsection for the specific country in the years 1995-2009;

$\bar{x}$ – arithmetic mean in the total of granted patents of NACE subsections for a specific country in the years 1995–2009 calculated according to the following relation:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

The higher the value of the concentration coefficient (kurtosis) is, the higher the concentration of the totals of granted patents in NACE subsections for the years 1995-2009 is around the average value. This means that the curve of distribution is more slender, hence a lower scattering of the observation values is noted. For a normal distribution the adopted value of kurtosis concentration coefficient *K* is 3. The value of the coefficient *K* decreased by 3 is called the coefficient of excess (flattening).

$$K_e = K - 3$$

where:

K – value of the kurtosis concentration coefficient;

K_e – value of the coefficient of excess[26].

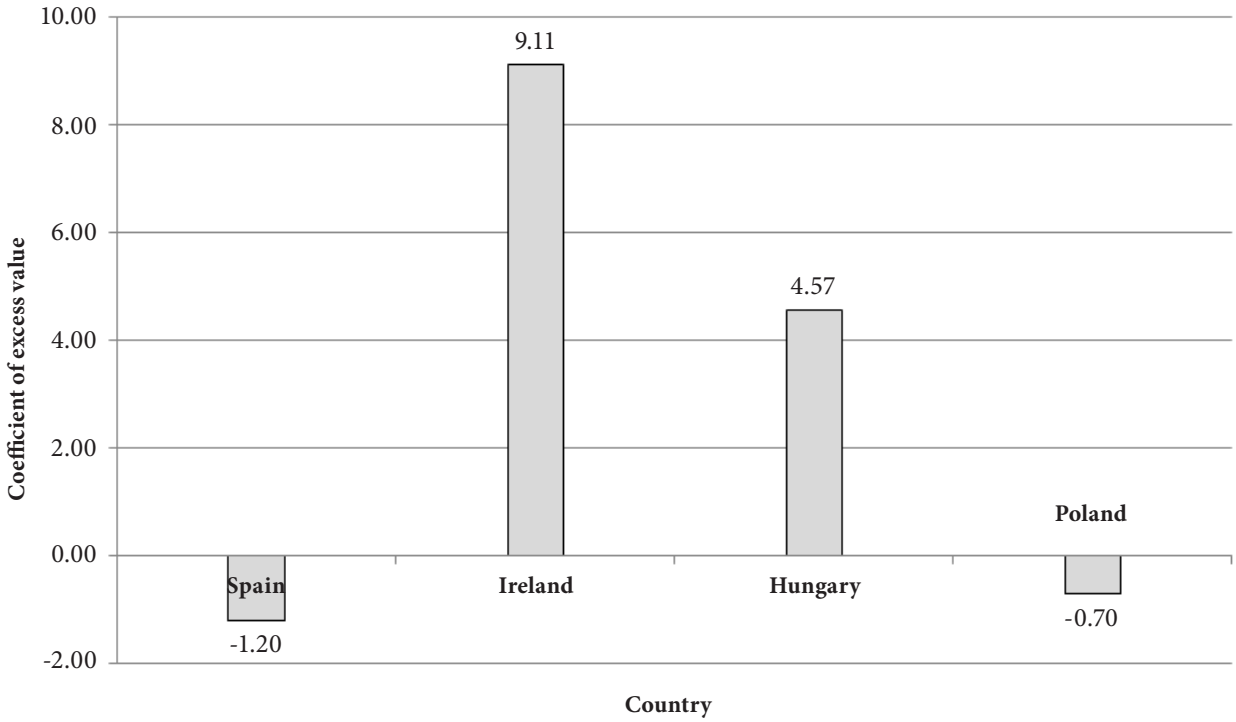
Table 15. Coefficient of concentration and excess

Coefficient\country	Spain	Ireland	Hungary	Poland
K	1.80	12.11	7.57	2.30
K_e	–1.20	9.11	4.57	–0.70

Source: proprietary study.

26 Ke = 0 – distribution of the total of patent grants of NACE Rev. 1.1 subsections for the specific country has a standard form (i.e. mesokurtic distribution). Ke > 0 – distribution of the total of patent grants of NACE Rev. 1.1 subsections for the specific country has a form which is more slender than standard (i.e. leptokurtic distribution); this means that the concentration of the total of patents is higher around their average value. Ke < 0 – distribution of the total of patent grants of NACE Rev. 1.1 subsections for a specific country has a form which is less slender than standard (i.e. platikurtic distribution); this means a higher scattering of the total of patents around their average value.

Chart 9. Coefficient of excess



Source: proprietary study.

Of the four studied countries, Ireland has the highest K_e value (9.11); this means that the distribution of the total of granted patents in NACE subsections for Ireland has a more slender form (leptokuric distribution) than the standard distribution form. Hence a higher concentration is observed for the total of patents around their average value. The K_e values for Poland (–0.7) and Spain (–1.2) indicate an oblate nature of the distribution when compared with the normal distribution curve, i.e. a lower concentration is observed around the average value.

4.3. Key development directions of technical innovations

By employing the Thomson Innovation database of patent statistics and the proposed algorithm of raw data set processing (14,567 records), this subsection presents the results of analysis of the key development directions for technical innovations in some selected European countries.

This subsection makes an attempt to verify the second research hypothesis which assumes that among all patent classification sections, electricity is the most exploited area in the context of awarded patent protection.

Table 16. Total of granted patents in individual countries in the years 1995-2009

Country	Spain	Ireland	Hungary	Poland
Total	8,881	2,272	2,026	1,388

Source: proprietary study.

Table 17 presents a detailed distribution of the cumulative number of granted patents by IPC classes in the 19 examined branches in specific countries.

Table 17. Total of granted patents at the IPC class level in individual countries in the years 1995-2009

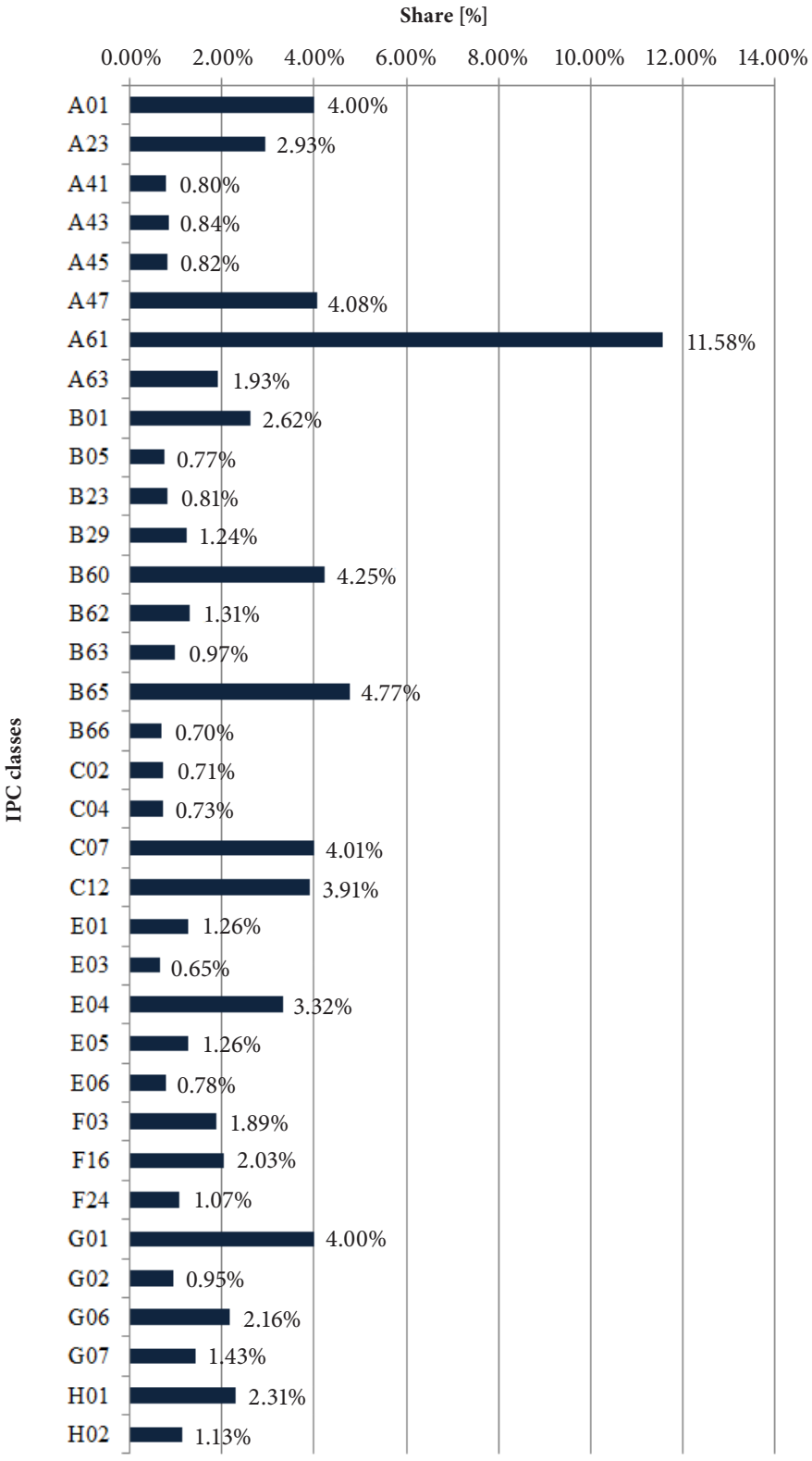
IPC class	Spain	Ireland	Hungary	Poland	IPC class	Spain	Ireland	Hungary	Poland
A01	355	69	74	28	C13	0	0	0	0
A21	29	10	14	3	C14	3	0	0	1
A22	37	2	0	1	C21	7	0	2	3
A23	260	44	48	18	C22	21	0	7	1
A24	30	2	11	11	C23	22	5	3	4
A41	71	5	5	1	C25	15	1	1	0
A42	16	2	1	0	C30	12	1	0	6
A43	75	1	11	1	C40	0	0	0	0
A44	22	2	4	0	C99	0	0	0	0
A45	73	11	7	8	D01	15	1	0	7
A46	19	3	3	2	D02	7	0	0	1
A47	362	52	38	49	D03	10	0	1	0
A61	1028	523	427	171	D04	6	0	0	2
A62	51	3	2	4	D05	1	0	0	0
A63	171	38	44	22	D06	57	1	4	3
A99	0	0	0	0	D07	3	0	0	0
B01	233	66	48	47	D21	18	1	3	5
B02	6	1	1	3	D99	0	0	0	0
B03	7	4	5	0	E01	112	13	14	11
B04	0	1	0	0	E02	54	13	4	7
B05	68	9	4	8	E03	58	5	20	12
B06	0	0	1	0	E04	295	65	35	63
B07	6	2	1	0	E05	112	5	17	23
B08	18	2	0	1	E06	69	10	2	12
B09	10	2	11	5	E21	8	9	0	0
B21	35	1	3	6	E99	0	0	0	4

IPC class	Spain	Ireland	Hungary	Poland	IPC class	Spain	Ireland	Hungary	Poland
B22	34	4	1	5	F01	38	2	10	18
B23	72	17	19	5	F02	31	5	16	15
B24	14	1	5	2	F03	168	7	14	15
B25	45	9	4	2	F04	23	3	3	5
B26	26	6	3	1	F15	10	1	0	3
B27	14	4	2	1	F16	180	13	37	40
B28	43	4	3	4	F17	7	0	3	4
B29	110	17	28	16	F21	27	13	3	3
B30	11	1	2	3	F22	0	0	0	1
B31	21	1	1	0	F23	23	10	11	7
B32	33	9	11	2	F24	95	21	19	18
B41	52	4	5	3	F25	23	4	2	1
B42	39	7	2	9	F26	8	2	1	2
B43	4	2	1	0	F27	4	0	2	2
B44	10	1	3	5	F28	10	3	7	4
B60	377	20	46	71	F41	28	2	7	7
B61	33	0	4	5	F42	8	1	0	3
B62	116	12	15	9	F99	0	0	0	0
B63	86	6	4	12	G01	355	137	85	53
B64	48	4	5	8	G02	84	26	38	7
B65	424	65	42	50	G03	14	11	6	0
B66	62	7	5	1	G04	16	3	1	0
B67	42	13	1	0	G05	32	12	6	4
B68	2	1	0	0	G06	192	215	84	50
B81	7	2	5	0	G07	127	21	10	14
B82	5	1	0	0	G08	55	10	14	1
B99	0	0	0	0	G09	0	0	0	0
C01	55	7	6	10	G10	33	5	4	2
C02	63	8	17	11	G11	25	23	14	2
C03	18	2	0	3	G12	0	0	0	0
C04	65	6	13	8	G21	4	0	8	0
C05	23	3	6	4	G99	0	0	0	0
C06	3	0	0	1	H01	205	78	30	40
C07	356	72	295	113	H02	100	27	34	21
C08	43	31	16	18	H03	27	19	2	9
C09	33	28	10	2	H04	235	160	48	28
C10	22	0	20	16	H05	32	14	6	8
C11	17	3	0	6	H99	0	0	0	0
C12	347	61	25	41	–	–	–	–	–

Source: proprietary study.

By adopting the Pareto rule, leading IPC classes were identified, totalling at least 80% of the total number of granted patents in the researched country.

Chart 10. Leading IPC classes of Spain

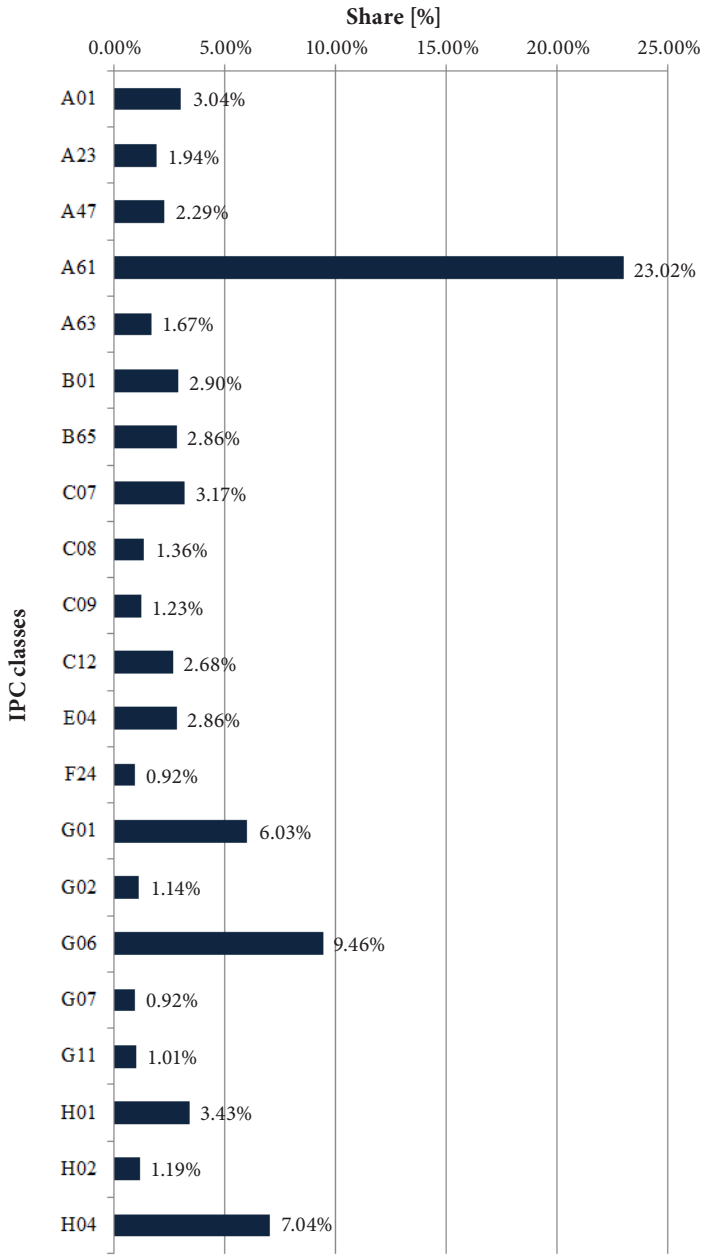


Source: proprietary study.

Chart 10 shows the leading IPC classes for Spain which total 80.63% of the share of granted patents in the entire research period. The most exploited engineering fields in Spain are: (1) medical or veterinary science; hygiene (A61); (2) conveying; packing; storing (B65); (3) vehicles (B60); (4) furniture; domestic articles or appliances (A47); (5) organic chemistry (C07); (6) agriculture; forestry; animal husbandry; hunting; trapping; fishing (A01); (7) measuring; testing (G01).

Table 3 (see subsection 1.4.1) presents mapping of the ICT sector with the use of the IPC. Based on this mapping it can be assumed that the following sections: physics (G) and electricity (H) are typical of the ICT area. Considering the aforementioned, a general conclusion can be further formulated that out of all granted patents to Spanish residents under PCT in the years 1995-2009, the patents compatible with the ICT area constituted 17.3% (see Table 17).

Chart 11. Leading IPC classes of Ireland

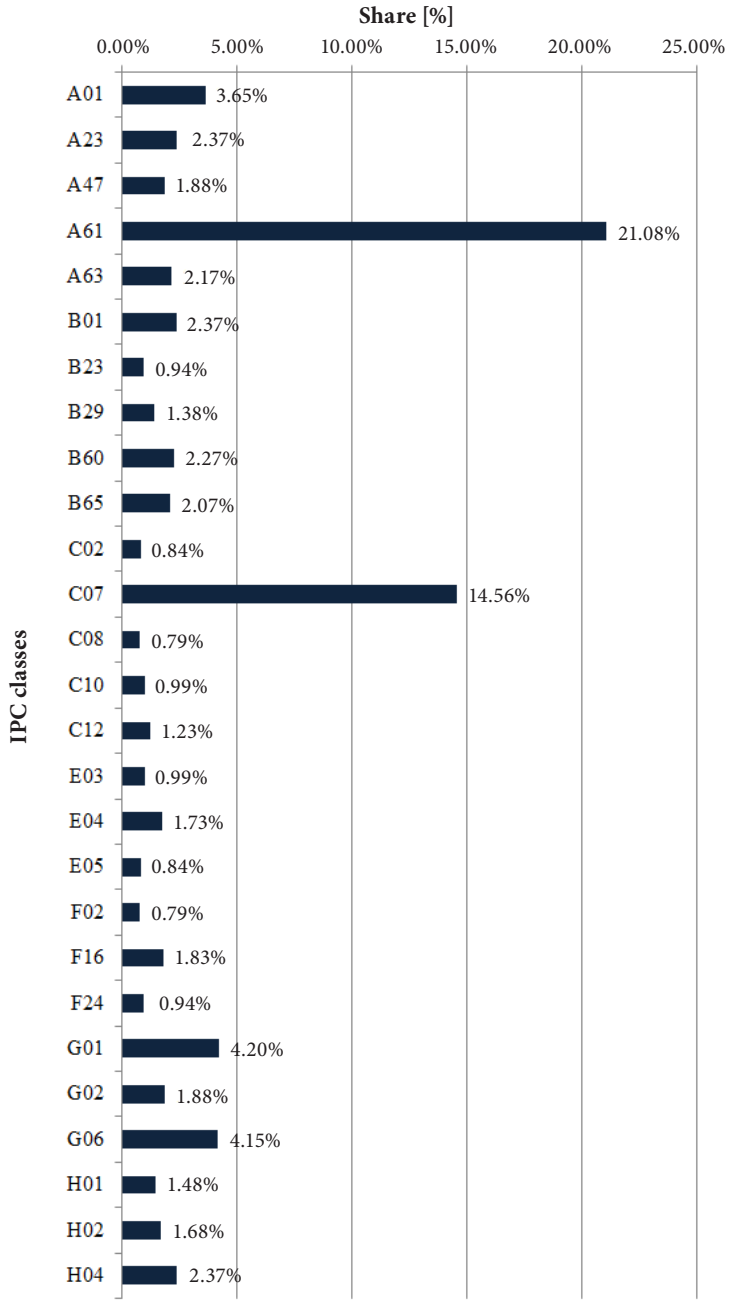


Source: proprietary study.

Chart 11 shows the leading IPC classes for Ireland which total 81.03% of the share of granted patents in the entire research period. The most exploited fields of technology in Ireland are: (1) medical or veterinary science; hygiene (A61); (2) computing; calculating; counting (G06); (3) electric communication technique (H04); (4) measuring; testing (G01).

Table 3 (see subsection 1.4.1) presents mapping of the ICT sector with the use of the IPC. Based on this mapping it can be assumed that the following sections: physics (G) and electricity (H) are typical of the ICT area. Considering the aforementioned, a general conclusion can be further formulated that out of all granted patents to Irish residents under PCT in the years 1995-2009, the patents compatible with the ICT area constituted 33.50% (see Table 17).

Chart 12. Leading IPC classes of Hungary

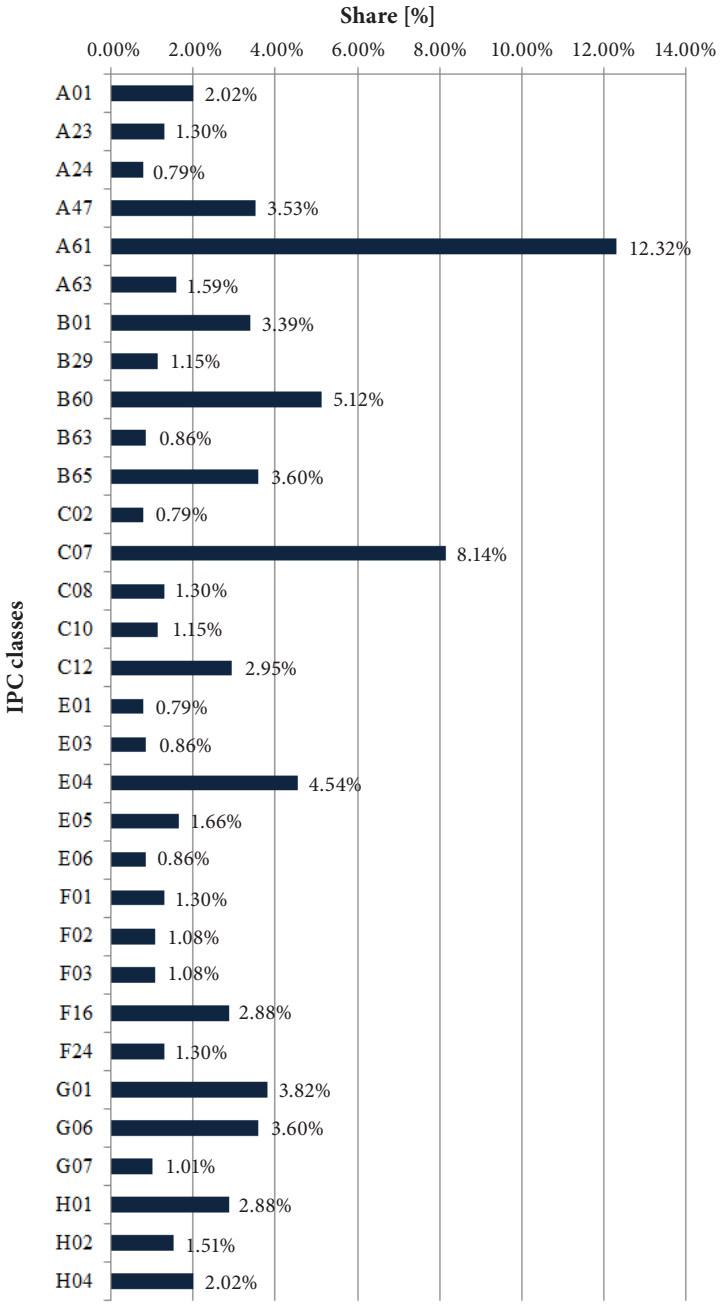


Source: proprietary study.

Chart 12 shows the leading IPC classes for Hungary which total 81.44% of the share of granted patents in the entire research period. The most exploited fields of technology in Hungary are: (1) medical or veterinary science; hygiene (A61); (2) organic chemistry (C07); followed by: measuring; testing (G01) and computing; calculating; counting (G06).

Table 3 (see subsection 1.4.1) presents mapping of the ICT sector with the use of the IPC. Based on this mapping it can be assumed that the following sections: physics (G) and electricity (H) are typical of the ICT area. Considering the aforementioned, a general conclusion can be further formulated that out of all granted patents to Hungarian residents under PCT in the years 1995-2009, the patents compatible with the ICT area constituted 19.25% (see Table 17).

Chart 13. Leading IPC classes of Poland



Source: proprietary study.

Chart 13 shows the leading IPC classes for Poland which total at 80.04% of the share of granted patents in the entire research period. The most exploited fields of technology in Poland are: (1) medical or veterinary science; hygiene (A61); (2) organic chemistry (C07); (3) vehicles (B60); (4) construction (E04).

Table 3 (see subsection 1.4.1) presents mapping of the ICT sector with the use of the IPC. Based on this mapping it can be assumed that the following sections: physics (G) and electricity (H) are typical of the ICT area. Considering the aforementioned, a general conclusion can be further formulated that among all granted patents to Polish residents under PCT in the years 1995-2009, the patents compatible with the ICT area constituted 17.20% (see Table 17).

Moving further to a lower level of the IPC (subclasses), the key directions were identified for the development of technical innovations (i.e. the largest number of granted patents in the examined period).

Table 18. Total of granted patents at the leading IPC subclasses level in individual countries in the years 1995-2009

Leading IPC subclass \ country	Spain	Ireland	Hungary	Poland
A61B	–	139	–	36
A61K	447	182	280	82
B65D	279	–	–	38
C07C	–	–	69	–
C07D	–	–	173	45
C12N	190	–	–	–
G01N	151	77	55	–
G06F	–	121	–	–

Source: proprietary study.

The most exploited IPC subclasses for Spain are:

1) preparations for medical, dental, or toilet purposes (A61K);
2) containers for storage or transport of articles or materials, e.g. bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings thereof; packaging elements; packages (B65D);
3) micro-organisms or enzymes; compositions thereof; propagating, preserving, or maintaining micro-organisms; mutation or genetic engineering; culture media (C12N);
4) examining or analysing materials by determining their chemical or physical properties (G01N).

The most exploited IPC subclasses for Ireland are:

1) similar to Spain – subclass A61K;
2) diagnosis; surgery; identification (A61B);
3) similar to Spain – subclass G01N;
4) electric digital data processing (G06F).

The most exploited IPC subclasses for Hungary are:

1) similar to Spain and Ireland – subclass A61K;
2) heterocyclic compounds (C07D);
3) acyclic or carbocyclic compounds (C07C);
4) subclass G01N.

The most exploited IPC subclasses for Poland are, in succession: A61K, C07D, B65D and A61B.

The full listing of granted patents (on the subclass level) to all examined branches of the selected economies is presented in Annex No. 4.

The presentation of the accomplished research results substantiates falsification of the posed hypothesis. There are no rational grounds to deem that the ICT sector production (including electricity) is the most exploited field in terms of awarded patent protection. The researched countries

are dominated by the 'production' of patents in the area of medicine (including biology and chemistry). Only Ireland shows a relatively clear patent activity in the area of electrical processing of digital data.

4.4. Scheme of interdependencies between branch patent activity and its share in GDP

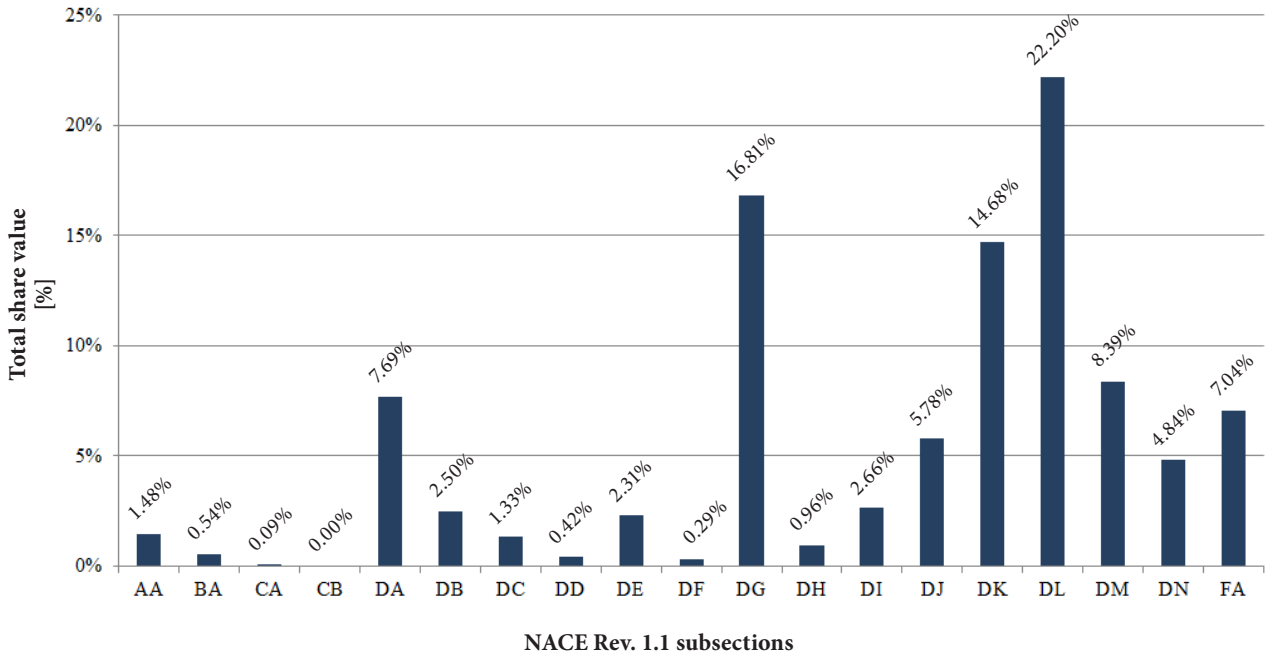
This subsection makes an attempt to verify the first research hypothesis which concerns the purported relation between the number of granted patents in a branch of economy and the changes in that branch share in the produced added value.

The gross value added (GVA) in market prices is the value of manufacturing at market prices reduced by the value of use in the purchase prices. The total of gross value average in the fixed prices of all industrial branches and of the value of indirect taxes, reduced by subventions for products results in the gross domestic product. The GVA of the entire economy is usually over 90% of the GDP (*Statistics Explained, Eurostat*).

This subsection presents for each of the countries: the structure of granted patents (by economic branches) obtained through the application of one of the developed concordance tables, the distribution of GVA produced by the branches, the correlation coefficient value and a hierarchical cluster analysis. The procedure serves directly to verify the first research hypothesis.

By using the data from Table 11, Chart 14 presents the distribution of the share of granted patents by 19 researched NACE subsections in Spain.

Chart 14. Distribution of the share of granted patents by 19 NACE subsections in Spain



Source: proprietary study based on the data in Table 11 (Number of granted patents in individual NACE subsections for Spain).

Chart 14 implies that the highest patent activity is found in:

1) manufacture of electrical and optical equipment (22.20% of all granted patents to Spanish residents under the PCT);
2) manufacture of chemicals, chemical products and man-made fibres (16.81%);
3) manufacture of machinery and equipment (14.68%).

The second important bundle of raw data is the distribution of the gross value added produced by individual branches of the Spanish economy. The distribution of the gross value added as generated by NACE subsections in Spain is shown in Table 19.

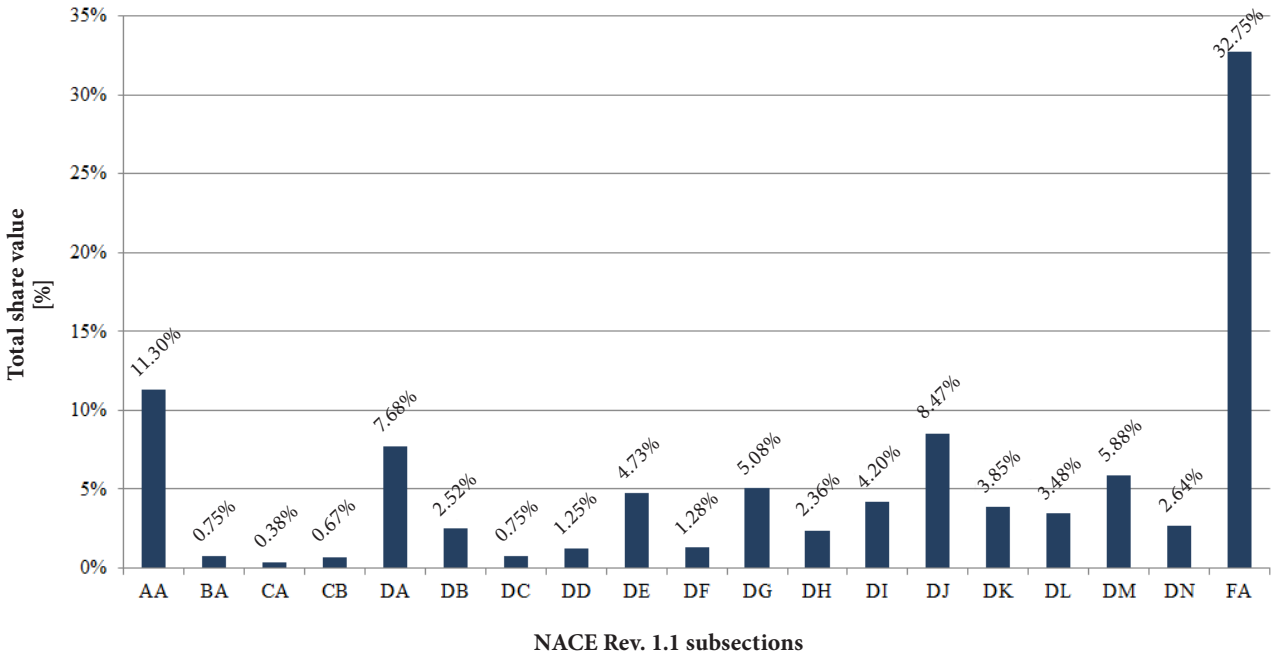
Table 19. Distribution of the gross value added as generated by NACE subsections in Spain (mln EUR)

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Share (%)
AA	17,227	20,746	21,697	22,399	21,885	23,498	24,762	25,010	26,450	25,674	24,423	22,894	25,490	24,976	24,292	351,423	11.30
BA	1,341	1,453	1,456	1,511	1,585	1,486	1,548	1,576	1,558	1,691	1,588	1,577	1,711	1,518	1,663	23,262	0.75
CA	1,416	1,281	929	859	781	764	804	739	778	805	569	562	565	487	413	11,752	0.38
CB	992	892	904	852	926	997	1,333	1,531	1,625	1,694	1,809	1,911	2,032	1,932	1,380	20,810	0.67
DA	12,573	12,758	13,244	13,561	14,198	14,119	14,627	14,888	15,848	16,394	17,939	18,087	19,488	20,245	20,969	238,938	7.68
DB	4,593	4,812	5,259	5,554	5,726	5,785	5,923	5,695	5,780	5,410	5,020	5,130	4,890	4,889	3,972	78,438	2.52
DC	1,434	1,610	1,643	1,754	1,666	1,658	1,670	1,588	1,604	1,503	1,504	1,417	1,449	1,488	1,216	23,204	0.75
DD	1,935	2,026	2,122	2,298	2,415	2,501	2,555	2,619	2,683	2,746	2,910	3,140	3,235	3,176	2,373	38,734	1.25
DE	6,291	6,643	7,272	7,741	8,165	9,366	9,752	10,302	10,497	10,850	11,840	12,149	12,440	12,332	11,450	147,090	4.73
DF	1,935	1,949	2,331	2,307	1,663	2,717	2,861	2,702	3,285	3,445	3,739	3,212	2,521	2,929	2,208	39,804	1.28
DG	7,047	7,185	7,958	8,242	8,877	9,691	10,521	10,699	10,753	11,452	12,019	12,646	13,172	13,907	13,772	157,941	5.08
DH	3,426	3,777	3,910	4,172	4,390	4,661	4,866	5,118	5,223	5,374	5,474	5,432	5,711	6,359	5,490	73,383	2.36
DI	5,972	5,828	6,333	6,955	7,555	7,976	8,684	8,952	9,080	9,649	10,703	11,271	11,604	11,420	8,677	130,659	4.20
DJ	9,535	10,095	11,413	12,410	13,843	16,062	17,361	18,129	18,744	19,914	21,032	23,654	25,365	25,763	20,105	263,425	8.47
DK	4,551	5,300	5,663	6,155	6,582	7,375	8,088	8,454	8,511	9,122	9,313	9,940	10,412	10,997	9,368	119,831	3.85
DL	5,470	6,279	6,344	6,717	6,968	7,302	7,586	7,004	7,160	7,183	7,132	8,221	8,794	9,003	7,073	108,236	3.48
DM	8,258	9,120	10,465	11,152	11,494	11,504	11,747	12,772	13,480	13,633	13,535	14,643	15,293	14,579	11,357	183,032	5.88
DN	3,062	3,473	3,906	4,338	4,887	5,415	5,605	5,626	5,791	6,325	6,593	6,903	6,921	7,152	6,095	82,092	2.64
FA	30,874	31,431	32,848	36,139	41,252	47,584	54,970	62,452	70,265	80,480	93,808	105,823	112,040	113,511	105,522	1,018,999	32.75
Total	127,932	136,658	145,697	155,116	164,858	180,461	195,263	205,856	219,115	233,344	250,950	268,612	283,133	286,663	257,395	3,111,053	100

Source: proprietary study based on the Eurostat database [National Accounts by 31 branches – aggregates at current prices (nama_nace31_c)].

Chart 15 makes a graphical complement to Table 19; it shows the structure of gross value added generated by NACE subsections in the examined economy.

Chart 15. Structure of the gross value added as generated by NACE subsections in Spain, years 1995-2009



Source: proprietary study based on the data in Table 19.

When assuming that the 19 examined economic branches of Spain form a certain finite set (for the purpose of this discourse), Chart 15 allows concluding that the highest share in GVA is held by:

1) construction;
2) agriculture, hunting and forestry;
3) manufacture of basic metals and fabricated metal products;
4) manufacture of food products, beverages and tobacco, etc.

The first formulated hypothesis entitles a suspicion that there is a cause-and-effect connection between the number of granted patents in an economic branch and the number's change in the generation of gross value added. Bilateral statistical (correlation) dependence is assumed here. Hence the further part of this subsection tries to verify the hypothesis by employing one of the methods for analysing interdependencies in the distribution of values of two processes, i.e. Pearson's coefficient of linear correlation.

Among other descriptive methods for measuring the strength and direction of two variables, the following were considered: Pearson's correlation ratios and Spearman's rank correlation coefficient. The nature of the examined processes, as well as their distribution, is the decisive factor in selecting the presentation of the results from the measurement which employs Pearson's linear correlation coefficient.

The linear correlation coefficient value of two time series was calculated from the dependence[27]:

$$r = \frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)\times\left(y_i - \bar{y}\right)}{\sqrt{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2 \sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2}}$$

where:

n – number of observations;

i – successive pair of observations of two time series;

x_i – successive observation of the number of granted patents in the specific NACE subsection;

y_i – successive observation of the gross value added generated by the specific NACE subsection;

$\bar{x}$ – arithmetic mean of the number of granted patents in the specific NACE subsection for the years 1995-2009, calculated as:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

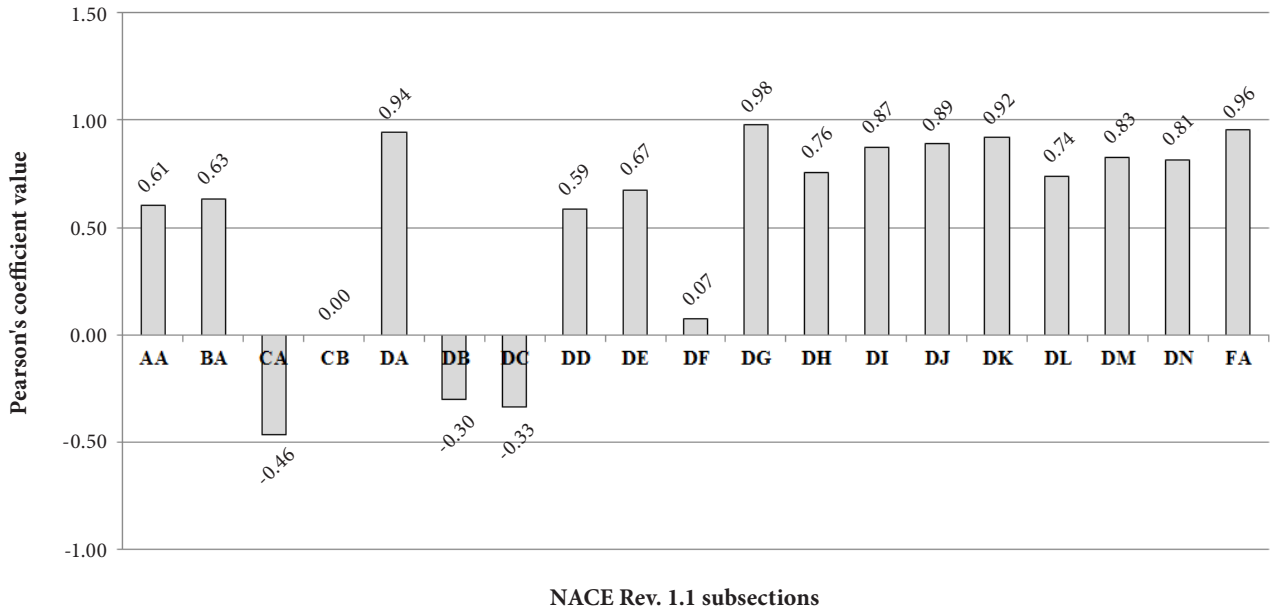
$\bar{y}$ – arithmetic mean of the gross value added generated by the specific NACE subsection for the years 1995-2009, calculated as:

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

By further employing the data (time series) included in Table 11 and 19, the values of Pearson's linear correlation were determined. Chart 16 presents the distribution of coefficient values for each economic branch.

27 Pearson's linear correlation coefficient is a measure of linear relationship. It can assume values in the range $-1 < r < 1$. The value $r = 0$ denotes that the linear dependence does not exist. It is usually assumed that: $r < 0.2$ denotes that no linear dependence exists, $0.2 < r < 0.4$ denotes a weak dependence, $0.4 < r < 0.7$ is a moderate dependence, $0.7 < r < 0.9$ is a strong dependence, $r > 0.9$ is a very strong dependence. A similar interpretation is used for negative values.

Chart 16. Distribution of Pearson's coefficient values for Spain



Source: proprietary study.

By employing a parametric Student's *t*-test for two means and independent samples at the assumed significance level $a = 0.05$ (for a bilateral critical area), the Pearson's coefficient values became statistically negligible for the following Spanish economic subsections: CA, DB, DC, DF.

Table 11 (Number of granted patents in individual NACE subsections for Spain) indicates that the highest patent activity characterises the following subsections: (1) DL; (2) DG; (3) DK. Strong and very strong statistical interdependencies were demonstrated in the subsections (Chart 16), along with a strong and very strong statistical significance. In the case of subsection CA (8 patents in the years 1995-2009) and CB (0 patents), there is no entitlement for any inference. The branches DB – Manufacture of textiles and textile products, and DC – Manufacture of leathers and leather products are characterised by a relatively low (when compared to other branches) patent activity. This means, respectively, 222 and 118 patents granted in the years 1995-2009. In the case of subsection DF – Manufacture of refined petroleum products and nuclear fuel, the cumulative number of patents is only 26. The test results confirm that there are no grounds for any deduction.

Irrespective of the analysis of the interdependencies of the researched processes, it was decided to expand the research with a cluster analysis (Everitt, Landau, Leese, Stahl, 2011; Kaufman, Rousseeuw, 2005), which groups elements in relatively homogeneous classes. The general basis of grouping is the similarity of elements, which can help solve issues in discovering the hidden structure in raw data. The cluster analysis can follow different procedures. A hierarchic method was adopted in this study.

The basis for a hierarchical cluster analysis for Spain is the data in Table 11 and 19. Due to significant differences in the values of the time series presented, they were standardised according to the following dependence:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S(x_j)}$$

where:

z_{ij} – standardised value of the number of patents (and respectively of the value of production in each NACE subsection) in the analysed countries;

$S(x_j)$ – standard deviation of the number of patents (and respectively of the value of production in each NACE subsection) in the analysed countries;

x_{ij} – successive value of an attribute;

$\bar{x}_j$ – arithmetic mean of an attribute (i.e. the number of patents and, respectively, the value of production).

The standardised values adopted as the input values for the cluster analysis are presented in Table 20.

Table 20. Standardised input values for the cluster analysis (Spain)

Country	Spain		Country	Spain	
NACE\standardised value	number of patents	production volume	NACE\standardised value	number of patents	production volume
AA	–0.597	0.828	DG	1.82	–0.026
BA	–0.744	–0.62	DH	–0.679	–0.399
CA	–0.815	–0.67	DI	–0.411	–0.146
CB	–0.829	–0.63	DJ	0.081	0.44
DA	0.383	0.332	DK	1.484	–0.194
DB	–0.435	–0.376	DL	2.67	–0.245
DC	–0.62	–0.62	DM	0.493	0.085
DD	–0.764	–0.551	DN	–0.066	–0.36
DE	–0.466	–0.073	FA	0.28	3.772
DF	–0.783	–0.547			

Source: proprietary study.

In order to calculate the distance between the individual subsections of NACE, an equation of Euclidian distance was used for two attributes and in accordance with the following dependence.

$$dist_{ij} = \sqrt{\sum_{k=1}^{p} (x_{ik} - x_{jk})^2}$$

where:

$dist_{ij}$ – distance value for individual NACE subsections (i.e. the analysed countries);

p – number of attributes, equal to the number of the variables which describe each subsection of NACE (here: p=2);

x_{ik} – successive value of the standardised number of patents in the specific NACE subsection (in individual countries);

x_{ik} – successive value of the production value in the specific NACE subsection (in individual countries);

k – successive object (NACE subsection) in individual countries.

As a result of the calculations, matrices of Euclidian distances were obtained for individual NACE subsections.

Table 21. Value of Euclidian distances of NACE subsections for Spain

NACE subsection	AA	BA	CA	CB	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	FA
AA	0	1.455	1.514	1.477	1.098	1.215	1.448	1.389	0.911	1.387	2.563	1.229	0.991	0.781	2.319	3.438	1.319	1.301	3.072
BA	1.455	0	0.087	0.086	1.475	0.393	0.124	0.071	0.613	0.083	2.632	0.231	0.579	1.343	2.269	3.434	1.423	0.726	4.51
CA	1.514	0.087	0	0.042	1.562	0.48	0.202	0.13	0.692	0.128	2.713	0.304	0.662	1.427	2.349	3.511	1.51	0.811	4.576
CB	1.477	0.086	0.042	0	1.547	0.469	0.21	0.103	0.665	0.096	2.717	0.277	0.64	1.405	2.355	3.52	1.503	0.809	4.54
DA	1.098	1.475	1.562	1.547	0	1.082	1.382	1.447	0.94	1.46	1.481	1.288	0.926	0.32	1.221	2.359	0.27	0.825	3.442
DB	1.215	0.393	0.48	0.469	1.082	0	0.306	0.372	0.304	0.387	2.282	0.244	0.232	0.966	1.929	3.108	1.036	0.369	4.21
DC	1.448	0.124	0.202	0.21	1.382	0.306	0	0.159	0.568	0.179	2.511	0.229	0.518	1.27	2.147	3.311	1.317	0.612	4.483
DD	1.389	0.071	0.13	0.103	1.447	0.372	0.159	0	0.563	0.020	2.636	0.175	0.538	1.302	2.276	3.447	1.408	0.723	4.448
DE	0.911	0.613	0.692	0.665	0.94	0.304	0.568	0.563	0	0.57	2.286	0.389	0.091	0.75	1.954	3.14	0.971	0.492	3.917
DF	1.387	0.083	0.128	0.096	1.46	0.387	0.179	0.020	0.57	0	2.655	0.181	0.547	1.311	2.295	3.466	1.424	0.741	4.448
DG	2.563	2.632	2.713	2.717	1.481	2.282	2.511	2.636	2.286	2.655	0	2.526	2.234	1.80	0.375	0.878	1.332	1.916	4.098
DH	1.229	0.231	0.304	0.277	1.288	0.244	0.229	0.175	0.389	0.181	2.526	0	0.368	1.131	2.173	3.352	1.267	0.613	4.28
DI	0.991	0.579	0.662	0.64	0.926	0.232	0.518	0.538	0.091	0.547	2.234	0.368	0	0.765	1.896	3.082	0.932	0.405	3.979
DJ	0.781	1.343	1.427	1.405	0.32	0.966	1.27	1.302	0.75	1.311	1.80	1.131	0.765	0	1.54	2.678	0.543	0.813	3.339
DK	2.319	2.269	2.349	2.355	1.221	1.929	2.147	2.276	1.954	2.295	0.375	2.173	1.896	1.54	0	1.186	1.030	1.56	4.145
DL	3.438	3.434	3.511	3.52	2.359	3.108	3.311	3.447	3.14	3.466	0.878	3.352	3.082	2.678	1.186	0	2.202	2.739	4.675
DM	1.319	1.423	1.51	1.503	0.27	1.036	1.317	1.408	0.971	1.424	1.332	1.267	0.932	0.543	1.030	2.202	0	0.715	3.693
DN	1.301	0.726	0.811	0.809	0.825	0.369	0.612	0.723	0.492	0.741	1.916	0.613	0.405	0.813	1.56	2.739	0.715	0	4.147
FA	3.072	4.51	4.576	4.54	3.442	4.21	4.483	4.448	3.917	4.448	4.098	4.28	3.979	3.339	4.145	4.675	3.693	4.147	0

Source: proprietary study.

Next, to calculate the distance between the clusters (groups) of NACE subsections, the arithmetic mean of the distances was used between all pairs of the subsection elements, according to the following dependence.

$$d(r,s) = \frac{1}{n_r n_s} \sum_{i=1}^{n_r} \sum_{j=1}^{n_s} dist(x_{ri}, x_{sj})$$

where:

$dist(r,s)$ – value of distance between individual clusters of NACE subsections (i.e. the analysed countries);

n_r – number of elements in a specific cluster r of a NACE subsection in the specific country;

n_s – number of elements in a specific cluster s of a NACE subsection in the specific country;

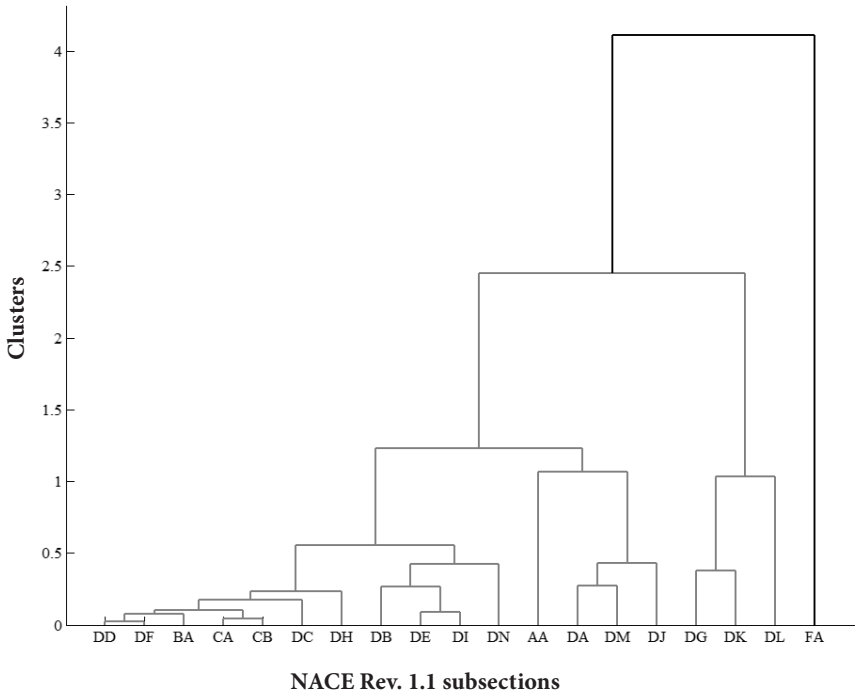
x_{ri} – successive element in cluster r of a NACE subsection in the specific country;

x_{sj} – successive element in cluster s of a NACE subsection in the specific country;

$dist\ (x_{ri}, x_{sj})$ – successive value of the distance between elements x_{ri} and x_{sj}.

Based on the calculations, dendrograms were developed for each analysed country (see: Sokal, Rholf, 1962). The dendrograms present the division into clusters (groups) of NACE subsections which result from the Euclidian distances between the standardised values of the attributes (the number of patents and the production volume), and the mean arithmetic distance between the clusters. Chart 17 presents the dendrogram for Spain.

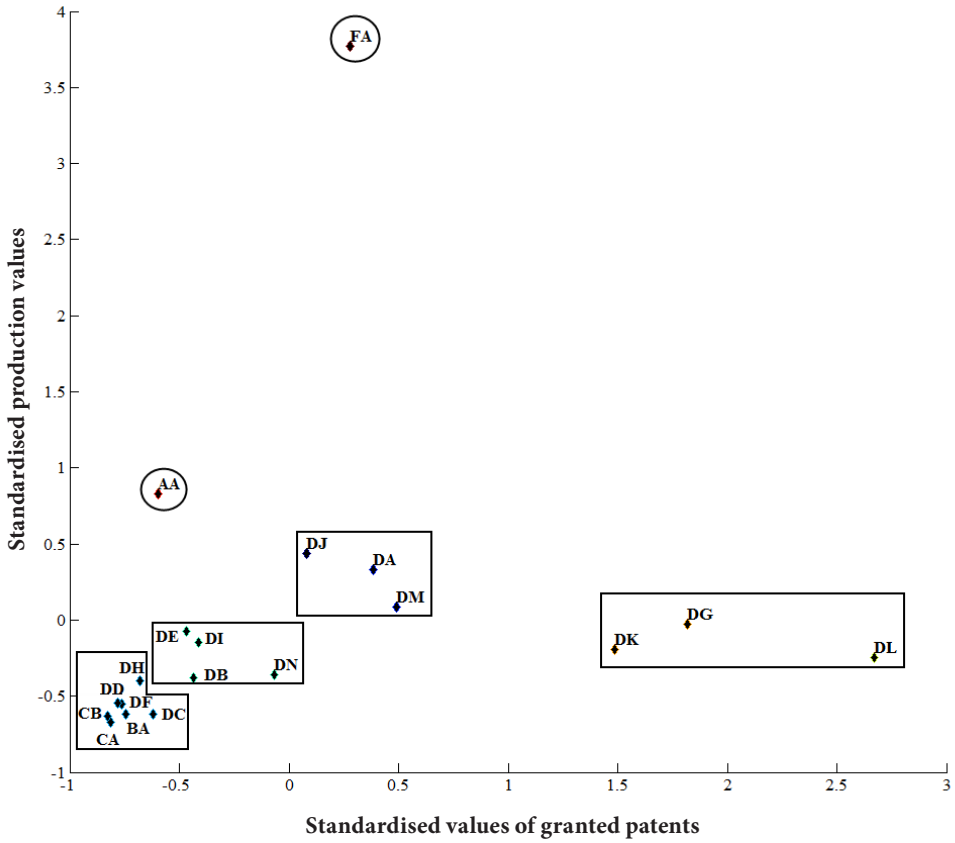
Chart 17. Cluster dendrogram for NACE subsections of Spain



Source: proprietary study.

Further on, dot diagrams were plotted for each country. The dots represent specific subsections of NACE. Their distribution results from the standardised values of their descriptive attributes (the number of patents and production volume). Chart 18 plots the clusters which result from the dendrogram in Chart 17.

Chart 18. Clusters of NACE subsections for Spain



Source: proprietary study.

The dendrogram readout allows plotting the following clusters of the NACE subsections of Spain:

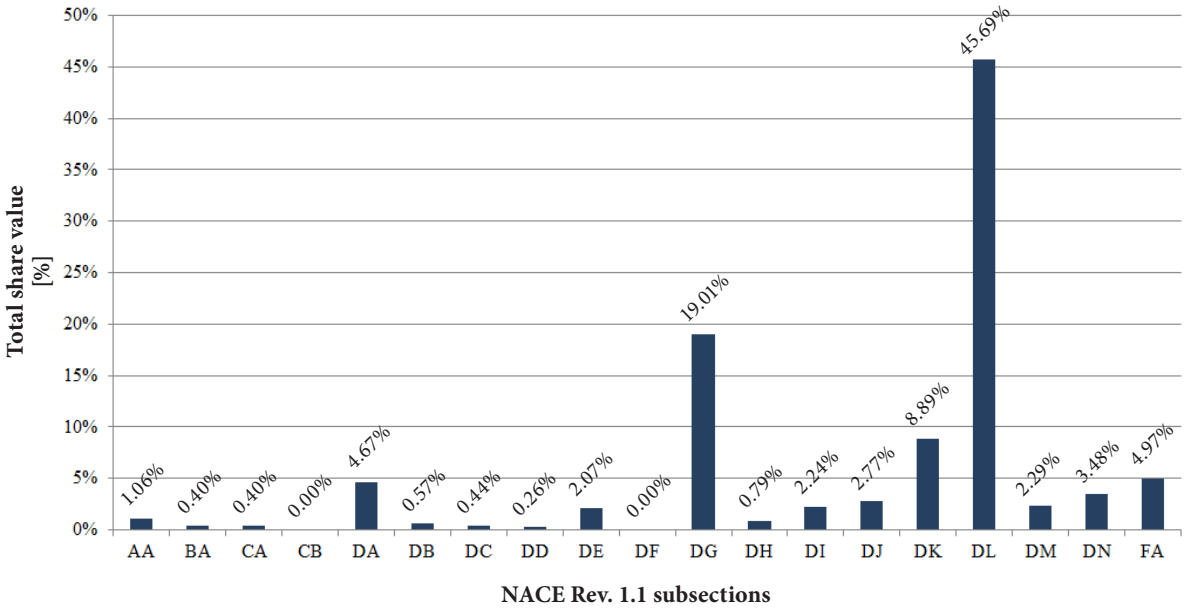
1) cluster 1: DK, DG, DL;
2) cluster 2: DM, DA, DJ;
3) cluster 3: DI, DE, DB, DN;
4) cluster 4: DH, DC, CB, CA, BA, DF, DD;
5) isolated subsection FA;
6) isolated subsection AA.

The produced clusters can be a subject of further and deeper research, e.g. for the common attributes, preconditions of the patent activity development in the branches, or differences between the clusters. The research, however, requires developing a separate procedure; this is beyond the adopted scope of this work.

The hypothesis about the purported relation between the number of granted patents in a branch and the changes in its share in the produced added value of Spain can be verified positively in terms of the leading branches in patent production. Concerning the following branches: manufacture of electrical and optical equipment; manufacture of chemicals, chemical products and man-made fibres; and manufacture of machinery and equipment, a high positive statistical interdependence was found between the patent activity of branches and the gross value added.

By using the data from Table 12, Chart 19 presents the distribution of the share of granted patents by 19 researched NACE subsections in Ireland.

Chart 19. Distribution of the share of granted patents by 19 NACE subsections in Ireland



Source: proprietary study based on the data in Table 12 (Number of granted patents in individual NACE subsections for Ireland).

Chart 19 implies that the highest patent activity is found in:

1) manufacture of electrical and optical equipment (45.69% of all granted patents to Irish residents under the PCT);
2) manufacture of chemicals, chemical products and man-made fibres (19.01%);
3) manufacture of machinery and equipment (8.89%).

The second important bundle of raw data is the distribution of the gross value added produced by individual branches of Irish economy. The distribution of the gross value added as generated by NACE subsections in Ireland is shown in Table 22.

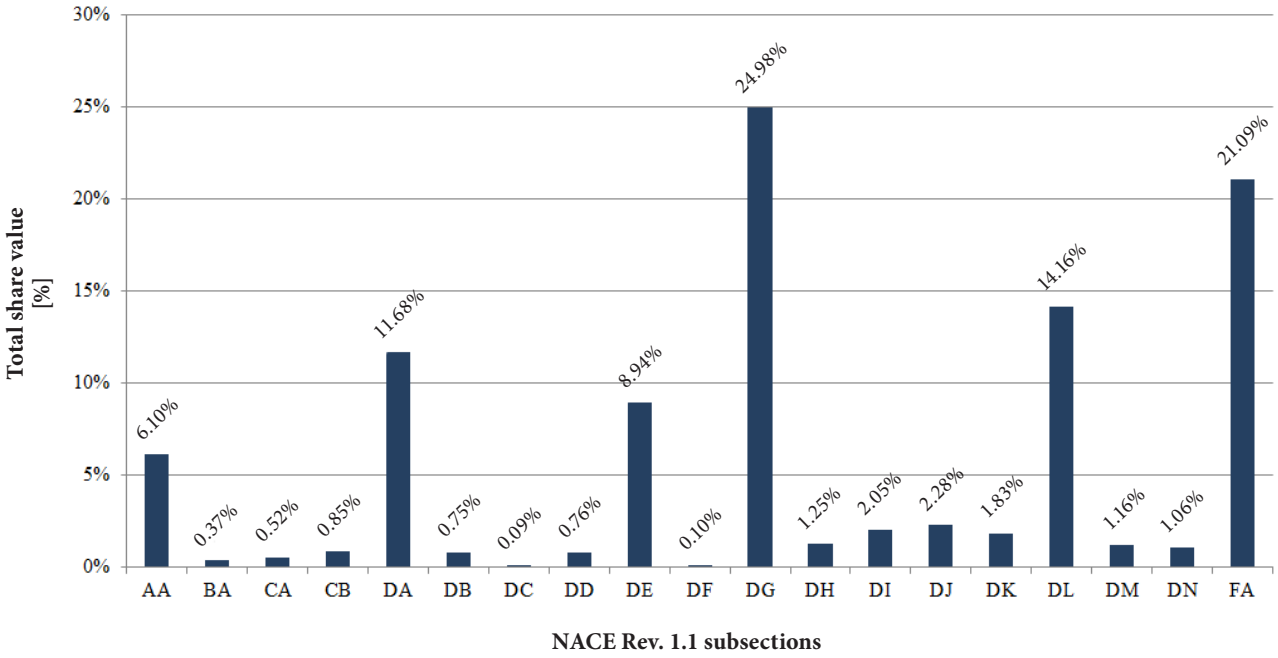
Table 22. Distribution of the gross value added as generated by NACE subsections in Ireland (mln EUR)

NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Share
AA	3,137	3,134	2,906	2,887	2,659	2,830	2,823	2,631	2,679	2,790	2,179	1,916	2,270	1,959	1,303	38,101	6.10
BA	208	229	230	256	259	120	117	118	98	88	103	101	111	125	118	2,280	0.37
CA	179	161	287	170	142	200	220	159	192	119	173	263	247	366	348	3,225	0.52
CB	177	179	211	206	226	275	339	331	427	364	410	566	828	419	375	5,333	0.85
DA	2,884	3,039	3,211	3,602	4,087	3,853	4,616	5,201	6,032	5,884	5,831	6,212	6,436	6,006	6,029	72,924	11.68
DB	422	369	386	416	344	334	354	313	296	272	255	237	263	237	217	4,714	0.75
DC	33	27	35	35	36	35	35	38	37	36	39	42	47	44	43	561	0.09
DD	149	168	223	242	294	325	307	326	365	400	436	458	445	316	272	4,726	0.76
DE	1,486	1,635	2,823	3,291	4,363	4,147	3,703	3,671	3,934	4,156	4,456	4,380	4,676	4,786	4,313	55,819	8.94
DF	20	18	27	35	23	58	54	34	43	37	66	68	85	32	32	631	0.10
DG	3,919	4,250	5,364	8,410	8,665	10,181	12,571	17,093	13,862	12,242	10,737	10,215	12,112	12,258	14,113	155,993	24.98
DH	344	372	370	411	416	493	514	515	552	602	599	656	758	632	562	7,794	1.25
DI	597	622	680	756	881	988	936	848	889	865	979	1,133	1,135	818	662	12,789	2.05
DJ	496	559	619	749	851	1,037	971	950	993	1,059	1,117	1,361	1,274	1,232	958	14,226	2.28
DK	549	594	641	677	722	738	779	825	819	742	859	913	965	870	716	11,408	1.83
DL	2,854	3,109	3,588	4,059	6,327	7,595	7,403	6,934	6,491	6,589	6,827	7,235	6,828	6,494	6,117	88,449	14.16
DM	284	322	332	365	379	483	491	541	556	540	580	622	660	594	504	7,252	1.16
DN	296	321	371	385	357	363	409	407	437	465	485	630	624	555	523	6,628	1.06
FA	2,541	2,878	3,361	4,276	5,366	7,019	8,152	8,923	10,054	11,808	14,262	16,501	16,147	12,336	8,114	131,737	21.09
Total	20,573	21,985	25,665	31,227	36,397	41,073	44,793	49,857	48,757	49,054	50,392	53,509	55,911	50,077	45,320	624,589	100

Source: proprietary study based on the Eurostat database [National Accounts by 31 branches – aggregates at current prices (nama_nace31_c)].

Chart 20 makes a graphical complement to Table 22; it shows the structure of gross value added generated by NACE subsections in the examined economy.

Chart 20. Structure of the gross value added as generated by NACE subsections in Ireland, years 1995-2009



Source: proprietary study based on the data in Table 22.

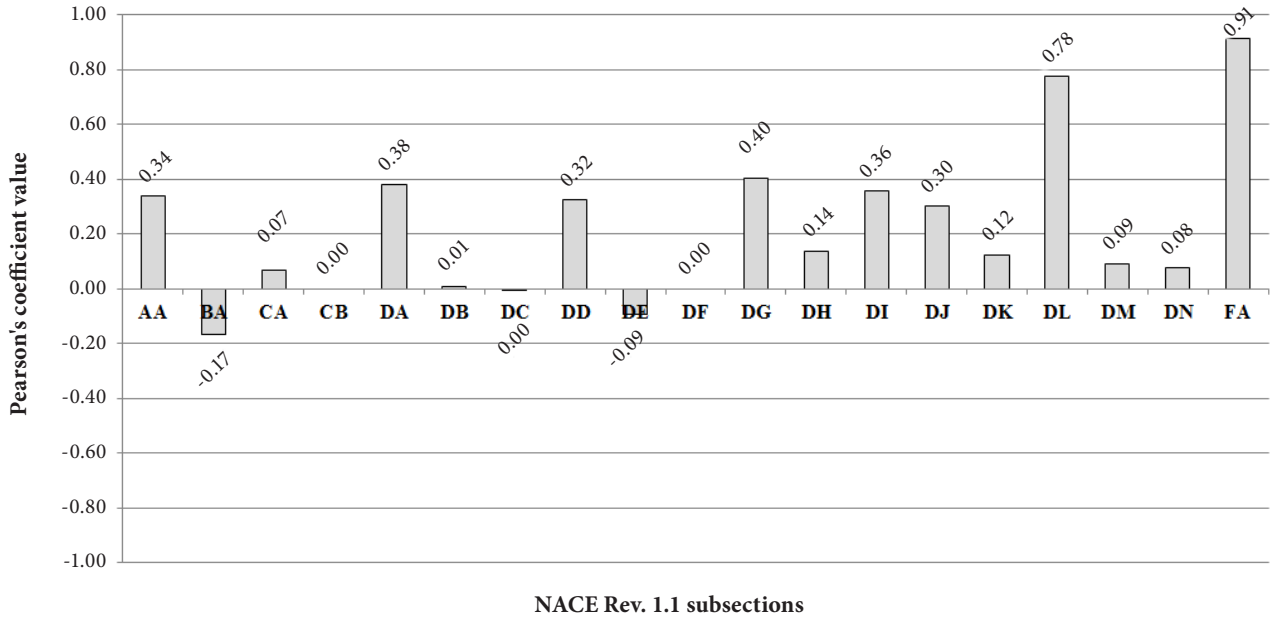
When assuming that the 19 examined economic branches of Ireland form a certain finite set (for the purpose of this discourse), Chart 20 leads to the conclusion that the highest share in GVA is held by:

1) manufacture of chemicals, chemical products and man-made fibres;
2) construction;
3) manufacture of electrical and optical equipment;
4) manufacture of food products, beverages and tobacco;
5) manufacture of pulp, paper and paper products; publishing and printing;
6) agriculture, hunting and forestry;

the share of the remaining branches is relatively small in the gross value added of Ireland.

By further employing the data (time series) included in Table 12 and 22, the values of Pearson's linear correlation coefficient were determined. Chart 21 presents the distribution of the coefficient values for each economic branch.

Chart 21. Distribution of Pearson's coefficient values for Ireland



Source: proprietary study.

Table 12 (Number of granted patents in individual NACE subsections for Ireland) indicates that the highest patent activity characterises the following subsections: (1) DL; (2) DG; (3) DK, similarly to Spain. In subsection DL – Manufacture of electrical and optical equipment, a strong statistical interdependence was found between the patent activity of the branch and its share in the GVA (this is also confirmed by the high value of test statistics).

Adopting a bilateral critical area, the values of test statistics turned out to be statistically negligible for all the remaining subsections (apart from construction). Construction (FA) in Ireland was granted 113 patents under the international procedure (5th place in the ranking of 19 analysed branches); a very high statistical interdependence was discovered here (with the highest value of test statistics).

The basis for the hierarchical cluster analysis for Ireland is the data in Tables 12 and 22. Due to significant differences in the values of the time series presented, they were standardised. The standardised values adopted as the input values for the cluster analysis are presented in Table 23.

Table 23. Standardised input values for the cluster analysis (Ireland)

Country	Ireland		Country	Ireland	
NACE / standardised value	number of patents	production volume	NACE / standardised value	number of patents	production volume
AA	–0.391	0.111	DG	1.278	2.625
BA	–0.452	–0.652	DH	–0.415	–0.535
CA	–0.452	–0.632	DI	–0.28	–0.428
CB	–0.489	–0.587	DJ	–0.231	–0.398
DA	–0.056	0.854	DK	0.337	–0.458
DB	–0.436	–0.60	DL	3.756	1.185
DC	–0.448	–0.689	DM	–0.276	–0.546
DD	–0.464	–0.60	DN	–0.166	–0.559
DE	–0.297	0.489	FA	–0.027	2.108
DF	–0.489	–0.687			

Source: proprietary study.

As a result of the calculations, matrices of Euclidian distances were obtained for individual NACE subsections.

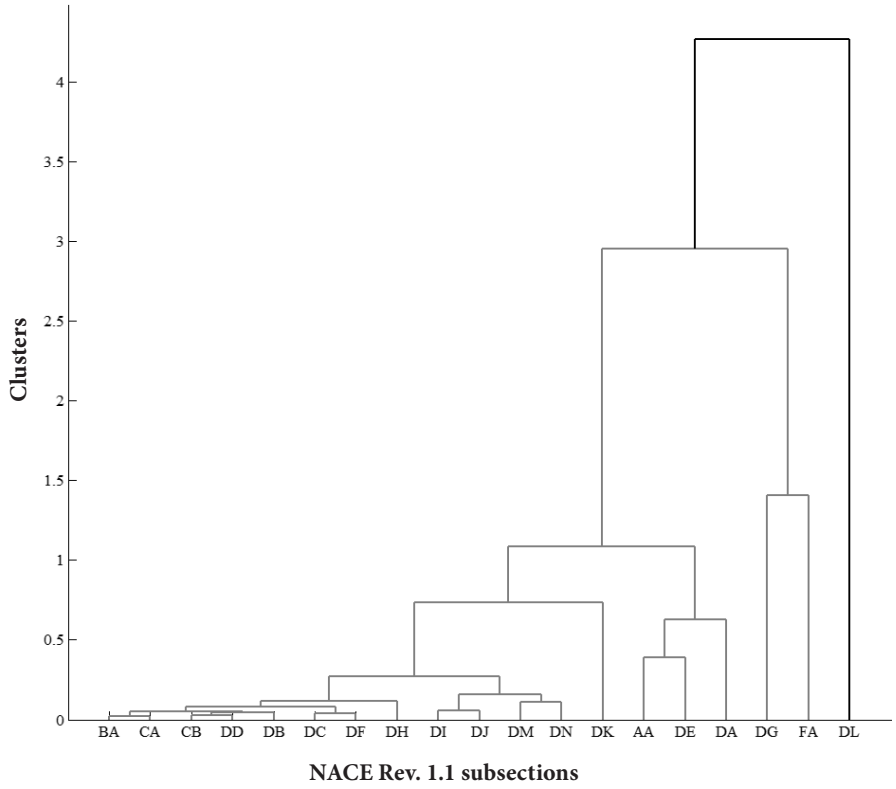
Table 24. Value of Euclidian distances of NACE subsections for Ireland

NACE subsection	AA	BA	CA	CB	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	FA
AA	0	0.766	0.746	0.705	0.815	0.713	0.802	0.715	0.389	0.805	3.017	0.647	0.551	0.533	0.924	4.283	0.668	0.708	2.029
BA	0.766	0	0.020	0.075	1.557	0.054	0.037	0.054	1.152	0.051	3.705	0.123	0.282	0.337	0.813	4.592	0.205	0.301	2.792
CA	0.746	0.020	0	0.058	1.538	0.036	0.057	0.034	1.132	0.066	3.688	0.104	0.267	0.322	0.808	4.584	0.196	0.295	2.772
CB	0.705	0.075	0.058	0	1.505	0.055	0.11	0.028	1.093	0.10	3.666	0.090	0.262	0.32	0.836	4.60	0.217	0.324	2.734
DA	0.815	1.557	1.538	1.505	0	1.503	1.592	1.51	0.437	1.601	2.217	1.434	1.302	1.264	1.369	3.826	1.417	1.418	1.254
DB	0.713	0.054	0.036	0.055	1.503	0	0.089	0.029	1.098	0.102	3.652	0.069	0.232	0.288	0.786	4.556	0.168	0.273	2.739
DC	0.802	0.037	0.057	0.11	1.592	0.089	0	0.090	1.188	0.041	3.736	0.158	0.31	0.363	0.819	4.603	0.223	0.31	2.828
DD	0.715	0.054	0.034	0.028	1.51	0.029	0.090	0	1.102	0.091	3.665	0.082	0.252	0.309	0.814	4.582	0.196	0.301	2.743
DE	0.389	1.152	1.132	1.093	0.437	1.098	1.188	1.102	0	1.192	2.653	1.031	0.917	0.889	1.139	4.112	1.036	1.057	1.641
DF	0.805	0.051	0.066	0.10	1.601	0.102	0.041	0.091	1.192	0	3.754	0.17	0.333	0.388	0.857	4.639	0.255	0.347	2.833
DG	3.017	3.705	3.688	3.666	2.217	3.652	3.736	3.665	2.653	3.754	0	3.584	3.427	3.378	3.223	2.866	3.531	3.496	1.403
DH	0.647	0.123	0.104	0.090	1.434	0.069	0.158	0.082	1.031	0.17	3.584	0	0.172	0.229	0.756	4.512	0.14	0.251	2.671
DI	0.551	0.282	0.267	0.262	1.302	0.232	0.31	0.252	0.917	0.333	3.427	0.172	0	0.058	0.618	4.347	0.118	0.174	2.548
DJ	0.533	0.337	0.322	0.32	1.264	0.288	0.363	0.309	0.889	0.388	3.378	0.229	0.058	0	0.572	4.29	0.155	0.175	2.513
DK	0.924	0.813	0.808	0.836	1.369	0.786	0.819	0.814	1.139	0.857	3.223	0.756	0.618	0.572	0	3.793	0.62	0.513	2.591
DL	4.283	4.592	4.584	4.60	3.826	4.556	4.603	4.582	4.112	4.639	2.866	4.512	4.347	4.29	3.793	0	4.388	4.292	3.894
DM	0.668	0.205	0.196	0.217	1.417	0.168	0.223	0.196	1.036	0.255	3.531	0.14	0.118	0.155	0.62	4.388	0	0.111	2.665
DN	0.708	0.301	0.295	0.324	1.418	0.273	0.31	0.301	1.057	0.347	3.496	0.251	0.174	0.175	0.513	4.292	0.111	0	2.671
FA	2.029	2.792	2.772	2.734	1.254	2.739	2.828	2.743	1.641	2.833	1.403	2.671	2.548	2.513	2.591	3.894	2.665	2.671	0

Source: proprietary study.

Next, to calculate the distance between the clusters (groups) of NACE subsections, the arithmetic mean of the distances was used between all pairs of the subsection elements (cf. Spain). Based on the calculations, a dendrogram was produced for Ireland. It presents the division into clusters (groups) of NACE subsections which result from the Euclidian distances between the standardised values of the attributes (the number of patents and the production volume), and the mean arithmetic distance between the clusters. Chart 22 presents the dendrogram for Ireland.

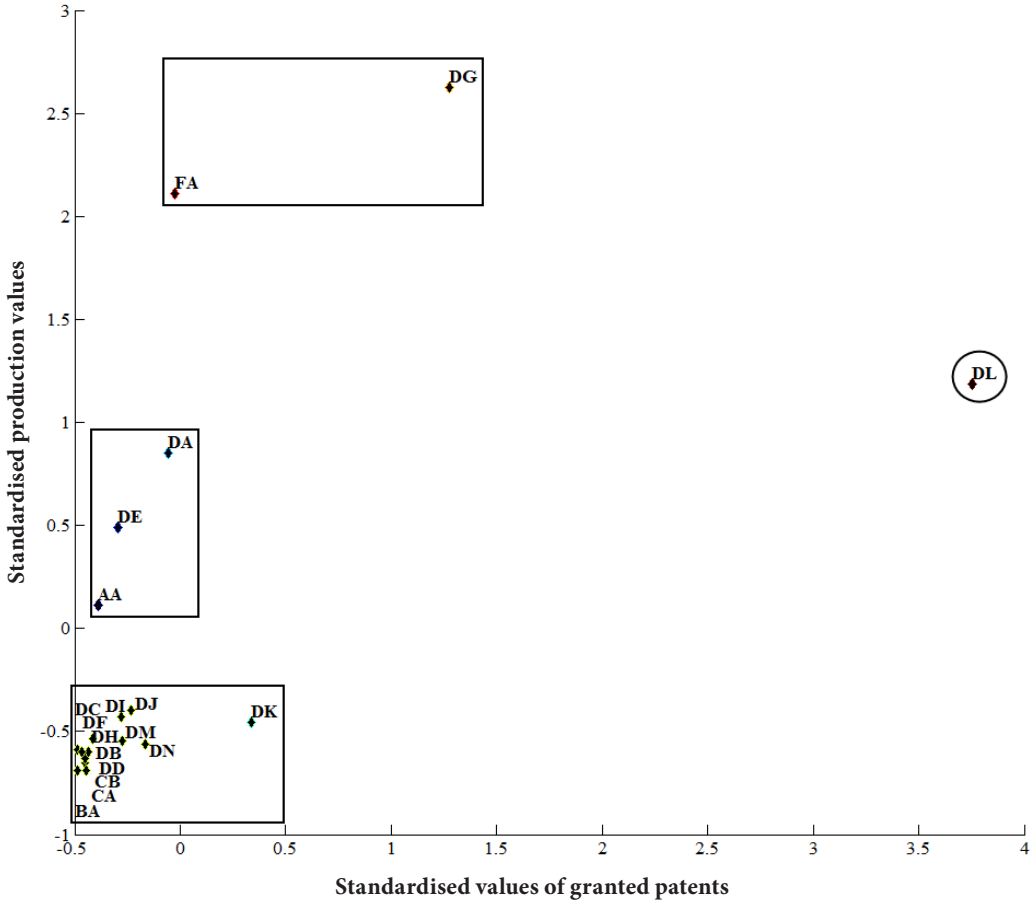
Chart 22. Cluster dendrogram for NACE subsections of Ireland



Source: proprietary study.

It was followed by a dot chart for Ireland. The dots represent specific subsections of NACE. Their distribution results from the standardised values of their descriptive attributes (the number of patents and production volume). Chart 23 plots the clusters which result from the dendrogram in Chart 22.

Chart 23. Clusters of NACE subsections for Ireland



Source: proprietary study.

The dendrogram readout allows plotting the following clusters of the NACE subsections of Ireland:

1) cluster 1: FA, DG;
2) cluster 2: DA, DE, AA;
3) cluster 3: DN, DM, DJ, DI, DH, DF, DC, DB, DD, CB CA, BA and DK;
4) isolated subsection DL.

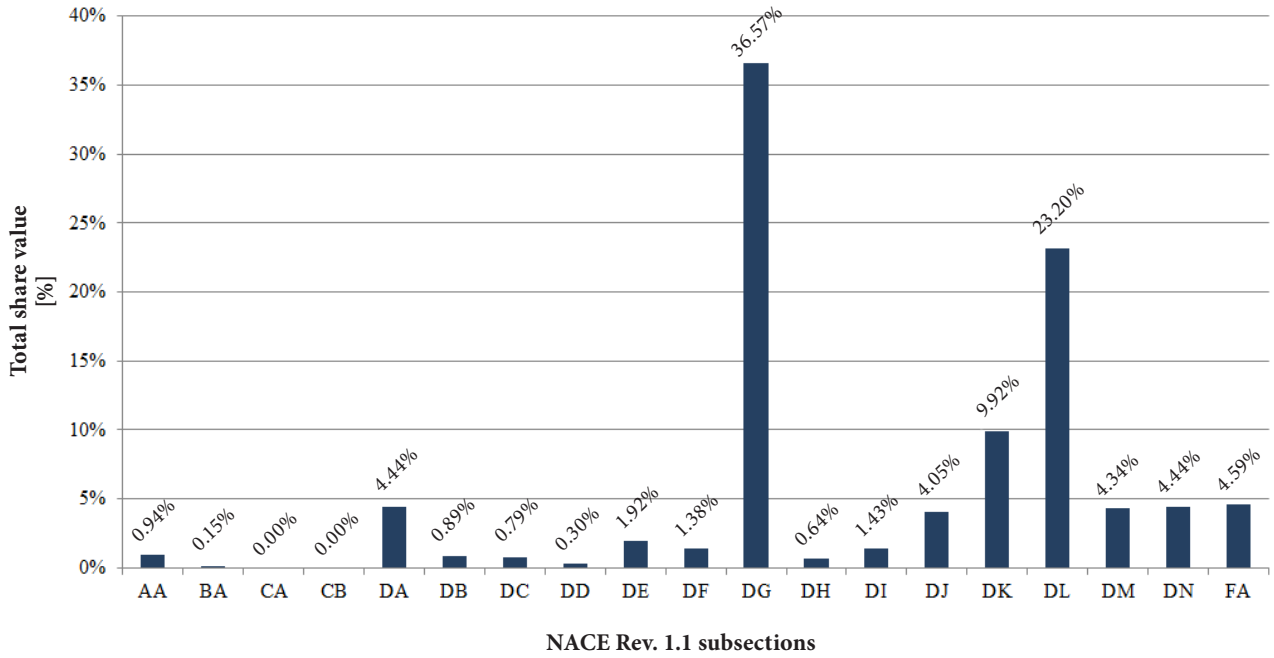
The produced clusters can be a subject of further and deeper research, e.g. for the common attributes, preconditions of patent activity development in the branches or the differences between the clusters. The research, however, requires developing a separate procedure; this is beyond the adopted scope of this work.

The hypothesis about the purported relation between the number of granted patents in a branch and the changes in its share in the produced added value of Ireland can be verified positively in terms of: manufacture of electrical and optical equipment (DL) and construction (FA). A high positive statistical interdependence was found between patent activity of branches and the gross value added.

The dendrogram shows two primary clusters of the Irish economy branches which give no substance for any generalising conclusions. However, the cluster analysis suggests that there can be some common attributes in this set. Subsections DL, FA and DG shall be examined separately.

By using the data from Table 13, Chart 24 presents the distribution of the share of granted patents by 19 researched NACE subsections in Hungary.

Chart 24. Distribution of the share of granted patents by 19 NACE subsections in Hungary



Source: proprietary study based on the data in Table 13 (Number of granted patents in individual NACE subsections for Hungary).

Chart 24 implies that the highest patent activity is found in:

1) manufacture of chemicals, chemical products and man-made fibres (36.57% of all granted patents to Hungarian residents under the PCT procedure);
2) manufacture of electrical and optical equipment (23.20%);
3) manufacture of machinery and equipment (8.89%);
4) construction; manufacture of food products, beverages and tobacco; manufacturing n.e.c.; manufacture of transport equipment; manufacture of basic metals and fabricated metal products (all within 4.59–4.05%).

The second important bundle of raw data is the distribution of the gross value added produced by individual branches of the Hungarian economy. The distribution of the gross value added as generated by NACE subsections in Hungary is shown in Table 25.

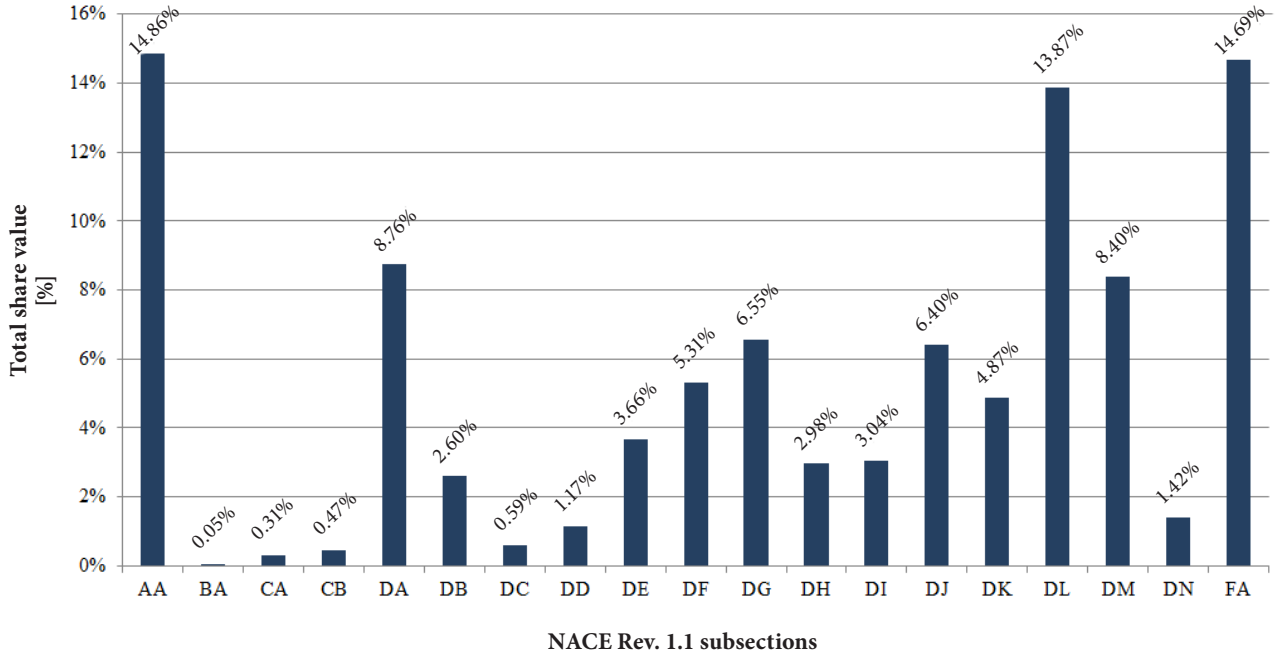
Table 25. Distribution of the gross value added as generated by NACE subsections in Hungary (mln HUF)

NACE\ year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Share (%)
AA	388,018	477,061	529,100	588,624	574,619	614,770	688,467	684,386	688,372	851,205	788,590	817,849	857,985	966,433	726,854	10,242,333	14.86
BA	1,022	1,101	1,427	2,034	1,968	1,830	2,723	3,285	2,414	3,609	1,971	3,148	2,970	3,558	3,399	36,459	0.05
CA	12,914	15,156	18,977	14,023	11,977	10,736	8,273	10,316	11,212	9,924	6,923	14,164	15,529	25,496	30,152	215,772	0.31
CB	8,940	9,614	13,905	13,336	15,447	17,630	20,936	24,056	25,162	28,108	35,106	31,217	24,112	28,550	24,753	320,872	0.47
DA	183,979	212,677	257,173	311,248	303,061	365,629	467,990	522,514	500,834	492,716	477,333	495,980	481,603	481,058	485,630	6,039,425	8.76
DB	74,131	91,284	111,185	133,884	143,341	147,337	166,852	152,879	137,125	131,690	110,447	110,049	103,190	94,280	81,038	1,788,712	2.60
DC	17,856	20,178	25,251	26,732	29,856	30,423	34,186	32,415	26,488	24,714	22,645	33,375	29,426	27,613	28,274	409,432	0.59
DD	26,463	33,215	37,560	38,729	47,387	50,723	59,905	56,621	60,483	65,534	60,328	64,774	70,329	70,877	60,168	803,096	1.17
DE	58,884	72,756	103,103	109,375	120,390	138,360	172,107	195,282	196,871	204,040	207,660	224,173	245,136	246,490	224,957	2,519,584	3.66
DF	101,629	116,448	165,845	179,421	184,517	152,784	139,376	205,758	193,730	308,571	348,173	410,535	342,900	396,388	416,167	3,662,242	5.31
DG	117,099	124,976	177,005	204,714	179,609	241,683	294,175	302,451	335,603	364,492	375,446	447,210	458,785	439,343	449,360	4,511,951	6.55
DH	37,502	50,561	64,490	80,177	88,865	102,232	127,661	139,189	157,868	167,172	177,568	181,003	211,041	225,544	240,266	2,051,139	2.98
DI	51,727	59,931	74,961	94,127	100,239	121,912	139,074	146,354	155,696	153,652	164,864	193,916	237,002	231,489	170,116	2,095,060	3.04
DJ	109,891	130,869	152,774	183,913	188,250	240,751	264,481	261,183	300,970	357,831	361,322	436,314	484,283	521,773	413,663	4,408,268	6.40
DK	71,554	89,796	127,888	135,373	152,100	167,930	193,494	224,483	229,965	246,955	280,719	332,582	364,163	377,345	363,036	3,357,383	4.87
DL	97,187	166,975	258,115	328,156	392,885	485,476	514,891	559,287	756,245	940,675	1,047,342	1,017,136	957,935	992,305	1,042,622	9,557,232	13.87
DM	58,023	84,907	145,820	224,492	271,340	316,872	310,857	332,376	384,225	425,284	480,422	634,064	733,769	746,804	640,739	5,789,994	8.40
DN	26,483	30,758	38,502	45,531	51,630	56,320	65,548	70,655	69,248	76,848	75,616	84,761	94,433	97,215	94,809	978,357	1.42
FA	215,593	249,456	338,196	397,870	455,075	571,845	654,556	771,671	766,416	850,699	905,343	962,597	1,000,002	1,004,727	976,749	10,120,795	14.69
Total	1,658,895	2,037,719	2,641,277	3,111,759	3,312,556	3,835,243	4,325,552	4,695,161	4,998,927	5,703,719	5,927,818	6,494,847	6,714,593	6,977,288	6,472,752	68,908,106	100

Source: proprietary study based on the Eurostat database [National Accounts by 31 branches – aggregates at current prices (nama_nace31_c)].

Chart 25 makes a graphical complement to Table 25; it shows the structure of gross value added generated by NACE subsections in the examined economy.

Chart 25. Structure of the gross value added as generated by NACE subsections in Hungary, years 1995-2009



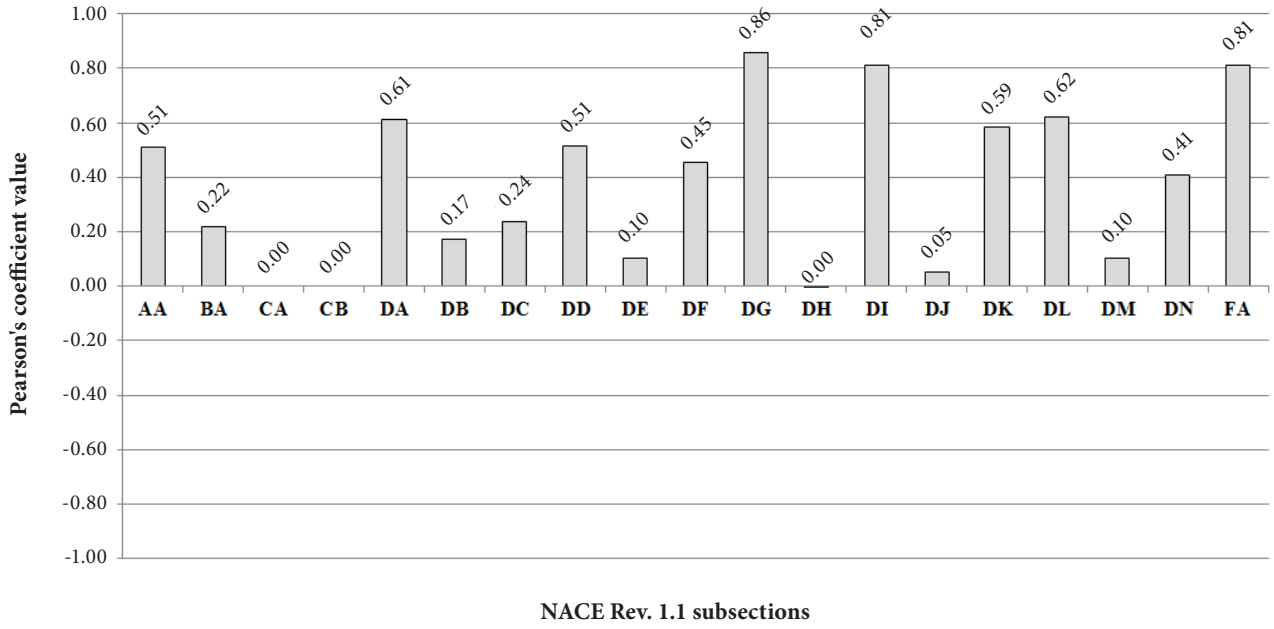
Source: proprietary study based on the data in Table 25.

When assuming that the 19 examined economic branches of Hungary form a certain finite set (for the purpose of this discourse), Chart 25 leads to the conclusion that the highest share in GVA is held by:

1) agriculture, hunting and forestry;
2) construction;
3) manufacture of electrical and optical equipment;
4) manufacture of food products, beverages and tobacco;
5) manufacture of transport equipment;
6) manufacture of chemicals, chemical products and man-made fibres;
7) manufacture of basic metals and fabricated metal products, etc.

By further employing the data (time series) included in Table 13 and 25, the values of Pearson's linear correlation coefficient were determined. Chart 26 presents the distribution of coefficient values for each economic branch.

Chart 26. Distribution of Pearson's coefficient values for Hungary



Source: proprietary study.

Table 13 (Number of granted patents in individual NACE subsections for Hungary) indicates that the highest patent activity characterises the following subsections: (1) DL; (2) DG; (3) DK, similarly to the previously discussed countries. Subsection DG – Manufacture of chemicals and chemical products shows a strong statistical interdependence. Concerning patent activity of other leading branches, the value of Pearson's correlation coefficient is rather strong (ca. 0.6). The test statistics confirm the statistical significance of the obtained coefficient values.

Subsections CA and CB did not reveal any patent activity (under the PCT); a very insignificant patent activity was discovered in subsection DH (13 patents). The coefficient value in the remaining NACE subsections varies in the range [0.05 to 0.81]. It should be noted that the values of test statistics were shownas statistically significant for: manufacture of food products (DA) and manufacture of wood (DD). Also note that Pearson's correlation coefficient is high (with the value of test statistics also being very high) in construction (FA) and manufacture of other non-metallic mineral products (DI).

The basis for the hierarchical cluster analysis for Hungary is the data in Table 13 and 25. Due to significant differences in the values of the time series presented, they were standardised. The standardised values which were adopted as the input values for the cluster analysis are presented in Table 26.

Table 26. Standardised input values for the cluster analysis (Hungary)

Country	Hungary		Country	Hungary	
NACE / standardised value	number of patents	production volume	NACE / standardised value	number of patents	production volume
AA	–0.465	1.968	DG	3.37	0.263
BA	–0.55	–1.068	DH	–0.497	–0.469
CA	–0.566	–1.015	DI	–0.412	–0.456
CB	–0.566	–0.984	DJ	–0.131	0.233
DA	–0.088	0.718	DK	0.501	–0.080
DB	–0.471	–0.547	DL	1.93	1.765
DC	–0.481	–0.957	DM	–0.099	0.644
DD	–0.535	–0.84	DN	–0.088	–0.788
DE	–0.359	–0.329	FA	–0.072	1.932
DF	–0.418	0.011			

Source: proprietary study.

As a result of the calculations, matrices of Euclidian distances were obtained for individual NACE subsections.

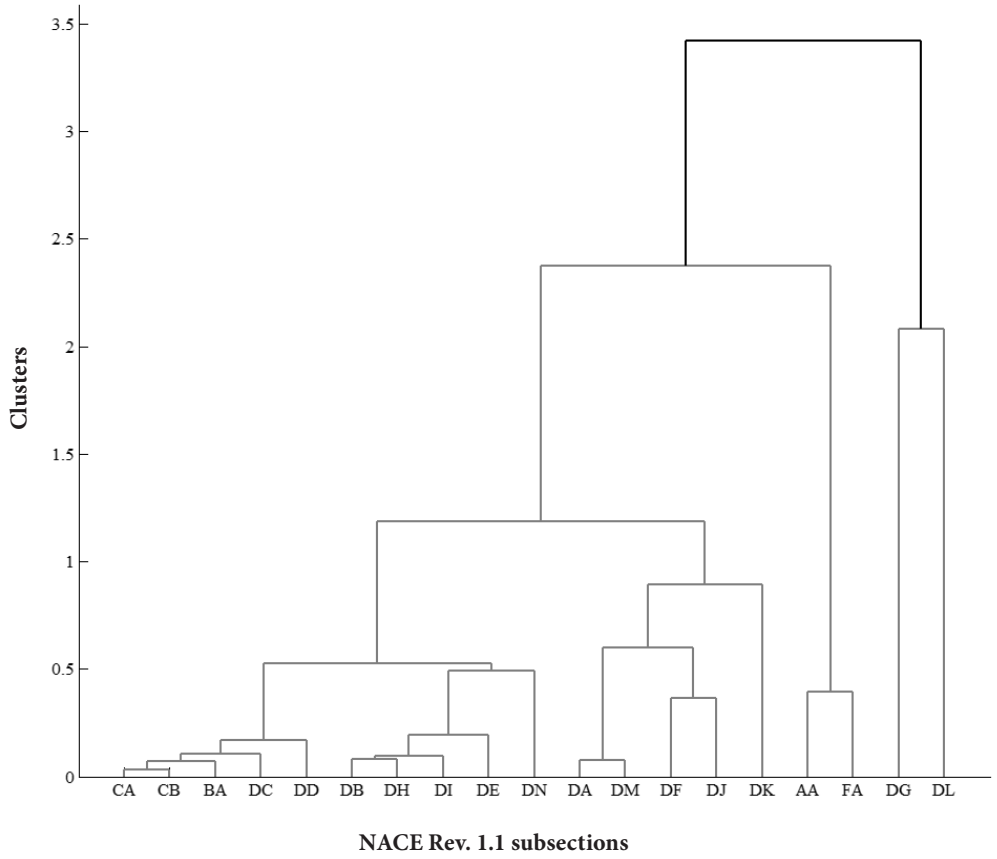
Table 27. Value of Euclidian distances of NACE subsections for Hungary

NACE subsection	AA	BA	CA	CB	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	FA
AA	0	3,038	2,985	2,954	1,306	2,515	2,926	2,810	2,300	1,959	4,197	2,438	2,425	1,768	2,265	2,404	1,375	2,782	0,395
BA	3,038	0	0,056	0,086	1,845	0,527	0,131	0,229	0,763	1,087	4,140	0,602	0,628	1,367	1,443	3,765	1,771	0,540	3,038
CA	2,985	0,056	0	0,031	1,798	0,478	0,103	0,178	0,716	1,036	4,138	0,550	0,580	1,321	1,419	3,736	1,723	0,529	2,988
CB	2,954	0,086	0,031	0	1,767	0,447	0,089	0,147	0,686	1,005	4,129	0,519	0,550	1,292	1,399	3,713	1,693	0,517	2,958
DA	1,306	1,845	1,798	1,767	0	1,321	1,721	1,621	1,082	0,780	3,488	1,255	1,218	0,487	0,992	2,274	0,075	1,506	1,215
DB	2,515	0,527	0,478	0,447	1,321	0	0,411	0,300	0,244	0,560	3,925	0,082	0,108	0,850	1,078	3,333	1,247	0,452	2,511
DC	2,926	0,131	0,103	0,089	1,721	0,411	0	0,129	0,640	0,970	4,040	0,489	0,506	1,240	1,317	3,637	1,646	0,428	2,918
DD	2,810	0,229	0,178	0,147	1,621	0,300	0,129	0	0,540	0,859	4,057	0,373	0,403	1,146	1,285	3,586	1,546	0,449	2,811
DE	2,300	0,763	0,716	0,686	1,082	0,244	0,640	0,540	0	0,345	3,776	0,196	0,137	0,607	0,896	3,103	1,007	0,533	2,280
DF	1,959	1,087	1,036	1,005	0,780	0,560	0,970	0,859	0,345	0	3,796	0,486	0,466	0,363	0,923	2,931	0,709	0,864	1,953
DG	4,197	4,140	4,138	4,129	3,488	3,925	4,040	4,057	3,776	3,796	0	3,936	3,850	3,501	2,889	2,080	3,489	3,614	3,825
DH	2,438	0,602	0,550	0,519	1,255	0,082	0,489	0,373	0,196	0,486	3,936	0	0,086	0,791	1,072	3,299	1,182	0,519	2,438
DI	2,425	0,628	0,580	0,550	1,218	0,108	0,506	0,403	0,137	0,466	3,850	0,086	0	0,744	0,988	3,228	1,143	0,464	2,412
DJ	1,768	1,367	1,321	1,292	0,487	0,850	1,240	1,146	0,607	0,363	3,501	0,791	0,744	0	0,705	2,568	0,412	1,021	1,701
DK	2,265	1,443	1,419	1,399	0,992	1,078	1,317	1,285	0,896	0,923	2,889	1,072	0,988	0,705	0	2,333	0,940	0,921	2,093
DL	2,404	3,765	3,736	3,713	2,274	3,333	3,637	3,586	3,103	2,931	2,080	3,299	3,228	2,568	2,333	0	2,318	3,254	2,010
DM	1,375	1,771	1,723	1,693	0,075	1,247	1,646	1,546	1,007	0,709	3,489	1,182	1,143	0,412	0,940	2,318	0	1,432	1,289
DN	2,782	0,540	0,529	0,517	1,506	0,452	0,428	0,449	0,533	0,864	3,614	0,519	0,464	1,021	0,921	3,254	1,432	0	2,720
FA	0,395	3,038	2,988	2,958	1,215	2,511	2,918	2,811	2,280	1,953	3,825	2,438	2,412	1,701	2,093	2,010	1,289	2,720	0

Source: proprietary study.

Next, to calculate the distance between the clusters (groups) of NACE subsections, the arithmetic mean of the distances was used between all pairs of the subsection elements (cf. Spain). Based on the calculations, a dendrogram was produced for Hungary. It presents the division into clusters (groups) of NACE subsections which result from the Euclidian distances between the standardised values of the attributes (the number of patents and the production volume), and the mean arithmetic distance between the clusters. Chart 27 presents the dendrogram for Hungary.

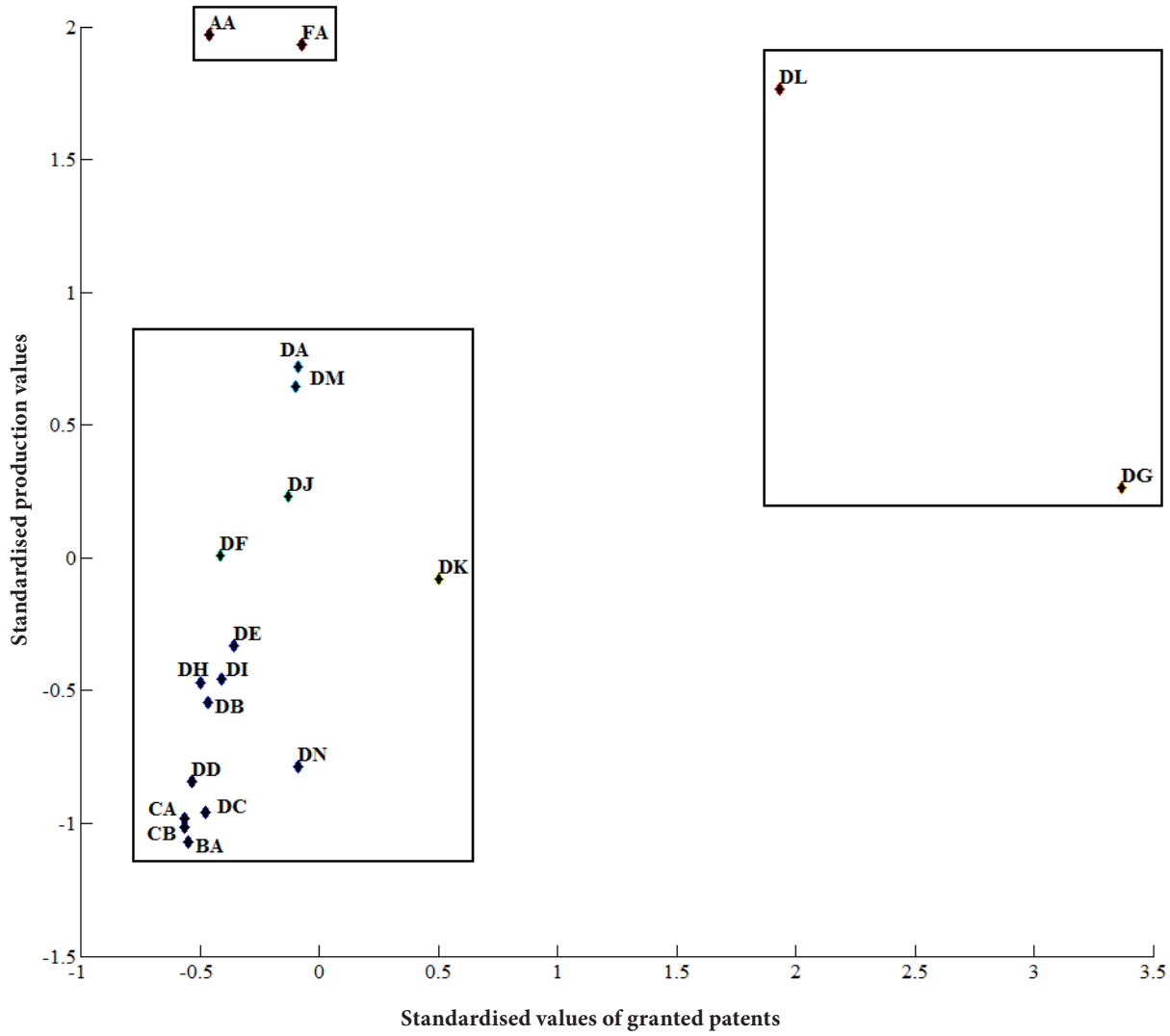
Chart 27. Cluster dendrogram for NACE subsections of Hungary



Source: proprietary study.

It was followed by a dot chart for Hungary. The dots represent specific subsections of NACE. Their distribution results from the standardised values of their descriptive attributes (the number of patents and production volume). Chart 28 plots the clusters which result from the dendrogram in Chart 27.

Chart 28. Clusters of NACE subsections for Hungary



Source: proprietary study.

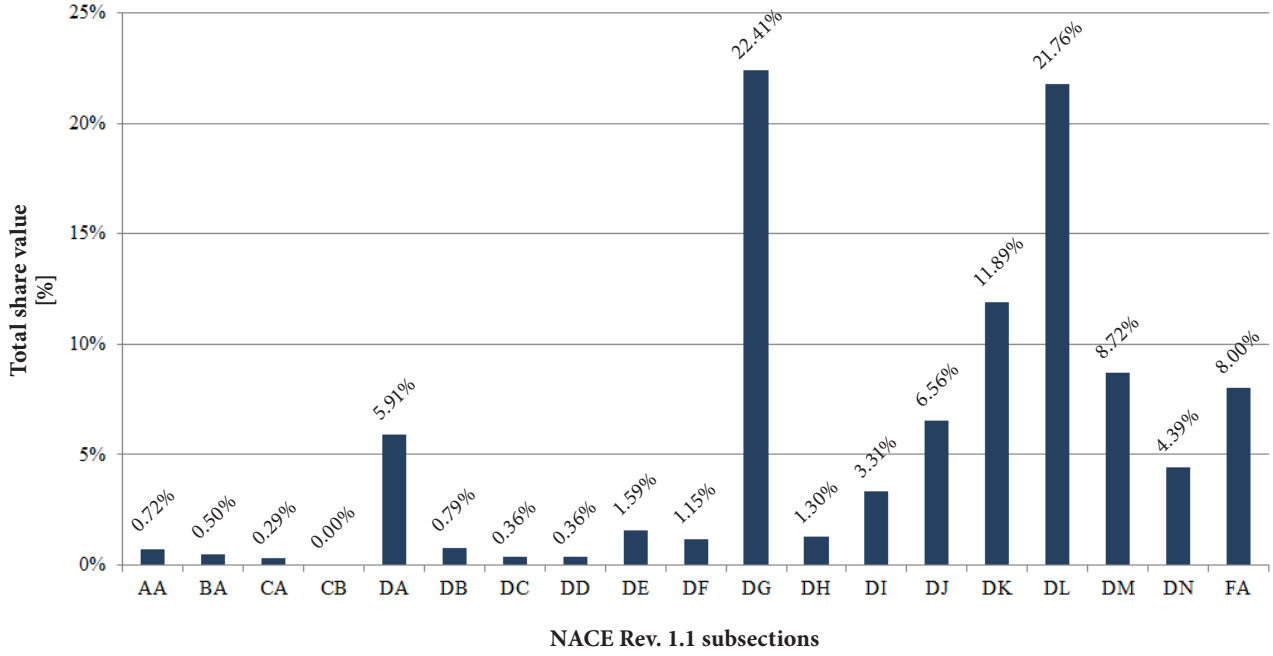
The dendrogram readout allows plotting the following clusters of the NACE subsections of Hungary:

1) cluster 1: DL, DG;
2) cluster 2: FA, AA;
3) cluster 3: DK, DJ, DF, DM, DA, DN, DE, DI, DH, DB, DD, DC, BA, CD, CA.

The hypothesis about the purported relation between the number of granted patents in a branch and the changes in its share in the produced added value of the Hungarian economy can be verified positively in terms of the leading branches in patent production. A high positive statistical interdependence was found between patent activity in the manufacture of chemicals and the gross value added. A slightly lower positive dependence is noted for manufacture of electrical and optical equipment and for manufacture of machinery and equipment. The dendrogram readouts and the proposed clusters for the examined branches of the Hungarian economy, especially cluster 3, do not give any explicit hints for further research in the perspective of the interdependence analysis results.

By using the data from Table 14, Chart 29 presents the distribution of the share of granted patents by 19 researched NACE subsections in Poland.

Chart 29. Distribution of the share of granted patents by 19 NACE subsections in Poland



Source: proprietary study based on the data in Table 14 (Number of granted patents in individual NACE subsections for Poland).

Chart 29 implies that the highest patent activity is found in:

1) manufacture of chemicals, chemical products and man-made fibres (22.41% of all granted patents to Polish residents under the PCT procedure);
2) manufacture of electrical and optical equipment (21.76%);
3) manufacture of machinery and equipment (11.89%);
4) manufacture of transport equipment (8.72%);
5) construction (8%); etc.

The second important bundle of raw data is the distribution of the gross value added produced by individual branches of the Polish economy. The distribution of the gross value added as generated by NACE subsections in Poland is shown in Table 28.

Table 28. Distribution of the gross value added as generated by NACE subsections in Poland (mln PLN)*

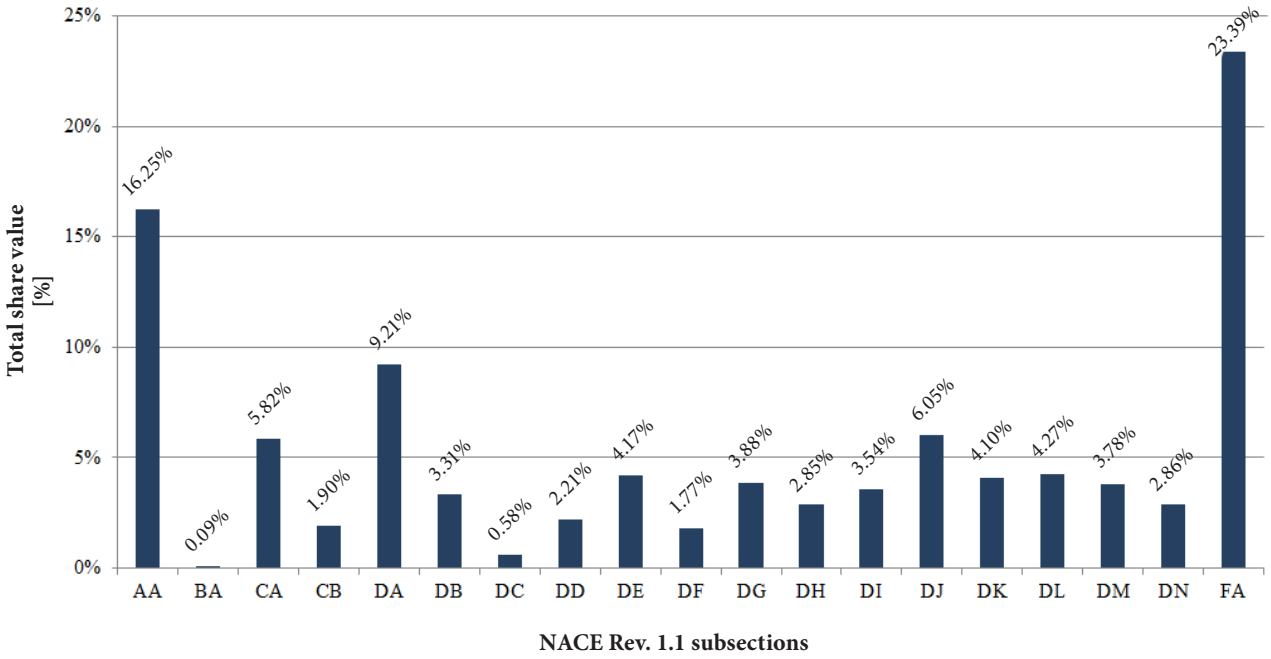
NACE\year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Share (%)
AA	23,672	27,893	29,957	31,604	30,430	32,625	35,249	32,111	32,444	41,749	39,051	39,712	44,377	41,556	43,345	525,775	16.25
BA	131	145	158	166	233	207	210	189	255	191	184	218	176	142	168	2,773	0.09
CA	12,561	12,561	12,561	10,609	10,522	11,684	12,819	11,921	11,708	15,820	15,402	12,561	12,561	12,561	12,561	188,409	5.82
CB	4,100	4,100	4,100	3,170	3,469	4,258	2,964	3,540	3,978	4,863	6,558	4,100	4,100	4,100	4,100	61,500	1.90
DA	11,202	12,645	16,790	18,460	20,188	21,864	20,948	21,030	22,108	24,139	29,231	19,873	19,873	19,873	19,873	298,098	9.21
DB	5,649	6,224	7,094	8,184	8,030	7,749	7,606	6,517	6,780	7,644	6,984	7,133	7,133	7,133	7,133	106,992	3.31
DC	1,045	1,307	1,337	1,197	1,653	1,349	1,273	1,234	1,140	1,122	1,032	1,244	1,244	1,244	1,244	18,667	0.58
DD	2,224	3,023	3,551	4,062	4,614	5,780	5,309	5,268	5,646	6,701	6,143	4,756	4,756	4,756	4,756	71,347	2.21
DE	4,854	5,329	5,956	7,119	8,378	11,069	11,035	11,027	10,173	11,835	12,191	8,997	8,997	8,997	8,997	134,954	4.17
DF	1,662	1,253	2,188	2,699	2,403	3,686	3,054	2,969	3,889	12,076	6,017	3,809	3,809	3,809	3,809	57,131	1.77
DG	5,210	5,937	6,887	7,518	7,907	9,056	8,819	9,000	9,454	10,671	11,487	8,359	8,359	8,359	8,359	125,381	3.88
DH	2,881	3,356	4,211	5,059	5,853	6,265	6,351	6,885	8,005	8,905	9,870	6,149	6,149	6,149	6,149	92,238	2.85
DI	3,534	4,573	5,636	6,708	7,212	9,232	8,231	8,670	9,474	10,493	10,117	7,625	7,625	7,625	7,625	114,382	3.54
DJ	7,907	9,073	11,043	12,724	12,721	13,167	11,028	12,696	14,575	19,087	19,436	13,042	13,042	13,042	13,042	195,623	6.05
DK	5,296	6,542	7,559	8,202	8,550	9,615	9,402	8,902	10,057	10,370	12,665	8,833	8,833	8,833	8,833	132,491	4.10
DL	4,399	5,876	7,008	8,455	10,568	10,250	10,310	9,672	11,267	11,286	12,098	9,199	9,199	9,199	9,199	137,985	4.27
DM	3,756	5,108	5,635	6,935	6,566	7,526	7,299	7,932	10,821	13,632	14,378	8,144	8,144	8,144	8,144	122,165	3.78
DN	3,151	3,644	5,257	5,803	6,797	5,987	5,948	5,867	8,001	8,726	8,725	6,173	6,173	6,173	6,173	92,599	2.86
FA	20,042	25,383	32,887	42,385	47,822	51,225	48,551	45,340	43,505	45,406	52,207	59,777	73,459	81,074	87,545	756,608	23.39
Total	123,276	143,972	169,815	191,059	203,916	222,594	216,406	210,770	223,280	264,716	273,776	229,704	248,009	252,769	261,055	3,235,118	100

* *Due to the fact that Eurostat databases lack the records for nearly all NACE subsections (except AA, BA and FA) for the years 2006-2009, and also for CA (1995-1997) (only for Poland), a simple extrapolation was employed to complement the missing data with regular arithmetic mean values of the available time series.*

Source: proprietary study based on the Eurostat database [National Accounts by 31 branches – aggregates at current prices (nama_nace31_c)].

Chart 30 makes a graphical complement to Table 28; it shows the structure of gross value added generated by NACE subsections in the examined economy.

Chart 30. Structure of the gross value added as generated by NACE subsections in Poland, years 1995-2009



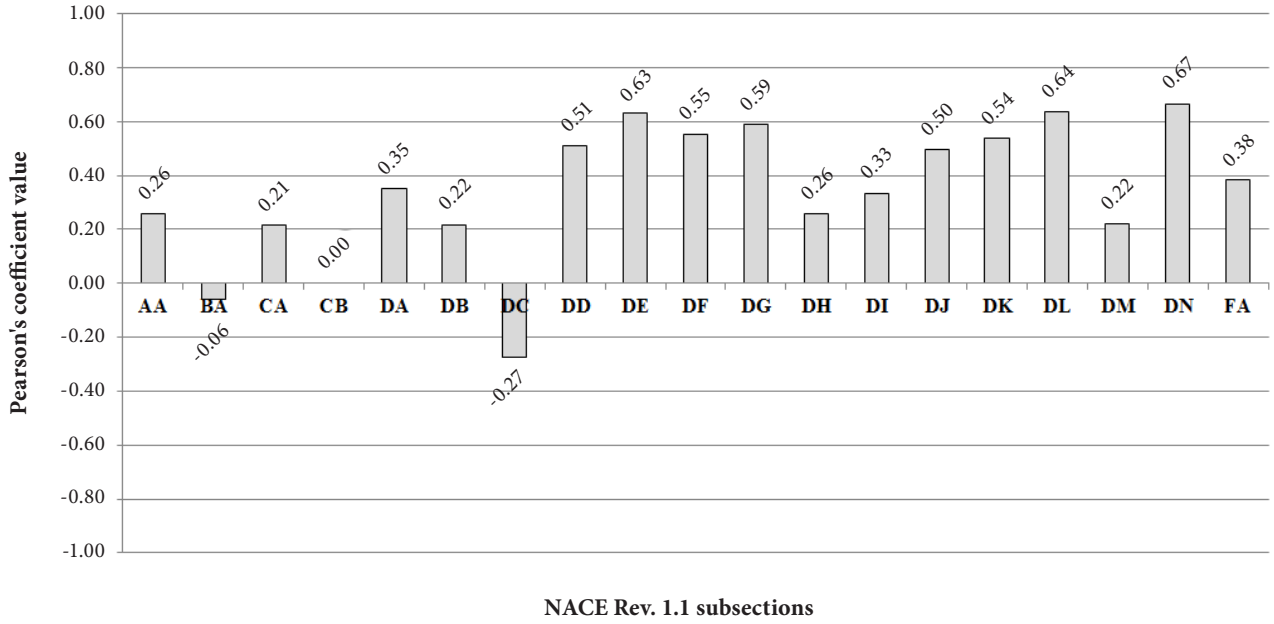
Source: proprietary study based on the data in Table 28.

When assuming that the 19 examined economic branches of Poland form a certain finite set (for the purpose of this discourse), Chart 30 leads to the conclusion that the highest share in GVA is held by:

1) construction;
2) agriculture, hunting and forestry;
3) manufacture of food products, beverages and tobacco;
4) manufacture of basic metals and fabricated metal products, etc.

By further employing the data (time series) included in Table 14 and 28, the values of Pearson's linear correlation coefficient were determined. The completed Pearson's chi-squared test of independence has revealed a stochastic independence of the researched variables. Chart 31 presents the distribution of coefficient values for each economic branch.

Chart 31. Distribution of Pearson's coefficient values for Poland



Source: proprietary study.

Table 14 (Number of granted patents in individual NACE subsections for Poland) indicates that the highest patent activity characterises the following subsections: (1) DG; (2) DL; (3) DK, similar to the previously discussed countries. The subsections are characterised by a moderate statistical interdependence in the range [0.54 to 0.64]. The results of a statistical significance test are favourable. Subsections BA, CB, CA, DC and DD reveal a very small patent activity (from 0 to 7 granted patents); the coefficient values are statistically negligible. As for the remaining subsections, the coefficient value is distributed on moderate and weak levels.

The basis for the hierarchical cluster analysis for Poland is the data in Table 14 and 28. Due to significant differences in the values of the time series presented, they were standardised. The standardised values adopted as the input values for the cluster analysis are presented in Table 29.

Table 29. Standardised input values for the cluster analysis (Poland)

Country	Poland		Country	Poland	
NACE / standardised value	number of patents	production volume	NACE / standardised value	number of patents	production volume
AA	–0.663	1.947	DG	2.501	–0.246
BA	–0.694	–0.917	DH	–0.579	–0.427
CA	–0.726	0.099	DI	–0.284	–0.306
CB	–0.768	–0.596	DJ	0.189	0.139
DA	0.094	0.70	DK	0.966	–0.207
DB	–0.652	–0.347	DL	2.406	–0.177
DC	–0.715	–0.83	DM	0.504	–0.263
DD	–0.715	–0.542	DN	–0.127	–0.425
DE	–0.537	–0.193	FA	0.399	3.211
DF	–0.60	–0.62			

Source: proprietary study.

As a result of the calculations, matrices of Euclidian distances were obtained for individual NACE subsections.

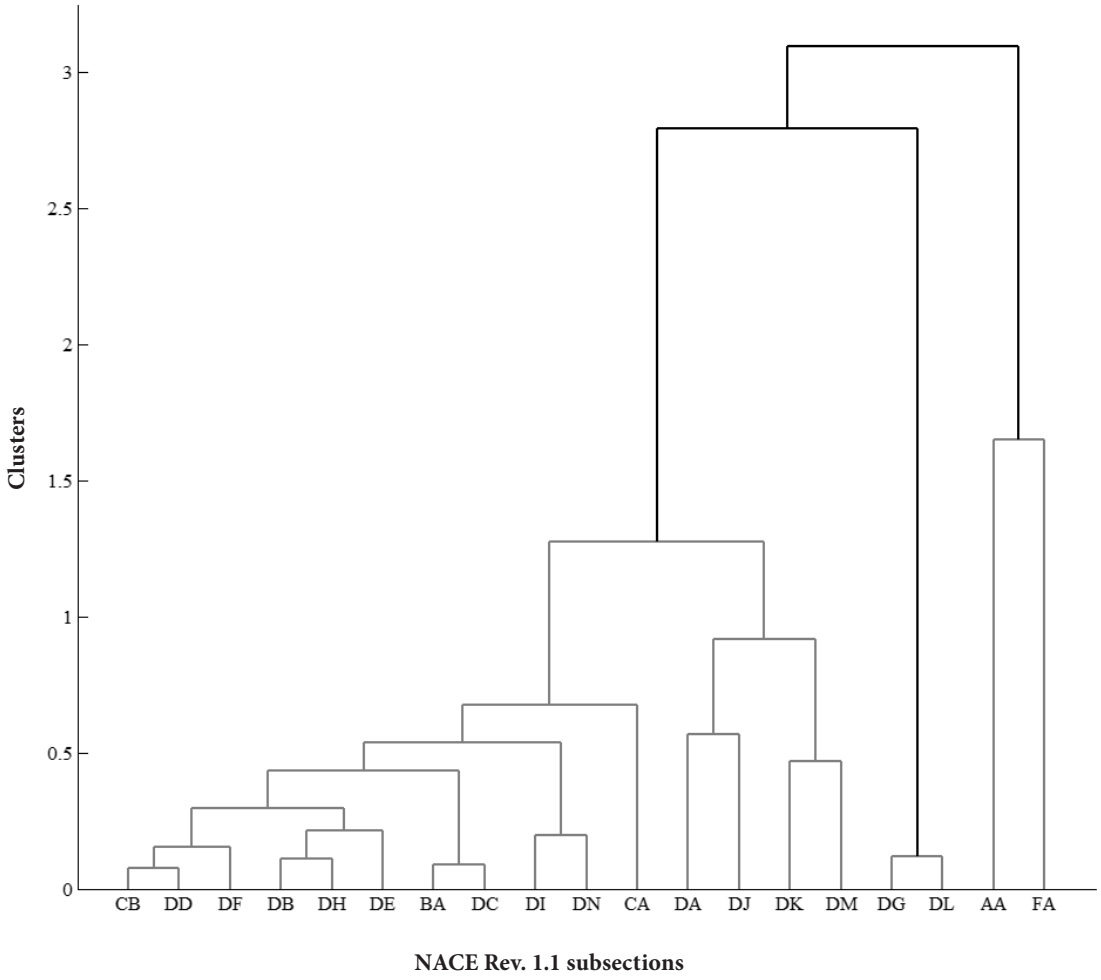
Table 30. Value of Euclidian distances of NACE subsections for Poland

NACE subsection	AA	BA	CA	CB	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	FA
AA	0	2.864	1.849	2.545	1.458	2.293	2.777	2.489	2.144	2.567	3.849	2.376	2.284	1.998	2.70	3.732	2.499	2.432	1.651
BA	2.864	0	1.017	0.33	1.799	0.572	0.090	0.376	0.741	0.312	3.265	0.503	0.736	1.376	1.806	3.188	1.365	0.751	4.27
CA	1.849	1.017	0	0.696	1.016	0.452	0.93	0.641	0.349	0.73	3.245	0.547	0.599	0.915	1.72	3.144	1.282	0.796	3.309
CB	2.545	0.33	0.696	0	1.556	0.275	0.24	0.075	0.464	0.17	3.287	0.253	0.564	1.206	1.777	3.202	1.314	0.663	3.981
DA	1.458	1.799	1.016	1.556	0	1.285	1.731	1.482	1.094	1.491	2.586	1.313	1.075	0.569	1.258	2.473	1.047	1.147	2.529
DB	2.293	0.572	0.452	0.275	1.285	0	0.488	0.205	0.192	0.278	3.155	0.109	0.37	0.971	1.625	3.063	1.159	0.531	3.709
DC	2.777	0.090	0.93	0.24	1.731	0.488	0	0.288	0.661	0.24	3.269	0.425	0.679	1.325	1.793	3.189	1.344	0.714	4.192
DD	2.489	0.376	0.641	0.075	1.482	0.205	0.288	0	0.391	0.139	3.23	0.178	0.491	1.131	1.715	3.143	1.251	0.60	3.914
DE	2.144	0.741	0.349	0.464	1.094	0.192	0.661	0.391	0	0.431	3.038	0.238	0.276	0.798	1.503	2.943	1.043	0.471	3.53
DF	2.567	0.312	0.73	0.17	1.491	0.278	0.24	0.139	0.431	0	3.123	0.193	0.445	1.094	1.619	3.038	1.16	0.511	3.958
DG	3.849	3.265	3.245	3.287	2.586	3.155	3.269	3.23	3.038	3.123	0	3.085	2.786	2.344	1.535	0.117	1.997	2.634	4.046
DH	2.376	0.503	0.547	0.253	1.313	0.109	0.425	0.178	0.238	0.193	3.085	0	0.318	0.954	1.561	2.995	1.095	0.452	3.767
DI	2.284	0.736	0.599	0.564	1.075	0.37	0.679	0.491	0.276	0.445	2.786	0.318	0	0.649	1.255	2.694	0.789	0.198	3.583
DJ	1.998	1.376	0.915	1.206	0.569	0.971	1.325	1.131	0.798	1.094	2.344	0.954	0.649	0	0.851	2.24	0.511	0.646	3.079
DK	2.70	1.806	1.72	1.777	1.258	1.625	1.793	1.715	1.503	1.619	1.535	1.561	1.255	0.851	0	1.44	0.466	1.115	3.465
DL	3.732	3.188	3.144	3.202	2.473	3.063	3.189	3.143	2.943	3.038	0.117	2.995	2.694	2.24	1.44	0	1.904	2.545	3.938
DM	2.499	1.365	1.282	1.314	1.047	1.159	1.344	1.251	1.043	1.16	1.997	1.095	0.789	0.511	0.466	1.904	0	0.651	3.476
DN	2.432	0.751	0.796	0.663	1.147	0.531	0.714	0.60	0.471	0.511	2.634	0.452	0.198	0.646	1.115	2.545	0.651	0	3.674
FA	1.651	4.27	3.309	3.981	2.529	3.709	4.192	3.914	3.53	3.958	4.046	3.767	3.583	3.079	3.465	3.938	3.476	3.674	0

Source: proprietary study.

Next, to calculate the distance between the clusters (groups) of NACE subsections, the arithmetic mean of the distances was used between all pairs of the subsection elements (cf. Spain). Based on the calculations, a dendrogram was produced for Poland. It presents the division into clusters (groups) of NACE subsections which result from the Euclidian distances between the standardised values of the attributes (the number of patents and the production volume), and the mean arithmetic distance between the clusters. Chart 32 presents the dendrogram for Poland.

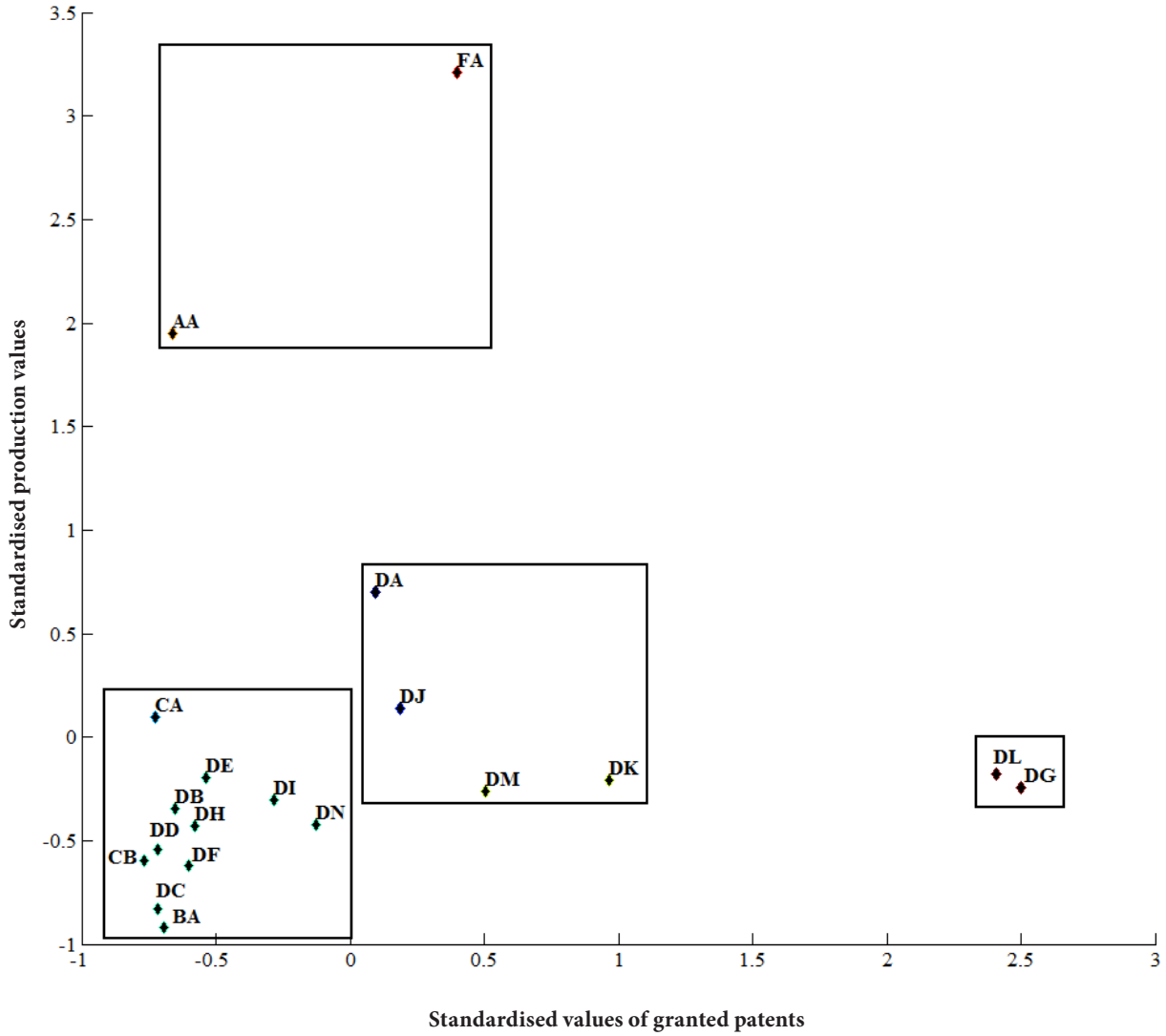
Chart 32. Cluster dendrogram for NACE subsections of Poland



Source: proprietary study.

It was followed by a dot chart for Poland. The dots represent specific subsections of NACE. Their distribution results from the standardised values of their descriptive attributes (the number of patents and production volume). Chart 33 plots the clusters which result from the dendrogram in Chart 32.

Chart 33. Clusters of NACE subsections for Poland



Source: proprietary study.

The dendrogram readout allows plotting the following clusters of the NACE subsections of Poland:

1) cluster 1: FA, AA;
2) cluster 2: DL, DG;
3) cluster 3: DM, DK, DJ, DA;
4) cluster 4: CA, DN, DI, DC, BA, DE, DH, DB, DF, DD, CB.

The hypothesis about the purported relation between the number of granted patents in a branch and the changes in its share in the produced added value of the Polish economy can be verified positively in terms of the leading branches in patent production, albeit with a great caution.

The correctness of the created dendrograms was verified for each country at a time with the Cophenetic correlation coefficient. It is a coefficient used for comparing the values applied for producing a dendrogram (generated by calculation vs. input values). The coefficient value approximate to one denotes a very strong correlation, which implies that the values used for generation of the

dendrograms do not deviate from the input values. The Cophenetic coefficient value for each country was calculated from the dependence (Sokal, Rholf, 1962):

$$c = \frac{\sum_{i<j}(x(i,j)-\bar{x})(t(i,j)-\bar{t})}{\sqrt{\left(\sum_{i<j}(x(i,j)-\bar{x})^2\right)\left(\sum_{i<j}(t(i,j)-\bar{t})^2\right)}}$$

where:

c – value of Cophenetic correlation coefficient;
$x(i,j)$ – value of the Euclidian distance between the input values i and j;
$t(i,j)$ – value of the distance between the clusters of a hierarchic dendrogram;
$\bar{x}$ – arithmetic mean of Euclidian distances between the values i and j;
$\bar{t}$ – arithmetic mean of the distance between the clusters of a hierarchic dendrogram.

The values of the Cophenetic correlation coefficient for the countries subject to the hierarchical cluster analysis of NACE subsections are: (1) Spain – 0.9505; (2) Ireland – 0.9712; (3) Hungary – 0.9388; (4) Poland – 0.9266.

The values of the Cophenetic correlation coefficient are high in all instances. Hence a conclusion that the dendrograms actually represent the clusters between NACE subsections in each of the analysed countries. Concerning Spain, Ireland and Poland, the cluster analysis corresponds to the analysis of interdependencies, providing substance for further exploration of branch clusters for the causes, barriers and nature of the patent activity development.

4.5. Market valuation of companies which represent innovative branches of Polish industry

A company's market value is increased through a positive ranking by the investors given to the company's strategy, current financial results and future perspectives of growth (Mishin, 2002; Brigham, 1997, et al.); traditional resources have been losing importance as a source of market value (Eustace, 2000). In extreme cases (Google), only two patents are the source of 95% of the market value of an enterprise (Haque, Smith, 2006). The average gap between the market value and the book value has been systematically growing since the beginning of the 1990s. This pattern is observed on the capital markets of numerous countries. Among other, but not as extreme tendencies, this one is clearly symptomatic and indicates the direction of further development of a business model for enterprises of the future.

A question raised at this point is: does protected knowledge owned by Polish businesses determine their market value? Research in the segment of OTC (over the counter) stock trading, on a sample of 80 companies with a documentation method, reveals certain interdependencies. The sectors qualified by the market operator as innovative employ intangible resources to a greater extent compared to traditional sectors. It is hard, however, to find a distinct dependence on the domestic OTC capital market between the volume of owned intangible assets and the market valuation of businesses in specific sectors (Wisła, 2009).

If capital market stakeholders (e.g. investment funds, pension funds, venture capital) are regarded as a professional group, their investment decisions should be dominated by the criterion of development potential of a company/branch based on an analysis of patent activity. Hence higher average annual valuations should be expected in the case of companies/branches with an increased patent activity.

The algorithm employed so far allows for describing a certain portion of innovative activity in economic branches. A general assumption can be cautiously adopted that the situation within a branch affects the perception and decisions of capital market investors, and mainly those investors who employ fundamental analysis. The branch analysis is an important component of such an investment approach.

The major obstacles in access to quality data from the stock trade markets of Spain, Ireland and Hungary, as well as the short time series in the case of Poland prevent a methodologically correct answer[28].

Hence the following presents a very general picture of relations between market valuations of selected economic branches, where companies are quoted on the controlled stock trading market, and patent activity of those branches. The following list does not provide any grounds for formulating any conclusions. They are only of an indicative nature.

28 Concerning the stock market in Spain, Ireland and Hungary, the information products (e.g. stock quotations) cannot be achieved by private persons (due to a substantial financial barrier). Concerning the Warsaw Stock Exchange, the products have been available in a digital format since 2002.

Table 31. Number of granted patents in selected NACE subsections for Poland

Year\NACE subclass\economic branch		2002	2003	2004	2005	2006	2007	2008	2009	Average
DA	Manufacture of food products, beverages and tobacco	3	7	10	8	8	9	8	20	9.13
DB	Manufacture of textiles and textile products	1	0	2	1	0	0	2	2	1.00
DD	Manufacture of wood and wood products	1	0	3	0	0	0	0	0	0.50
DF	Manufacture of coke, refined petroleum products and nuclear fuel	2	4	3	3	0	1	0	2	1.88
DG	Manufacture of chemicals, chemical products and man-made fibres	14	18	40	35	33	29	41	46	32.00
DJ	Manufacture of basic metals and fabricated metal products	6	10	10	7	5	13	13	10	9.25
DK	Manufacture of machinery and equipment	19	13	13	12	11	16	15	17	14.50
DL	Manufacture of electrical and optical equipment	20	34	52	35	28	29	28	28	31.75
FA	Construction	11	20	11	8	7	9	8	11	10.63

Source: Table 14 (Number of granted patents in individual NACE subsections for Poland).

Table 14 (Number of granted patents in individual NACE subsections for Poland) and Table 34 indicate that the highest patent activity in the years 1995-2009 characterises the following subsections: (1) DG; (2) DL; (3) DK.

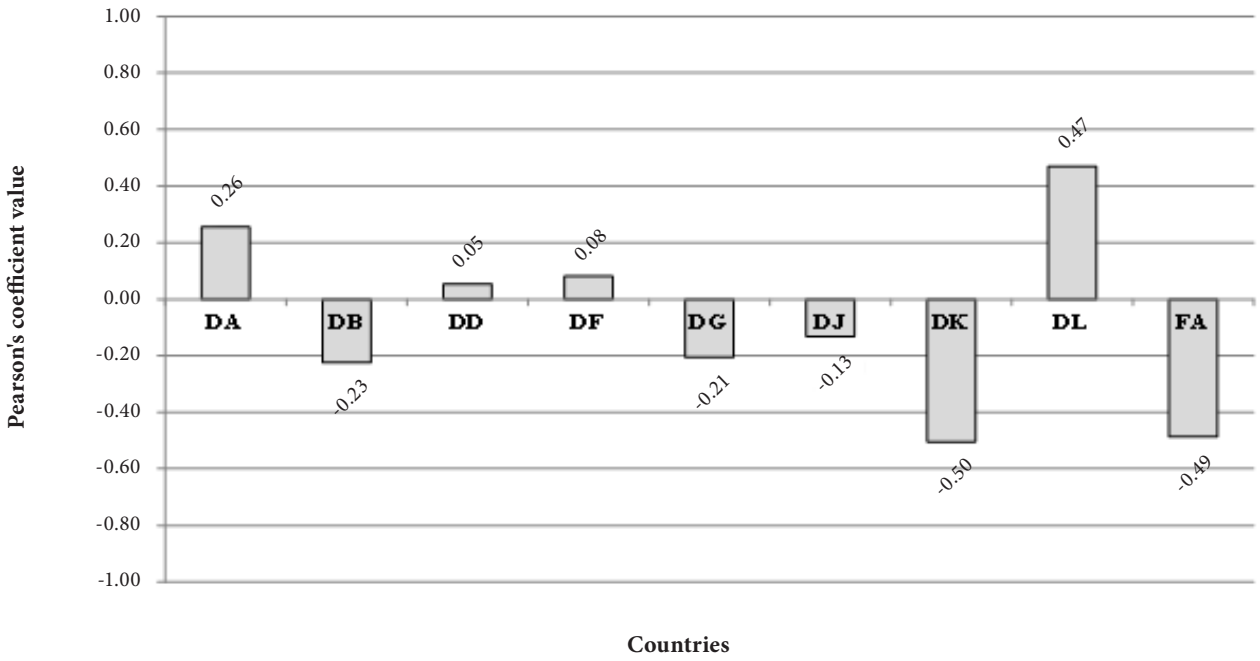
Table 32. Market valuation of selected branches on the domestic controlled stock trading market

Year (the last session day of the year) economic branch		2002	2003	2004	2005	2006	2007	2008	2009	Average
		C/WK	C/WK	C/WK	C/WK	C/WK	C/WK	C/WK	C/WK	C/WK
DA	Manufacture of food products, beverages and tobacco	1.18	2.79	3.25	2.79	3.56	3.57	1.56	2.51	2.65
DB	Manufacture of textiles and textile products	0.27	1.37	3.29	2.98	2.53	2.51	0.57	0.84	1.80
DD	Manufacture of wood and wood products	1.86	4.32	3.4	2.64	4.18	3.27	1.2	2.37	2.91
DF	Manufacture of coke, refined petroleum products and nuclear fuel	1.11	1.11	1.11	1.11	0.98	1.73	0.81	0.91	0.55
DG	Manufacture of chemicals, chemical products and man-made fibres	1.07	1.54	1.71	1.52	2.52	2.18	0.42	0.83	1.47
DJ	Manufacture of basic metals and fabricated metal products	0.73	1.43	1.51	1.85	2.81	2.62	0.77	1.93	1.71
DK	Manufacture of machinery and equipment	0.86	1.15	1.53	1.61	3.33	2.54	0.71	1.24	1.62
DL	Manufacture of electrical and optical equipment	2.5	3.1	3.25	2.47	2.96	2.36	1.06	1.19	2.36
FA	Construction	1.01	1.41	1.99	2.14	4.5	4.37	1.72	1.77	2.36

Source: WSE quotation.

By further employing the data (time series) included in Table 31 and 32, the values of Pearson's linear correlation coefficient were determined. Chart 34 presents the distribution of coefficient values for selected economic branches.

Chart 34. Distribution of Pearson's coefficient values for Poland (selected branches)



Source: proprietary study.

Considering the aforementioned reservations, mainly including a very poor quality of time series, no generalising conclusions are introduced here. Only general notes are formulated instead, which closely correspond to the aforementioned lists.

Firstly, a good practice which Polish companies should adopt is reporting of intangible assets in their ownership. The statement of the possessed intellectual properties should be enclosed with periodic (semi-annual and annual) reports as an important source of information for stakeholders. The stakeholders should have the opportunity for proper examination and assessment of the role of intangible assets in the generation of sales receipts. Reporting on the possessed intellectual property volume – apart from being a significant source of knowledge on the enterprise condition and potential – can contribute to limiting a high variance of market valuations, which has been particularly onerous, especially since 2008.

The official order (i.e. the Polish Accounting Law) to produce the aforementioned reports will result in a necessity to learn more on intellectual property management in Polish enterprises. Such obligations may contribute to the creation and reinforcement of intellectual property culture in the society.

Secondly, economic practice and theory have failed so far to work out an effective model for measuring and valuation of intangible assets. The chief task for the economy in the forthcoming years is to find an effective means of measuring and analysis of knowledge-based economy products.

Conclusion

The dynamics of socioeconomic changes prevent statistical classification systems and statistical tools from capturing the changes with proper accuracy and on time. In the case of research on innovation, the data sets collected so far help us understand only certain parts of the processes, especially those which apply to process input. The results, which are products, output and impact, often evade scientific recognition. It is thus more difficult to discover regularities or schemes of interdependence, or to formulate universal theories which would become feasible in domestic and regional economic policies. The presented concordance table, combining categories of two economic classifications: NACE and IPC, is a solution to this problem.

The authors believe that the concordance table with the created programming code have a great potential for use and further development in various fields of exploration of socioeconomic processes, especially in science, engineering, innovation activity, and macro and mesoeconomic comparative studies. Hence the authors hope that this publication will spur a wider public discussion on the proposed measurement tool.

In the scientific part of this work, a procedure was successfully designed to verify the adopted hypotheses. In the case of the first hypothesis, which assumes that the changes in the real economy domain should, to an extent, represent patent activity, moderate success has been achieved. The hypothesis was positively verified for the branches of examined economies:

1) Spain – manufacture of electrical and optical equipment (DL), manufacture of chemicals, chemical products and man-made fibres (DG), manufacture of machinery and equipment (DK), and also construction;
2) Ireland – the same branches apply as in Spain;
3) Hungary – manufacture of chemicals, chemical products and man-made fibres, manufacture of electrical and optical equipment, manufacture of machinery and equipment; along with construction, manufacture of other non-metallic mineral products, manufacture of food products, and manufacture of wood and wood products;
4) Poland – manufacture of chemicals, chemical products and man-made fibres, manufacture of electrical and optical equipment, manufacture of machinery and equipment.

Hence there is a scheme, or pattern, emerging for the examined countries. In each case, the branches marked as DL, DG and DK are among the branches which lead in the number of granted patents and the strength of interdependence with the branch production volume.

The other hypothesis assumes that the ICT sector has a special role in the economy, which is expressed by the highest percentage of granted patents in section H – Electricity of the IPC. The results of the research substantiate falsification of the hypothesis. There are no rational grounds to consider the ICT sector production as the most exploited field in terms of awarded patent protection. The researched countries are dominated by the "production" of patents in the area of medicine (including biology and chemistry). Only Ireland shows relatively clear patent activity in the area of electrical processing of digital data.

References

1. *A Framework for Biotechnology Statistics* (2005), OECD, Paris.
2. *A Guide for Information Society Measurements and Analysis* (2005), OECD, Paris.
3. *A new ranking of the world's most innovative countries* (2009), An Economist Intelligence Unit report Sponsored by Cisco, Economist Intelligence Unit Limited.
4. Agrawal R., Srikant R. (1994), *Fast Algorithms for Mining Association Rules*, Proc. of 1994 International Conference on Very Large Databases VLDB, Santiago de Chile, Morgan Kaufman.
5. Anthony S.D., Johnson M.W., Sinfield J.V., Altman E.J. (2010), *Przez innowację do wzrostu: jak wprowadzić innowację przełomową* (The Innovator's Guide to Growth: Putting Disruptive Innovation To Work), Wolters Kluwer, Warsaw.
6. Babrowski A.J., Bonner R.F. (2003), *Zarządzanie wiedzą korporacyjną – dwa podejścia* (Corporate knowledge management) in: *Zarządzanie wiedzą w systemach informacyjnych* (Knowledge management in IT systems), ed. W. Abramowicz, et al., Wroclaw University of Economics, Wrocław.
7. Bendyk E. (1999), *Ideologia społeczeństwa informacyjnego* (Ideology of the information society), "ComputerWorld" 1999, issue 33.
8. Barro R., Sala-I-Martin X. (1995), *Economic Growth*, Chapter 8, McGraw-Hill, New York.
9. Brdulak J.J. (2005), *Zarządzanie wiedzą a proces innowacji produktu* (Knowledge management and the product innovation process) SGH, Warsaw.
10. Brigham E. (1997), *Podstawy zarządzania finansami* (Fundamentals of Financial Management), vol. 2, PWE, Warsaw, pp. 293–330.
11. Cichy K. (2008), *Kapitał ludzki i postęp techniczny jako determinanty wzrostu gospodarczego* (Human resources and technological progress as determinants of economic growth), The Knowledge & Innovation Institute, Warsaw.
12. Cohen W.M., Merrill S.A. (2003), *Patents in the Knowledge-Based Economy*, The National Academies Press, Washington.
13. Coe D.T., Helpman E. (1995), *International R&D spillovers*, "European Economic Review", vol. 39, pp. 859–887.
14. *Community Innovation Survey 2006–2008* (2009), Central Statistics Office, Information Section, Skehard Road, Cork.
15. Decision No. 1608/2003/EC of the European Parliament and of the Council of 22 July 2003 concerning production and development of Community statistics on science and technology.
16. Denison E.F. (1967), *Why Growth Rates Differ. Postwar Experience in Nine Western Countries*, Brookings Institution, Washington.
17. Doktorowicz K. (2002), *Koncepcja społeczeństwa informacyjnego w polityce Unii Europejskiej* (The concept of the information society in the policy of the European Union), in: *Polskie doświadczenia w kształtowaniu społeczeństwa informacyjnego. Dylematy cywilizacyjno-kulturowe* (The Polish experiences in shaping of the information society. Cultural and civilisational dillemas), ed. L. Haber, AGH University of Science and Technology, Krakow.

18. Griliches Z. (1990), *Patent statistics as economic indicators: a survey*, "Journal of Economic Literature", vol. 28, pp. 1661–1707.
19. The Lisbon Group (1996), *Granice konkurencji* (Limits to Competition), Poltext, Warsaw.
20. Guzik R. (2004), *Przestrzenne zróżnicowanie potencjału innowacyjnego w Polsce* (Spatial differentiation of the innovative potential in Poland), in: *Innowacyjność polskiej gospodarki* (Innovation of the Polish economy), ed. M. Górzyński, R. Woodward, "Zeszyty Innowacyjne", issue 2, CASE.
21. Eustace C. (2000), *The Intangible Economy – Impact and Policy Issues*, Report of the European High-Level Expert Group on the Intangible Economy, European Commission.
22. Evenson R., Puttnam J. (1988), *The Yale-Canada Patent Flow Concordance*, Economic Growth Centre Working Paper, Yale University.
23. Everitt B., Landau S., Leese M., Stahl D. (2011), *Cluster Analysis*, John Willey & Sons, West Sussex, UK, pp. 61–69 and 71–98.
24. Fagerberg J., Srholec M., Knell M. (2007), *The competitiveness of nations: Why some countries prosper while others fall behind*, "World Development", no. 35(10).
25. Fayyad U., Piatetsky-Shapiro G. (1996), *Advances in Knowledge Discovery and Data Mining*, MIT Press.
26. *Frascati Manual 2002, Proposed Standard Practice for Surveys on Research and Experimental Development Manuel de Frascati 2002*, OECD, Paris, 2002.
27. Francesco C., Piantab M. (2008), *Demand and innovation in productivity growth*, "International Review of Applied Economics", vol. 22, no. 6, pp. 655–672.
28. Griliches Z. (1990), *Patent Statistics as Economic Indicators*, A Survey, "Journal of Economic Literature", vol. 28, pp. 1661–1707.
29. Polish Central Statistical Office (2011), *Nauka i technika w Polsce w 2009 roku* (Science and technology in Poland in the year 2009), The Statistical Office in Szczecin.
30. Polish Central Statistical Office (2010), *Działalność innowacyjna przedsiębiorstw 2006*–2009 (Corporate innovative activity in the years 2006-2009), The Statistical Office in Szczecin.
31. Haque N., Smith G. (2006), *The economic role of intellectual property*, Building and enforcing intellectual property value 2006, Deloitte&Touche LLP, pp. 48–51.
32. Han J., Fu Y., Wang W. et al. (1996), *A System for Mining Knowledge in Large Relational Databases*, School of Computing Science-Simon Fraser University-British Columbia, Canada.
33. *Handbook on Economic Globalisation Indicators* (2005), OECD, Paris.
34. Hollanders H., Tarantola S. (2011), *Innovation Union Scoreboard 2010 – Methodology report*, MERIT (Maastricht University) and Joint Research Centre (JRC), Unit G3.
35. *Informacja na temat prac nad przygotowaniem nowych klasyfikacji oraz regulacji Unii Europejskiej wprowadzających od 2007 r. zmiany w podstawowych klasyfikacjach gospodarczych* (Information about the work on preparation of new EU classifications and regulations implementing changes in the basic economic classification from the year 2007), Polish Central Statistical Office, Warsaw 2005.
36. *Innovation Union Scoreboard 2010. The Innovation Union's performance scoreboard for Research and Innovation* (2011), The Maastricht Economic and social Research and training centre on

Innovation and Technology (UNU-MERIT) with the contribution of DG JRC G3 of the European Commission.

37. Jaffe A.B., Fogarty M.S., Banks B.A. (1998), *Evidence from patents and patent citations on the impact of NASA and other federal labs on commercial innovation*, "Journal of Industrial Economics", vol. 46, pp. 183–205.
38. Jaffe A.B., Henderson R., Trajtenberg M. (1993), *Geographic localization of knowledge spillovers as evidenced by patent citations*, "Quarterly Journal of Economics", vol. 108, pp. 577–598.
39. Jaffe A.B., Trajtenberg M. (1996), *Flows of knowledge from universities and federal labs: modeling the flow of patent citations over time and across institutional and geographic boundaries*, "Proceedings of the National Academy of Sciences", vol. 93, pp. 12671–12677.
40. Jaffe A.B. (1986), *Technological opportunity and spillover of R&D: evidence from firms' patents, profits, and market value*, "American Economic Review", vol. 76, pp. 984–1001.
41. Jones C.I., Williams J.C. (1998), *Measuring the social return to R&D*, "Quarterly Journal of Economics", vol. 113, pp. 1119–1135.
42. Johnson D.K.N. (2002), *The OECD Technology Concordance (OTC): Patents by industry of manufacture and sector of use*, OECD, DSTI, "Working Paper" 2002, no. 5.
43. Kaldor N. (1966), *Causes of the slow rate of growth in the United Kingdom*, Cambridge, Cambridge University Press.
44. Kałuszyńska E. (2005), *Wiedza i informacja* (Knowledge and information), in: *Informacja a rozumienie* (Information and understanding), ed. M. Heller, J. Mączka, Polish Academy of Arts and Sciences, Centre of Interdisciplinary Research "Biblios", Krakow.
45. Kasprzycki D., Matczewski A., Okoń-Horodyńska E., du Vall M., Wisła R. (2008), *Zarządzanie własnością intelektualną w przedsiębiorstwie – regulaminy korzystania z wyników prac intelektualnych powstałych w przedsiębiorstwie* (Intellectual property management in enterprises. Rules for use of intellectual output generated in enterprises), Krakow, work commissioned by the Polish Ministry of Economy.
46. Kaufer E. (2002), *Economics of Technical Change I: The Economics of the Patent System*, Taylor & Francis.
47. Kaufman L., Rousseeuw P. (2005), *Finding Groups in Data: An Introduction to Cluster Analysis*, John Willey & Sons, West Sussex, UK, pp. 12–21, 37–53.
48. Keller W. (2004), *International technology diffusion*, "Journal of Economic Literature", vol. 42, pp. 752–782.
49. Kozłowski J. (2009), *Statystyka nauki, techniki i innowacji w krajach UE i OECD. Stan i problemy rozwoju* (Statistics of science, technology and innovation in the EU and OECD countries. The status and issues of development), Ministry of Science and Higher Education, Warsaw.
50. Krugman P. (1998), *What is new about new economic geography?* "Oxford Rewiew of Economic Policy", vol. 14, no. 2.
51. Kubielas A. (2009), *Innowacje i luka technologiczna w gospodarce globalnej opartej na wiedzy. Strukturalne i makroekonomiczne uwarunkowania* (Innovations and the technological gap in the global knowledge-based economy. Structural and macroeconomic conditions), University of Warsaw, Warsaw.

52. Lanjouw J.O., Pakes A., Putnam J. (1998), *How to count patents and value intellectual property: uses of patent renewal and application data*, "Journal of Industrial Economics", vol. 46, pp. 405–433.
53. Lanjouw J.O., Mody A. (1996), *Innovation and the international diffusion of environmentally responsive technology*, "Research Policy", vol. 25, pp. 549–571.
54. Liberda Z.B. (2008), *Patenty w skali światowej i w poszczególnych krajach* (Patents on the global scale and in specific countries), in: *Tendencje innowacyjnego rozwoju polskich przedsiębiorstw* (Tendencies for innovative growth in the Polish businesses), ed. E. Okoń-Horodyńska, A. Zachorowska-Mazurkiewicz, The Knowledge & Innovation Institute, Warsaw, pp. 13–21.
55. Martinez C., Guellec D. (2003), *Overview of recent trends in patent regimes in United States, Japan and Europe*, OECD, IPR, Innovation and Economic Performance.
56. Mattelart A. (2004), *Społeczeństwo informacji* (Society of information), Universitas, Krakow.
57. *Measuring Knowledge Management in the Business Sector – first steps* (2003), OECD, Canada.
58. *Międzynarodowa Klasyfikacja Patentowa, Wskazówki dla użytkowników* (2006) (International Patent Classification. User guidelines), The Polish Patent Office, Warsaw.
59. Mishkin F.S. (2002), *Ekonomika pieniądza, bankowości i rynków finansowych* (The Economics of Money, Banking, and Financial Markets), WN PWN, pp. 854–899.
60. Morzy T. (1999), *Eksploracja danych: problemy i rozwiązania* (Data mining: problems and solutions) conference materials, The 5th Conference of ORACLE Users and Developers titled "Integration of Data and IT Systems", Zakopane (http://www.ploug.org.pl/konf_99/pdf/7.pdf).
61. Myrdal G. (1957), *Economic theory and underdeveloped regions*, Duckworth, London.
62. Noga M. (2000), *Makroekonomia* (Macroeconomy) Wroclaw University of Economics, Wroclaw.
63. OECD (2009), *Guide To Measuring The Information Society*, Paris.
64. Ozden B., Ramaswamy S., Silberschatz A. (1998), *Cyclic Association Rules*, In Proc. 1998 International Conference on Data Engineering (ICDE'98), Orlando, FL.
65. *Oslo Manual, Guidelines for Collecting and Interpreting Innovation Data*, 3rd edition, OECD Paris 2005,
66. Ożegalska-Trybalska J. (2009), *Prawne aspekty ochrony własności intelektualnej* (Legal aspects of intellectual property protection), in: R. Wisła, *Rozwój współpracy sektorów publicznego i prywatnego z wykorzystaniem praw własności intelektualnej* (Development of cooperation between the public and private sectors with the use of intellectual property rights), The Knowledge & Innovation Institute, Warsaw, pp. 53–72.
67. Pakes A. (1985), *On patents, R&D, and the stock market rate of return*, "Journal of Political Economy", vol. 93, pp. 390– 409.
68. *Patenting by organizations 2010* (2011), A Patent Technology Monitoring Team Report, USPTO.
69. Pohulak-Żołędowska E. (2009), *Znaczenie ochrony praw własności intelektualnej* (Significance of intellectual rights protection), in: *Kapitał intelektualny i jego ochrona* (Intellectual capital and its protection), ed. E. Okoń-Horodyńska, R. Wisła, The Knowledge & Innovation Institute, Warsaw, pp. 197–206.
70. Popp D. (2005), *Lessons from patents: Using patents to measure technological change in environmental models*, "Ecological Economics", vol. 54, pp. 209–226.

71. *Regional Innovation Scoreboard 2009. Methodology report* (2009), The Maastricht Economic and social Research and training centre on Innovation and Technology (UNU-MERIT) with the contribution of DG JRC G3 of the European Commission.
72. Romer P. (1990), *Endogenous Technological Change*, "Journal of Political Economy", no. 98, pp. 71–103.
73. Council Regulation (EEC) no. 3037/90 of 9 October 1990 on the statistical classification of economic activities in the European Community (OJ L 293, 24.10.1990).
74. Commission Regulation (EC) no. 973/2007 of 20 August 2007 amending certain EC Regulations on specific statistical domains implementing statistical classification of economic activities NACE Revision 2 (OJ L 216/10, 21.08.2007).
75. Scherer, F.M. (1982), *Demand-Pull and Technological Inventions: Schmookler Revisited*, "Journal of Industrial Economics", vol. 30, no. 3.
76. Schmoch U. (2008), *Concept of a Technology Classification for Country Comparisons*[1]. *Final Report to the World Intellectual Property Organisation*, Fraunhofer Institute for Systems and Innovation Research, Karlsruhe.
77. Schmookler, J. (1966), *Invention and Economic Growth*, Harvard University Press, Cambridge.
78. *Science, technology and innovation in Europe* (2010), Publications of the European Union, Collection: Pocketbooks, Luxemburg.
79. *Science, technology and innovation in Europe* (2009), Publications of the European Union, Collection: Pocketbooks, Luxemburg.
80. Skyrme D.J. (1999), *Knowledge Networking*, http://www.skyrme.com/kmpresentations/berlin98.pdf.
81. Schmoch U. (2008), *Concept of a Technology Classification for Country Comparisons*, Final Report to the World Intellectual Property Organisation (WIPO), Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.
82. Sobczyk M. (2002), *Statystyka* (Statistics), WN PWN, Warsaw.
83. Sokal R., Rholf F., (1962), *The Comparison of Dendrograms by Objective Methods*, "Taxon", vol. 11, no. 2, pp. 33–40.
84. Solow R.M. (1957), *Technical change and the aggregate production function*, "Review of Economics and Statistics", no. 39, pp. 312–20.
85. Stoneman P. (2002), *The Economics of Technological Diffusion*, Blackwell Publishers, Oxford UK.
86. *The Community Innovation Survey 2006, Methodological recommendations* (In accordance with section 7 of the annex to the Commission Regulation on innovation statistics, no. 1450/2004), final version April 27, 2006.
87. Szul R. (2007), *Teorie i koncepcje w polityce regionalnej* (Theories and concepts in regional policy), in: *Rozwój, region, przestrzeń* (Development, region, space), ed. G. Gorzelak, A. Tucholska, Ministry of Regional Development, Warsaw.
88. *The Community Innovation Survey 2010* (CIS 2010), The Harmonised Survey Questionnaire, The Community Innovation Survey 2010, final version July 9, 2010.
89. *The Global Innovation Index 2011. Accelerating Growth and Development* (2011), ed. S. Dutta, INSEAD, http://www.globalinnovationindex.org/gii/GII%20COMPLETE_PRINTWEB.pdf.

90. *The Innovation Imperative in Manufacturing: How the United States Can Restore Its Edge* (2009), Boston Consulting Group/National Association of Manufacturers, Boston, document available on the BCG official website, http://www.bcg.com/documents/file15445.pdf.
91. *The Measurement of Scientific and Technological Activities: Using Patent Data as Science and Technology Indicators – Patent Manual* (1994), OECD, Paris.
92. *The OECD Innovation Strategy: Getting a Head Start on Tomorrow* (2010), OECD, Paris.
93. *The Science and Engineering Indicators* (2010), National Science Foundation, http://www.nsf.gov/statistics/seind10/pdf/seind10.pdf, Statistics in Focus Eurostat, Science, Technology and Industry Scoreboard OECD (from 1999).
94. Trajtenberg M. (2005), *Innovation Policy for Development: An Overview*, Paper prepared for LAEBA, Second Annual Meeting, November 28–29, 2005, Tel Aviv University.
95. Triplett J.E. (1993), *Economic Concepts for Economic Classifications*, "Survey of Current Business", pp. 45–49.
96. Uzawa H. (1965), *Optimum Technological Change in an Aggregative Model of Economic Growth*, "International Economic Review", no. 6, pp. 18–31.
97. Welsum V., Vickery D.G. (2005), *New Perspectives on ICT Skills and Employment*, STI Information Economy Working Paper, DSTI/ICCP/IE(2004)10/FINAL, OECD, Paris.
98. Wisła R. (2010), *Aktywa niematerialne i ich wpływ na wycenę przedsiębiorstw z branż usługowych na rynku New Connect* (Intangible assets and their effect on the valuation of businesses in the New Connect services branches), Zeszyty Naukowe WSBiF, Bielsko-Biała, pp. 120–137.
99. Wisła R. (2009), *Własność intelektualna oraz ekonomiczne uzasadnienie jej ochrony* (Intellectual property and the economic substantiation of its protection), Zeszyty Naukowe WSBiF, Bielsko-Biała, pp. 60–76.
100. Witten I.H., Frank E., Hall M.A. (2011), *Data Mining. Practical Machine Learning Tools and Techniques with Java Implementations*, Morgan Kaufmann, Machine Learning Group at University of Waikato.
101. Wierzbołowski J. (2006), *Społeczeństwo informacyjne a integracja Polski w ramach Unii Europejskiej* (Information society and the integration of Poland in the European Union), "Ekonomista", issue 1, pp. 27–51.
102. van Welsum D., Vickery G. (2005), *New Perspectives on ICT Skills and Employment*, STI Information Economy Working Paper, DSTI/ICCP/IE(2004)10/FINAL, OECD, Paris.
103. Verspagen B., van Moergastel T., Slabbers M. (1994), *MERIT concordance table: IPC – ISIC (rev. 2)*, Maastricht Economic Research Institute on Innovation and Technology University of Limburg, http://www.merit.unu.edu/publications/rmpdf/1994/rm1994–004.pdf.
104. Verspagen B. (2005), *Mapping Technological Trajectories as Patent Citation Networks*, "A Study on the History of Fuel Cell Research", MERIT-Infonomics Research Memorandum Series 2005–020.
105. Zając K. (1994), *Zarys metod statystycznych* (Outline of statistical methods), PWE, Warsaw.
106. Zeliaś A. (2000), *Metody statystyczne* (Statistical methods), PWE, Warsaw.

Online reference

1. *Statistics Explained*, Eurostat, http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Value_added
2. http://www.census.gov/eos/www/naics/history/history.html (classification concepts)
3. http://www.merit.unu.edu/MEI/papers/Patents%20as%20a%20measure%20of%20eco-innovation.pdf

List of tables, charts and figures

Tables

Charts

Figures

Annex No. 1

Table 33. Representation of the IPC in NACE (section level)©

NACE code	IPC code
1	A01G0001, A01G0007, A01G0011, A01G0016, A01G0017, A01G0029, A01G0033, A01H, A01K0047, A01K0049, A01K0051, A01K0053, A01K0055, A01K0057, A01K0059, A01K0001, A01K0003, A01K0005, A01K0007, A01K0009, A01K0011, A01K0013, A01K0014, A01K0015, A01K0017, A01K0019, A01K0021, A01K0023, A01K0025, A01K0027, A01K0029, A01K0031, A01K0033, A01K0035, A01K0037, A01K0039, A01K0041, A01K0043, A01K0045, A01L, A01M
2	A01G0023
5	A01K0061, A01K0063, A01K0065, A01K0067, A01K0069, A01K0071, A01K0073, A01K0074, A01K0075, A01K0077, A01K0079, A01K0080, A01K0081, A01K0083, A01K0085, A01K0087, A01K0089, A01K0091, A01K0093, A01K0095, A01K0097, A01K0099
10	C10F, E21C0025, E21C0027, E21C0029, E21C0031, E21C0033, E21C0035, E21C0037, E21C0039, E21C004116, E21C004118, E21C004126, E21C004128, E21C004132, E21C0045, E21C004702, E21C004704, E21C004706, E21C004708, E21C0049, E21C0050, E21C0051, E21D, E21F
11	E21B, E21C004124
13	E21C004122, E21C004130
14	E21C004120, E21C004710
15	A01J001116, A01J0027, A01J0015, A01J0025, A21D, A22C, A23B, A23C, A23D, A23F, A23G, A23J, A23K, A23L, B02, C11B0001, C11B0003, C11B0005, C11B0007, C11B0011, C11B0015, C11C, C12C, C12G, C12H, C12J, C12L, C12M, C12N, C12P, C12Q, C12R, C12S0001, C12S000320, C12S000322, C12S000324, C12S0005, C12S0007, C12S0009, C12S0011, C12S0099, C13
16	A24
17	B65D0030, B65D0033, D01B, D01D, D01F0001, D01F0002, D01F0004, D01F0006, D01F0008, D01F0009, D01F0011, D01G0001, D01G0003, D01G0005, D01G0007, D01G0009, D01G0013, D01G0015, D01G0017, D01G0019, D01G0021, D01G0023, D01G0025, D01G0027, D01G0029, D01G0031, D01G0033, D01G0035, D01H, D02, D03D0001, D03D0003, D03D0005, D03D0007, D03D0009, D03D0011, D03D0013, D03D0015, D03D0017, D03D0019, D03D0021, D03D0023, D03D0025, D03D0027, D04, D05, D06B, D06C, D06F, D06G, D06H, D06J, D06L0001, D06M, D06N, D06Q, D07
18	A41, A42, A44B, A45B, D06L0003, D06P
19	A43B, A43C, A45C, A45F, B05D000712, B29D0035, B68B, B68C, B68F0001, B68G, C14
20	B05D000706, B05D000708, B05D000710, B27D, B27F, B27H, B27J, B27K, B27L, B27M, B27N, B32B0021, B32B0037, B32B0038, B32B0039, B32B0041, B32B0043, B65D0019, E04C000210, E04C000212, E04C000214, E04C000216, E04C000218, E04C000312, E04C000314, E04C000316, E04C000317, E04C000318, E04C000342, E04F0011108, E04F001310, E04F001504, E06B000106, E06B000108, E06B000110, E06B000310, E06B000374, E06B000384, E06B000504
21	D21B, D21C, D21D, D21H, D21J, B32B0023, B31, B32B0029, B65D0003, B65D0005, B65D0017, B65D0025, B65D0027
22	B41C, B41M, B42C, B42F, B42D, G03C000510, G03C000512, G06K, G11
23	B32B0011, C10B0047, C10B0049, C10B0051, C10B0053, C10B0055, C10B0057, C10C, C10G0001, C10G0002, C10G0003, C10G0005, C10G0007, C10G0009, C10G0011, C10G0015, C10G001702, C10G001704, C10G001706, C10G001707, C10G001708, C10G0017085, C10G001709, C10G0017095, C10G001902, C10G001904, C10G001906, C10G0019067, C10G0019073, C10G002102, C10G002104, C10G002106, C10G002108, C10G002110, C10G002112, C10G002114, C10G002116, C10G002118, C10G002120, C10G002122, C10G002124, C10G002126, C10G002127, C10G002130, C10G002502, C10G002503, C10G002505, C10G002506, C10G002508, C10G002509, C10G002511, C10G0027, C10G0029, C10G0031, C10G0032, C10G0033, C10G0035, C10G0045, C10G0047, C10G0049, C10G0050, C10G0051, C10G0053, C10G0055, C10G0057, C10G0059, C10G0061, C10G0063, C10G0065, C10G0067, C10G0069, C10G0070, C10G0071, C10G007302, C10G007304, C10G007306, C10G007308, C10G007310, C10G007312, C10G007314, C10G007316, C10G007318, C10G007320, C10G007322, C10G007324, C10G007326, C10G007328, C10G007330, C10G007332, C10G007334, C10G007336, C10G007338, C10G007340, C10G007342, C10G007344, C10G0075, C10L, C10M, C10N, G21

NACE code	IPC code
24	A01N, A01P, A45D, A61K, A61L, A61P, A61Q, A62D, B01D0001, B01D0003, B01D0007, B01D0009, B01D0011, B01D0012, B01D0015, B01D0017, B01D0019, B01D0021, B01D0024, B01D0025, B01D0027, B01D0029, B01D0033, B01D0035, B01D0036, B01D0037, B01D0039, B01D0041, B01D0043, B01D0045, B01D0046, B01D0047, B01D0049, B01D0051, B01D0053, B01D0057, B01D0059, B01D0061, B01D0063, B01D0065, B01D0067, B01D0069, B01D007102, B01D007104, B01D007106, B01D007108, B01D007110, B01D007112, B01D007114, B01D007116, B01D007118, B01D007120, B01D007122, B01D007126, B01D007128, B01D007130, B01D007132, B01D007134, B01D007136, B01D007138, B01D007140, B01D007142, B01D007144, B01D007146, B01D007148, B01D007150, B01D007152, B01D007154, B01D007156, B01D007158, B01D007160, B01D007162, B01D007164, B01D007166, B01D007168, B01D007170, B01D007172, B01D007174, B01D007176, B01D007178, B01D007180, B01D007182, B01F, B01J, B03D, B08, B29B0007, B29B0009, B29B0011, B29B0013, B29B0015, B29C, B29D0017, B29K0001, B29K0023, B29K0025, B29K0027, B29K0029, B29K0031, B29K0033, B29K0035, B29K0045, B29K0055, B29K0059, B29K0061, B29K0063, B29K0067, B29K0069, B29K0071, B29K0073, B29K0075, B29K0077, B29K0079, B29K0081, B29K0083, B29K0085, B29K0086, B29K0091, B29K0095, B29K0096, B29K0101, B29K0103, B29K0105, B29K0201, B29K0207, B29K0209, B29K0219, B29K0221, B29K0223, B29K0225, B29K0227, B29K0229, B29K0231, B29K0233, B29K0235, B29K0245, B29K0255, B29K0259, B29K0261, B29K0263, B29K0267, B29K0269, B29K0271, B29K0273, B29K0275, B29K0277, B29K0279, B29K0281, B29K0283, B29K0285, B29K0286, B29K0295, B29K0296, B29K0301, B29K0303, B29K0305, B29K0307, B29K0309, B29K0311, B29K0401, B29K0421, B29K0423, B29K0425, B29K0427, B29K0429, B29K0431, B29K0433, B29K0435, B29K0445, B29K0455, B29K0459, B29K0461, B29K0463, B29K0467, B29K0469, B29K0471, B29K0473, B29K0475, B29K0477, B29K0479, B29K0481, B29K0483, B29K0485, B29K0486, B29K0491, B29K0495, B29K0496, B29K0501, B29K0503, B29K0505, B29K0507, B29K0509, B29K0511, B29K0601, B29K0621, B29K0623, B29K0625, B29K0627, B29K0629, B29K0631, B29K0633, B29K0635, B29K0645, B29K0655, B29K0659, B29K0661, B29K0663, B29K0667, B29K0669, B29K0671, B29K0673, B29K0675, B29K0677, B29K0679, B29K0681, B29K0683, B29K0685, B29K0686, B29K0691, B29K0695, B29K0696, B29K0701, B29K0703, B29K0705, B29K0707, B29K0709, B29K0711, B29L, B32B0001, B32B0003, B32B0005, B32B0007, B32B0009, B32B0027, B32B0033, B65D0053, C01, C05, C06, C07, C08B, C08C, C08F, C08G, C08H, C08J0003, C08J0005, C08J0007, C08J0009, C08J0099, C08K, C08L, C08L0009, C08L0011, C08L0013, C08L0015, C08L0017, C08L0019, C08L0021, C08L002322, C08L005104, C09B, C09C, C09D, C09F, C09G, C09H, C09J, C09K0003, C09K0005, C09K0008, C09K0009, C09K001102, C09K001104, C09K001106, C09K001107, C09K001108, C09K001154, C09K001155, C09K001156, C09K001157, C09K001158, C09K001159, C09K001160, C09K001161, C09K001162, C09K001163, C09K001164, C09K001165, C09K001166, C09K001167, C09K001168, C09K001169, C09K001170, C09K001171, C09K001172, C09K001173, C09K001174, C09K001175, C09K001176, C09K001177, C09K001178, C09K001179, C09K001180, C09K001181, C09K001182, C09K001183, C09K001184, C09K001185, C09K001186, C09K001187, C09K001188, C09K001189, C09K0013, C09K0015, C09K0017, C09K0019, C09K0021, C09K0101, C09K0103, C09K0105, C09K0107, C09K0109, C10H, C10J, C10K, C11B0009, C11D, G03C0001, G03C000502, G03C000504, G03C000506, G03C000508, G03C000514, G03C000516, G03C000517, G03C000518, G03C000520, G03C000522, G03C000526, G03C000528, G03C000529, G03C000530, G03C0005305, G03C0005315, G03C000531, G03C000532, G03C000538, G03C000539, G03C0005395, G03C000540, G03C000542, G03C000544, G03C000546, G03C000548, G03C000550, G03C000556, G03C000558, G03C000560, G03C0007, G03C0008, G03C0009, G03C0011, F25J
25	B29D0001, B29D0005, B29D0007, B29D0011, B29D0012, B29D0015, B29D0016, B29D0019, B29D0021, B29D0022, B29D0023, B29D0024, B29D0025, B29D0028, B29D0029, B29D0030, B29D0033, B29K0007, B29K0407, B29K0607, B29K0009, B29K0409, B29K0609, B29K0019, B29K0021, B29K0419, B29K0619, B32B0025, B60C, B65D0021, B65D0035, B65D0037, B65D0063, B65D0065, B65D0071, B65D0073, B65D0075, B65D0077, B65D0079, B65D0081, B65D0083, B65D0085, E04C000220, E04C000222, E04C000507, E06B000126, E06B000128, E06B000130, E06B000326, E06B000328, E06B000330, E06B000378, E06B000386
26	A47K, B01L, B24D0003, B24D0005, B24D0009, B24D0007, B24D0011, B24D0013, B28, B32B0013, B32B0017, B32B0018, B32B0019, B44C, B65D0023, B65D0088, B65D009002, B65D009004, B65D009006, B65D009008, B65D009010, B65D009012, B65D009014, B65D009016, B65D009018, B65D009020, B65D009022, B65D009024, B65D009026, B65D009028, B65D009032, B65D009034, B65D009036, B65D009038, B65D009040, B65D009042, B65D009044, B65D009046, B65D009048, B65D009050, B65D009052, B65D009054, B65D009056, B65D009058, B65D009060, B65D009062, B65D009064, B65D009066, C03, C04, C22C0101, C30, C40, E03D0011, E03D0013, E04C000204, E04C000206, E04C000320, E04C000322, E04C000326, E04C000334, E04C000344, E04F0011116, E04F001314, E04F001508, E06B000124, E06B000318, E06B000508
27	B05D000720, B05D000722, B21C, B21D, B21F, B22D0001, B22D0003, B22D0007, B22D0011, B22D0013, B22D0015, B22D0017, B22D0018, B22D0019, B22D0021, B22D0023, B22D0025, B22D0027, B22D0029, B22D0030, B22D0031, B22D0043, C21, C22B0001, C22B0003, C22B0004, C22B0005, C22B0007, C22B0009, C22B0011, C22B0013, C22B0015, C22B0017, C22B0019, C22B0021, C22B0023, C22B0025, C22B0026, C22B0030, C22B0034, C22B0035, C22B0041, C22B0043, C22B0047, C22B0058, C22B0059, C22B0060, C22B0061, C22C0001, C22C0003, C22C0005, C22C0007, C22C0009, C22C0011, C22C0012, C22C0013, C22C0014, C22C0016, C22C0018, C22C0019, C22C0020, C22C0021, C22C0022, C22C0023, C22C0024, C22C0025, C22C0026, C22C0027, C22C0028, C22C0029, C22C0030, C22C0032, C22C0033, C22C0035, C22C0037, C22C0038, C22C0043, C22C0045, C22C0047, C22C0049, C22C0111, C22C0121, C22F, F16L

NACE code	IPC code
28	B05D000714, B05D000716, B05D000718, B21B, B21G, B21H, B21J, B21K, B21K0011, B21L, B22F, B23B0001, B23B0035, B23B0037, B23G0007, B23G0009, B23H, B23K0001, B23K0005, B23K0007, B23K0009, B23K0010, B23K0011, B23K0013, B23K0015, B23K0017, B23K0020, B23K0023, B23K0025, B23K0026, B23K0028, B23K0031, B23K0033, B23K0101, B23K0103, B23P0005, B23P0006, B23P0009, B23P0011, B23P0013, B23P0015, B23P0017, B23P0025, B32B0015, B65D0001, B65D0006, B65D0008, B65D0013, B65D0039, B65D0041, B65D0043, B65D0045, B65D0047, B65D0049, B65D0050, B65D0051, B65D0055, B65D0057, B65D0059, B65D0061, B65D0067, B65D0069, C23, E04C000208, E04C000304, E04C000306, E04C000307, E04C000308, E04C000309, E04C000310, E04C000311, E04C000332, E04C000340, E04C000501, E04C000502, E04C000503, E04C000504, E04C000506, E04C0005065, E04C000518, E04F0011112, E04F001312, E04F001506, E05, E06B000112, E06B000114, E06B000116, E06B000118, E06B000120, E06B000122, E06B000312, E06B000376, E06B000506, F16B, F16S, F17B, F17C, F22, F24B, F24C, F24D, F24H, F24J
29	A01B, A01C, A01D, A01F, A01G0003, A01G0005, A01G0009, A01G0013, A01G0015, A01G0025, A01G0027, A01G0031, A01J0001, A01J0003, A01J0005, A01J0007, A01J0009, A01J0011, A01J0013, A01J0017, A01J0019, A01J0021, A01J0023, A21B, A21C, A22B, A23N, A23P, A43D, A47G, A47H, A47J, A47L, A61D, A61G, A62C, B01, B03B, B04, B05B, B05C, B05D0001, B05D0003, B05D0005, B05D000702, B05D000704, B05D000724, B05D000726, B06, B07, B22C, B22D0002, B22D0005, B22D0009, B22D0033, B22D0035, B22D0037, B22D0039, B22D0041, B22D0045, B22D0046, B22D0047, B23B0003, B23B0005, B23B0007, B23B0009, B23B0011, B23B0013, B23B0015, B23B0017, B23B0019, B23B0021, B23B0023, B23B0025, B23B0027, B23B0029, B23B0031, B23B0033, B23B0039, B23B0041, B23B0043, B23B0045, B23B0047, B23B0049, B23B0051, B23C0001, B23C0003, B23C0005, B23C0007, B23C0009, B23D, B23F, B23G0001, B23G0003, B23G0005, B23G0011, B23K0003, B23K0035, B23K0037, B23P0019, B23P0021, B23P0023, B23Q, B24, B25, B26, B27B, B27C, B27G, B30, B41B, B41D, B41F, B41G, B41K, B41N, B42B, B44B, B61D0001, B65B, B65C, B66, B68F0003, B67, B81, C10B0001, C10B0003, C10B0005, C10B0007, C10B0009, C10B0011, C10B0013, C10B0015, C10B0017, C10B0019, C10B0021, C10B0023, C10B0025, C10B0027, C10B0029, C10B0031, C10B0033, C10B0035, C10B0037, C10B0039, C10B0041, C10B0043, C10B0045, C25, D03C, D03D0029, D03D0031, D03D0033, D03D0035, D03D0037, D03D0039, D03D0041, D03D0043, D03D0045, D03D0047, D03D0049, D03D0051, D03J, D21F, D21G, F01, F02C, F02G, F02K, F03, F04, F15, F16C, F16D, F16F, F16G, F16H, F16J, F16K, F16M, F16N, F16P, F16T, F23, F24F, F25B, F25C, F25D, F26, F27, F28, F41, F42
30	B41J, B41L, B43, G06C, G06D, G06E, G06F, G06G, G06J, G06M, G06N, G06Q, G06T
31	H02B, H02G, H02H, H02J, H02K, H02M, H02P, H01B0001, H01B0003, H01B0005, H01B0007, H01B0009, H01B0011, H01B0012, H01B0013, H01B0017, H01B0019, H01M0002, H01M0004, H01M000602, H01M000604, H01M000606, H01M000608, H01M000610, H01M000612, H01M000614, H01M000616, H01M000618, H01M000620, H01M000622, H01M000624, H01M000626, H01M000628, H01M000630, H01M000632, H01M000634, H01M000636, H01M000638, H01M000640, H01M000642, H01M000644, H01M000646, H01M000648, H01M000650, H01M0008, H01M001002, H01M001004, H01M001005, H01M0010052, H01M00100525, H01M0010054, H01M0010056, H01M00100561, H01M00100562, H01M00100563, H01M00100564, H01M00100565, H01M00100566, H01M00100567, H01M00100568, H01M00100569, H01M0010058, H01M00100583, H01M00100585, H01M00100587, H01M001006, H01M001008, H01M001010, H01M001012, H01M001014, H01M001016, H01M001018, H01M001020, H01M001022, H01M001024, H01M001026, H01M001028, H01M001030, H01M001032, H01M001034, H01M001036, H01M001038, H01M001039, H01M001042, H01M001044, H01M001046, H01M001048, H01M001050, H01M001052, H01M0012, H01M0014, H01M0016, F21, B03C, H02N, H01P, H01Q, H01R, H01T, H05
32	B82, H01C, H01F, H01G, H01H, H01J0001, H01J0003, H01J0005, H01J0007, H01J0011, H01J0013, H01J0015, H01J0017, H01J0019, H01J0021, H01J0023, H01J0025, H01J0027, H01J0029, H01J0031, H01J0033, H01J0035, H01J0037, H01J0040, H01J0041, H01J0043, H01J0045, H01J0047, H01J0049, H01J0061, H01J0063, H01J0065, H01K, H01L, H01S, H03, H04
33	A61B, A61C, A61F, A61H, A61J, A61M, A61N, A62B, G01, G07, G08, G12, G05, G02, G03B, G03D, G03F, G03C0003, G03G0005, G03G0007, G03G0008, G03G0009, G03G0011, G03G0013, G03G0015, G03G0016, G03G0017, G03G0019, G03G002102, G03G002104, G03G002106, G03G002108, G03G002112, G03G002114, G03G002116, G03G002118, G03G002120, G03H, G04
34	B60B, B60D, B60F, B60G, B60H, B60J, B60K, B60L, B60Q, B60T, B62D0001, B62D0003, B62D0005, B62D0006, B62D0007, B62D0009, B62D0011, B62D0012, B62D0013, B62D0015, B62D0017, B62D0019, B62D0021, B62D0023, B62D0024, B62D0025, B62D0027, B62D0029, B62D0031, B62D0033, B62D0035, B62D0037, B62D0039, B62D0041, B62D0043, B62D0047, B62D0049, B62D0051, B62D0053, B62D0055, B62D0057, B62D0059, B62D0061, B62D0063, B62D0065, B62D0101, B62D0103, B62D0105, B62D0107, B62D0109, B62D0111, B62D0113, B62D0115, B62D0117, B62D0119, B62D0121, B62D0123, B62D0125, B62D0127, B62D0131, B62D0133, B62D0135, B62D0137, F02B, F02D, F02F, F02M, F02N, F02P
35	B60M, B60N, B60P, B60R, B60S, B60V, B60W, B61, B62B, B62C, B62H, B62J, B62K, B62L, B62M, B63, B64, B65G, B65H

NACE code	IPC code
36	A44C, A46, A47B, A47C, A47D, A47F, A63, G10
37	B09, B29B0017, B62D0067, B65D009030, B65F, C08J0011, C09K001101, C10G001710, C10G001908, C10G002128, C10G002512, C10G007323, C11B0013, C12F, C12S000302, C12S000304, C12S000306, C12S000308, C12S000310, C12S000312, C12S000314, C12S000316, C12S000318, D01C, D01F0013, D01G0011, G03G002110, H01B0015, H01J0009, H01M000652, H01M001054
45	C02, E01, E02B, E02C, E02D, E02F, E03B, E03C, E03D0001, E03D0003, E03D0005, E03D0007, E03D0009, E03F, E04B, E04C0001, E04C000202, E04C000224, E04C000226, E04C000228, E04C0002284, E04C0002288, E04C0002292, E04C0002296, E04C000230, E04C000232, E04C000234, E04C000236, E04C000238, E04C000240, E04C000242, E04C000252, E04C000254, E04C000302, E04C000328, E04C000329, E04C0003292, E04C0003293, E04C0003294, E04C000330, E04C000336, E04C000338, E04C000346, E04C000508, E04C000510, E04C000512, E04C000516, E04C000520, E04D, E04F0010, E04F001102, E04F0011022, E04F0011025, E04F0011028, E04F0011032, E04F0011035, E04F0011038, E04F001104, E04F001106, E04F001109, E04F0011104, E04F001116, E04F001117, E04F001118, E04F001302, E04F001304, E04F001306, E04F001307, E04F0013072, E04F0013073, E04F0013074, E04F0013075, E04F0013076, E04F0013077, E04F0013078, E04F001308, E04F001309, E04F001315, E04F001316, E04F001318, E04F001321, E04F001322, E04F001323, E04F001324, E04F001325, E04F001326, E04F001328, E04F001330, E04F001502, E04F0015022, E04F0015024, E04F001510, E04F001512, E04F001514, E04F001516, E04F001518, E04F001520, E04F001522, E04F0017, E04F0019, E04F0021, E04G, E04H, E06B000102, E06B000104, E06B000132, E06B000134, E06B000136, E06B000138, E06B000140, E06B000152, E06B000156, E06B000158, E06B000160, E06B000162, E06B000164, E06B000166, E06B000168, E06B000170, E06B000301, E06B000302, E06B000304, E06B000306, E06B000308, E06B000314, E06B000316, E06B000320, E06B000322, E06B000324, E06B000332, E06B000334, E06B000336, E06B000338, E06B000340, E06B000342, E06B000344, E06B000346, E06B000348, E06B000350, E06B000352, E06B000354, E06B000356, E06B000358, E06B000360, E06B000362, E06B000364, E06B000366, E06B0003663, E06B0003667, E06B000367, E06B0003673, E06B0003677, E06B000368, E06B000370, E06B000372, E06B000380, E06B000382, E06B000388, E06B000390, E06B000392, E06B000394, E06B000396, E06B0003964, E06B0003968, E06B0003972, E06B0003976, E06B000398, E06B0003984, E06B0003988, E06B000399, E06B000501, E06B000502, E06B000510, E06B000511, E06B000512, E06B000514, E06B000516, E06B000518, E06B000520, E06B0007, E06B0009, E06B0011, E06C, F17D

Source: proprietary study.

Annex No. 2

Table 34. Representation of the IPC in NACE (subsection level)©

NACE code	IPC code
AA	A01G0001, A01G0007, A01G0011, A01G0016, A01G0017, A01G0023, A01G0029, A01G0033, A01H, A01K0047, A01K0049, A01K0051, A01K0053, A01K0055, A01K0057, A01K0059, A01K0001, A01K0003, A01K0005, A01K0007, A01K0009, A01K0011, A01K0013, A01K0014, A01K0015, A01K0017, A01K0019, A01K0021, A01K0023, A01K0025, A01K0027, A01K0029, A01K0031, A01K0033, A01K0035, A01K0037, A01K0039, A01K0041, A01K0043, A01K0045, A01L, A01M
BA	A01K0061, A01K0063, A01K0065, A01K0067, A01K0069, A01K0071, A01K0073, A01K0074, A01K0075, A01K0077, A01K0079, A01K0080, A01K0081, A01K0083, A01K0085, A01K0087, A01K0089, A01K0091, A01K0093, A01K0095, A01K0097, A01K0099
CA	C10F, E21B, E21C0025, E21C0027, E21C0029, E21C0031, E21C0033, E21C0035, E21C0037, E21C0039, E21C004116, E21C004118, E21C004124, E21C004126, E21C004128, E21C004132, E21C0045, E21C004702, E21C004704, E21C004706, E21C004708, E21C0049, E21C0050, E21C0051, E21D, E21F
CB	E21C004120, E21C004122, E21C004130, E21C004710
DA	A01J001116, A01J0027, A01J0015, A01J0025, A21D, A22C, A23B, A23C, A23D, A23F, A23G, A23J, A23K, A23L, A24, B02, C11B0001, C11B0003, C11B0005, C11B0007, C11B0011, C11B0015, C11C, C12C, C12G, C12H, C12J, C12L, C12M, C12N, C12P, C12Q, C12R, C12S0001, C12S000320, C12S000322, C12S000324, C12S0005, C12S0007, C12S0009, C12S0011, C12S0099, C13
DB	A41, A42, A44B, A45B, B65D0030, B65D0033, D01B, D01D, D01F0001, D01F0002, D01F0004, D01F0006, D01F0008, D01F0009, D01F0011, D01G0001, D01G0003, D01G0005, D01G0007, D01G0009, D01G0013, D01G0015, D01G0017, D01G0019, D01G0021, D01G0023, D01G0025, D01G0027, D01G0029, D01G0031, D01G0033, D01G0035, D01H, D02, D03D0001, D03D0003, D03D0005, D03D0007, D03D0009, D03D0011, D03D0013, D03D0015, D03D0017, D03D0019, D03D0021, D03D0023, D03D0025, D03D0027, D04, D05, D06B, D06C, D06F, D06G, D06H, D06J, D06L0001, D06L0003, D06M, D06N, D06Q, D06P, D07
DC	A43B, A43C, A45C, A45F, B05D000712, B29D0035, B68B, B68C, B68F0001, B68G, C14
DD	B05D000706, B05D000708, B05D000710, B27D, B27F, B27H, B27J, B27K, B27L, B27M, B27N, B32B0021, B32B0037, B32B0038, B32B0039, B32B0041, B32B0043, B65D0019, E04C000210, E04C000212, E04C000214, E04C000216, E04C000218, E04C000312, E04C000314, E04C000316, E04C000317, E04C000318, E04C000342, E04F0011108, E04F001310, E04F001504, E06B000106, E06B000108, E06B000110, E06B000310, E06B000374, E06B000384, E06B000504
DE	B31, B32B0023, B32B0029, B41C, B41M, B42C, B42D, B42F, B65D0003, B65D0005, B65D0017, B65D0025, B65D0027, D21B, D21C, D21D, D21H, D21J, G03C000510, G03C000512, G06K, G11
DF	B32B0011, C10B0047, C10B0049, C10B0051, C10B0053, C10B0055, C10B0057, C10C, C10G0001, C10G0002, C10G0003, C10G0005, C10G0007, C10G0009, C10G0011, C10G0015, C10G001702, C10G001704, C10G001706, C10G001707, C10G001708, C10G0017085, C10G001709, C10G0017095, C10G001902, C10G001904, C10G001906, C10G0019067, C10G0019073, C10G002102, C10G002104, C10G002106, C10G002108, C10G002110, C10G002112, C10G002114, C10G002116, C10G002118, C10G002120, C10G002122, C10G002124, C10G002126, C10G002127, C10G002130, C10G002502, C10G002503, C10G002505, C10G002506, C10G002508, C10G002509, C10G002511, C10G0027, C10G0029, C10G0031, C10G0032, C10G0033, C10G0035, C10G0045, C10G0047, C10G0049, C10G0050, C10G0051, C10G0053, C10G0055, C10G0057, C10G0059, C10G0061, C10G0063, C10G0065, C10G0067, C10G0069, C10G0070, C10G0071, C10G007302, C10G007304, C10G007306, C10G007308, C10G007310, C10G007312, C10G007314, C10G007316, C10G007318, C10G007320, C10G007322, C10G007324, C10G007326, C10G007328, C10G007330, C10G007332, C10G007334, C10G007336, C10G007338, C10G007340, C10G007342, C10G007344, C10G0075, C10L, C10M, C10N, G21

NACE code	IPC code
DG	A01N, A01P, A45D, A61K, A61L, A61P, A61Q, A62D, B01D0001, B01D0003, B01D0007, B01D0009, B01D0011, B01D0012, B01D0015, B01D0017, B01D0019, B01D0021, B01D0024, B01D0025, B01D0027, B01D0029, B01D0033, B01D0035, B01D0036, B01D0037, B01D0039, B01D0041, B01D0043, B01D0045, B01D0046, B01D0047, B01D0049, B01D0051, B01D0053, B01D0057, B01D0059, B01D0061, B01D0063, B01D0065, B01D0067, B01D0069, B01D007102, B01D007104, B01D007106, B01D007108, B01D007110, B01D007112, B01D007114, B01D007116, B01D007118, B01D007120, B01D007122, B01D007126, B01D007128, B01D007130, B01D007132, B01D007134, B01D007136, B01D007138, B01D007140, B01D007142, B01D007144, B01D007146, B01D007148, B01D007150, B01D007152, B01D007154, B01D007156, B01D007158, B01D007160, B01D007162, B01D007164, B01D007166, B01D007168, B01D007170, B01D007172, B01D007174, B01D007176, B01D007178, B01D007180, B01D007182, B01F, B01J, B03D, B08, B29B0007, B29B0009, B29B0011, B29B0013, B29B0015, B29C, B29D0017, B29K0001, B29K0023, B29K0025, B29K0027, B29K0029, B29K0031, B29K0033, B29K0035, B29K0045, B29K0055, B29K0059, B29K0061, B29K0063, B29K0067, B29K0069, B29K0071, B29K0073, B29K0075, B29K0077, B29K0079, B29K0081, B29K0083, B29K0085, B29K0086, B29K0091, B29K0095, B29K0096, B29K0101, B29K0103, B29K0105, B29K0201, B29K0207, B29K0209, B29K0219, B29K0221, B29K0223, B29K0225, B29K0227, B29K0229, B29K0231, B29K0233, B29K0235, B29K0245, B29K0255, B29K0259, B29K0261, B29K0263, B29K0267, B29K0269, B29K0271, B29K0273, B29K0275, B29K0277, B29K0279, B29K0281, B29K0283, B29K0285, B29K0286, B29K0295, B29K0296, B29K0301, B29K0303, B29K0305, B29K0307, B29K0309, B29K0311, B29K0401, B29K0421, B29K0423, B29K0425, B29K0427, B29K0429, B29K0431, B29K0433, B29K0435, B29K0445, B29K0455, B29K0459, B29K0461, B29K0463, B29K0467, B29K0469, B29K0471, B29K0473, B29K0475, B29K0477, B29K0479, B29K0481, B29K0483, B29K0485, B29K0486, B29K0491, B29K0495, B29K0496, B29K0501, B29K0503, B29K0505, B29K0507, B29K0509, B29K0511, B29K0601, B29K0621, B29K0623, B29K0625, B29K0627, B29K0629, B29K0631, B29K0633, B29K0635, B29K0645, B29K0655, B29K0659, B29K0661, B29K0663, B29K0667, B29K0669, B29K0671, B29K0673, B29K0675, B29K0677, B29K0679, B29K0681, B29K0683, B29K0685, B29K0686, B29K0691, B29K0695, B29K0696, B29K0701, B29K0703, B29K0705, B29K0707, B29K0709, B29K0711, B29L, B32B0001, B32B0003, B32B0005, B32B0007, B32B0009, B32B0027, B32B0033, B65D0053, C01, C05, C06, C07, C08B, C08C, C08F, C08G, C08H, C08J0003, C08J0005, C08J0007, C08J0009, C08J0099, C08K, C08L, C08L0009, C08L0011, C08L0013, C08L0015, C08L0017, C08L0019, C08L0021, C08L002322, C08L005104, C09B, C09C, C09D, C09F, C09G, C09H, C09J, C09K0003, C09K0005, C09K0008, C09K0009, C09K001102, C09K001104, C09K001106, C09K001107, C09K001108, C09K001154, C09K001155, C09K001156, C09K001157, C09K001158, C09K001159, C09K001160, C09K001161, C09K001162, C09K001163, C09K001164, C09K001165, C09K001166, C09K001167, C09K001168, C09K001169, C09K001170, C09K001171, C09K001172, C09K001173, C09K001174, C09K001175, C09K001176, C09K001177, C09K001178, C09K001179, C09K001180, C09K001181, C09K001182, C09K001183, C09K001184, C09K001185, C09K001186, C09K001187, C09K001188, C09K001189, C09K0013, C09K0015, C09K0017, C09K0019, C09K0021, C09K0101, C09K0103, C09K0105, C09K0107, C09K0109, C10H, C10J, C10K, C11B0009, C11D, G03C0001, G03C000502, G03C000504, G03C000506, G03C000508, G03C000514, G03C000516, G03C000517, G03C000518, G03C000520, G03C000522, G03C000526, G03C000528, G03C000529, G03C000530, G03C0005305, G03C000531, G03C0005315, G03C000532, G03C000538, G03C000539, G03C0005395, G03C000540, G03C000542, G03C000544, G03C000546, G03C000548, G03C000550, G03C000556, G03C000558, G03C000560, G03C0007, G03C0008, G03C0009, G03C0011, F25J
DH	B29D0001, B29D0005, B29D0007, B29D0011, B29D0012, B29D0015, B29D0016, B29D0019, B29D0021, B29D0022, B29D0023, B29D0024, B29D0025, B29D0028, B29D0029, B29D0030, B29D0033, B29K0007, B29K0407, B29K0607, B29K0009, B29K0409, B29K0609, B29K0019, B29K0021, B29K0419, B29K0619, B32B0025, B60C, B65D0021, B65D0035, B65D0037, B65D0063, B65D0065, B65D0071, B65D0073, B65D0075, B65D0077, B65D0079, B65D0081, B65D0083, B65D0085, E04C000220, E04C000222, E04C000507, E06B000126, E06B000128, E06B000130, E06B000326, E06B000328, E06B000330, E06B000378, E06B000386
DI	A47K, B01L, B24D0003, B24D0005, B24D0009, B24D0007, B24D0011, B24D0013, B28, B32B0013, B32B0017, B32B0018, B32B0019, B44C, B65D0023, B65D0088, B65D009002, B65D009004, B65D009006, B65D009008, B65D009010, B65D009012, B65D009014, B65D009016, B65D009018, B65D009020, B65D009022, B65D009024, B65D009026, B65D009028, B65D009032, B65D009034, B65D009036, B65D009038, B65D009040, B65D009042, B65D009044, B65D009046, B65D009048, B65D009050, B65D009052, B65D009054, B65D009056, B65D009058, B65D009060, B65D009062, B65D009064, B65D009066, C03, C04, C22C0101, C30, C40, E03D0011, E03D0013, E04C000204, E04C000206, E04C000320, E04C000322, E04C000326, E04C000334, E04C000344, E04F0011116, E04F001314, E04F001508, E06B000124, E06B000318, E06B000508

NACE code	IPC code
DJ	B05D000714, B05D000716, B05D000718, B05D000720, B05D000722, B21B, B21C, B21D, B21F, B21G, B21H, B21J, B21K, B21K0011, B21L, B22D0001, B22D0003, B22D0007, B22D0011, B22D0013, B22D0015, B22D0017, B22D0018, B22D0019, B22D0021, B22D0023, B22D0025, B22D0027, B22D0029, B22D0030, B22D0031, B22D0043, B22F, B23B0001, B23B0035, B23B0037, B23G0007, B23G0009, B23H, B23K0001, B23K0005, B23K0007, B23K0009, B23K0010, B23K0011, B23K0013, B23K0015, B23K0017, B23K0020, B23K0023, B23K0025, B23K0026, B23K0028, B23K0031, B23K0033, B23K0101, B23K0103, B23P0005, B23P0006, B23P0009, B23P0011, B23P0013, B23P0015, B23P0017, B23P0025, B32B0015, B65D0001, B65D0006, B65D0008, B65D0013, B65D0039, B65D0041, B65D0043, B65D0045, B65D0047, B65D0049, B65D0050, B65D0051, B65D0055, B65D0057, B65D0059, B65D0061, B65D0067, B65D0069, C21, C22B0001, C22B0003, C22B0004, C22B0005, C22B0007, C22B0009, C22B0011, C22B0013, C22B0015, C22B0017, C22B0019, C22B0021, C22B0023, C22B0025, C22B0026, C22B0030, C22B0034, C22B0035, C22B0041, C22B0043, C22B0047, C22B0058, C22B0059, C22B0060, C22B0061, C22C0001, C22C0003, C22C0005, C22C0007, C22C0009, C22C0011, C22C0012, C22C0013, C22C0014, C22C0016, C22C0018, C22C0019, C22C0020, C22C0021, C22C0022, C22C0023, C22C0024, C22C0025, C22C0026, C22C0027, C22C0028, C22C0029, C22C0030, C22C0032, C22C0033, C22C0035, C22C0037, C22C0038, C22C0043, C22C0045, C22C0047, C22C0049, C22C0111, C22C0121, C22F, C23, E04C000208, E04C000304, E04C000306, E04C000307, E04C000308, E04C000309, E04C000310, E04C000311, E04C000332, E04C000340, E04C000501, E04C000502, E04C000503, E04C000504, E04C000506, E04C0005065, E04C000518, E04F0011112, E04F001312, E04F001506, E05, E06B000112, E06B000114, E06B000116, E06B000118, E06B000120, E06B000122, E06B000312, E06B000376, E06B000506, F16B, F16L, F16S, F17B, F17C, F22, F24B, F24C, F24D, F24H, F24J
DK	A01B, A01C, A01D, A01F, A01G0003, A01G0005, A01G0009, A01G0013, A01G0015, A01G0025, A01G0027, A01G0031, A01J0001, A01J0003, A01J0005, A01J0007, A01J0009, A01J0011, A01J0013, A01J0017, A01J0019, A01J0021, A01J0023, A21B, A21C, A22B, A23N, A23P, A43D, A47G, A47H, A47J, A47L, A61D, A61G, A62C, B01, B03B, B04, B05B, B05C, B05D0001, B05D0003, B05D0005, B05D000702, B05D000704, B05D000724, B05D000726, B06, B07, B22C, B22D0002, B22D0005, B22D0009, B22D0033, B22D0035, B22D0037, B22D0039, B22D0041, B22D0045, B22D0046, B22D0047, B23B0003, B23B0005, B23B0007, B23B0009, B23B0011, B23B0013, B23B0015, B23B0017, B23B0019, B23B0021, B23B0023, B23B0025, B23B0027, B23B0029, B23B0031, B23B0033, B23B0039, B23B0041, B23B0043, B23B0045, B23B0047, B23B0049, B23B0051, B23C0001, B23C0003, B23C0005, B23C0007, B23C0009, B23D, B23F, B23G0001, B23G0003, B23G0005, B23G0011, B23K0003, B23K0035, B23K0037, B23P0019, B23P0021, B23P0023, B23Q, B24, B25, B26, B27B, B27C, B27G, B30, B41B, B41D, B41F, B41G, B41K, B41N, B42B, B44B, B61D0001, B65B, B65C, B66, B68F0003, B67, B81, C10B0001, C10B0003, C10B0005, C10B0007, C10B0009, C10B0011, C10B0013, C10B0015, C10B0017, C10B0019, C10B0021, C10B0023, C10B0025, C10B0027, C10B0029, C10B0031, C10B0033, C10B0035, C10B0037, C10B0039, C10B0041, C10B0043, C10B0045, C25, D03C, D03D0029, D03D0031, D03D0033, D03D0035, D03D0037, D03D0039, D03D0041, D03D0043, D03D0045, D03D0047, D03D0049, D03D0051, D03J, D21F, D21G, F01, F02C, F02G, F02K, F03, F04, F15, F16C, F16D, F16F, F16G, F16H, F16J, F16K, F16M, F16N, F16P, F16T, F23, F24F, F25B, F25C, F25D, F26, F27, F28, F41, F42
DL	A61B, A61C, A61F, A61H, A61J, A61M, A61N, A62B, B03C, B41J, B41L, B43, B82, F21, G01, G02, G03B, G03C0003, G03D, G03F, G03G0005, G03G0007, G03G0008, G03G0009, G03G0011, G03G0013, G03G0015, G03G0016, G03G0017, G03G0019, G03G002102, G03G002104, G03G002106, G03G002108, G03G002112, G03G002114, G03G002116, G03G002118, G03G002120, G03H, G04, G05, G06C, G06D, G06E, G06F, G06G, G06J, G06M, G06N, G06Q, G06T, G07, G08, G12, H01B0001, H01B0003, H01B0005, H01B0007, H01B0009, H01B0011, H01B0012, H01B0013, H01B0017, H01B0019, H01C, H01F, H01G, H01H, H01J0001, H01J0003, H01J0005, H01J0007, H01J0011, H01J0013, H01J0015, H01J0017, H01J0019, H01J0021, H01J0023, H01J0025, H01J0027, H01J0029, H01J0031, H01J0033, H01J0035, H01J0037, H01J0040, H01J0041, H01J0043, H01J0045, H01J0047, H01J0049, H01J0061, H01J0063, H01J0065, H01K, H01L, H01M0002, H01M0004, H01M000602, H01M000604, H01M000606, H01M000608, H01M000610, H01M000612, H01M000614, H01M000616, H01M000618, H01M000620, H01M000622, H01M000624, H01M000626, H01M000628, H01M000630, H01M000632, H01M000634, H01M000636, H01M000638, H01M000640, H01M000642, H01M000644, H01M000646, H01M000648, H01M000650, H01M0008, H01M001002, H01M001004, H01M001005, H01M0010052, H01M00100525, H01M0010054, H01M0010056, H01M00100561, H01M00100562, H01M00100563, H01M00100564, H01M00100565, H01M00100566, H01M00100567, H01M00100568, H01M00100569, H01M0010058, H01M00100583, H01M00100585, H01M00100587, H01M001006, H01M001008, H01M001010, H01M001012, H01M001014, H01M001016, H01M001018, H01M001020, H01M001022, H01M001024, H01M001026, H01M001028, H01M001030, H01M001032, H01M001034, H01M001036, H01M001038, H01M001039, H01M001042, H01M001044, H01M001046, H01M001048, H01M001050, H01M001052, H01M0012, H01M0014, H01M0016, H01P, H01Q, H01R, H01S, H01T, H02B, H02G, H02H, H02J, H02K, H02M, H02N, H02P, H03, H04, H05

NACE code	IPC code
DM	B60B, B60D, B60F, B60G, B60H, B60J, B60K, B60L, B60M, B60N, B60P, B60Q, B60R, B60S, B60T, B60V, B60W, B61, B62B, B62C, B62D0001, B62D0003, B62D0005, B62D0006, B62D0007, B62D0009, B62D0011, B62D0012, B62D0013, B62D0015, B62D0017, B62D0019, B62D0021, B62D0023, B62D0024, B62D0025, B62D0027, B62D0029, B62D0031, B62D0033, B62D0035, B62D0037, B62D0039, B62D0041, B62D0043, B62D0047, B62D0049, B62D0051, B62D0053, B62D0055, B62D0057, B62D0059, B62D0061, B62D0063, B62D0065, B62D0101, B62D0103, B62D0105, B62D0107, B62D0109, B62D0111, B62D0113, B62D0115, B62D0117, B62D0119, B62D0121, B62D0123, B62D0125, B62D0127, B62D0131, B62D0133, B62D0135, B62D0137, B62H, B62J, B62K, B62L, B62M, B63, B64, B65G, B65H, F02B, F02D, F02F, F02M, F02N, F02P
DN	A44C, A46, A47B, A47C, A47D, A47F, A63, B09, B29B0017, B62D0067, B65D009030, B65F, C08J0011, C09K001101, C10G001710, C10G001908, C10G002128, C10G002512, C10G007323, C11B0013, C12F, C12S000302, C12S000304, C12S000306, C12S000308, C12S000310, C12S000312, C12S000314, C12S000316, C12S000318, D01C, D01F0013, D01G0011, G03G002110, G10, H01B0015, H01J0009, H01M000652, H01M001054
FA	C02, E01, E02B, E02C, E02D, E02F, E03B, E03C, E03D0001, E03D0003, E03D0005, E03D0007, E03D0009, E03F, E04B, E04C0001, E04C000202, E04C000224, E04C000226, E04C000228, E04C0002284, E04C0002288, E04C0002292, E04C0002296, E04C000230, E04C000232, E04C000234, E04C000236, E04C000238, E04C000240, E04C000242, E04C000252, E04C000254, E04C000302, E04C000328, E04C000329, E04C0003292, E04C0003293, E04C0003294, E04C000330, E04C000336, E04C000338, E04C000346, E04C000508, E04C000510, E04C000512, E04C000516, E04C000520, E04D, E04F0010, E04F001102, E04F0011022, E04F0011025, E04F0011028, E04F0011032, E04F0011035, E04F0011038, E04F001104, E04F001106, E04F001109, E04F0011104, E04F001116, E04F001117, E04F001118, E04F001302, E04F001304, E04F001306, E04F001307, E04F0013072, E04F0013073, E04F0013074, E04F0013075, E04F0013076, E04F0013077, E04F0013078, E04F001308, E04F001309, E04F001315, E04F001316, E04F001318, E04F001321, E04F001322, E04F001323, E04F001324, E04F001325, E04F001326, E04F001328, E04F001330, E04F001502, E04F0015022, E04F0015024, E04F001510, E04F001512, E04F001514, E04F001516, E04F001518, E04F001520, E04F001522, E04F0017, E04F0019, E04F0021, E04G, E04H, E06B000102, E06B000104, E06B000132, E06B000134, E06B000136, E06B000138, E06B000140, E06B000152, E06B000156, E06B000158, E06B000160, E06B000162, E06B000164, E06B000166, E06B000168, E06B000170, E06B000301, E06B000302, E06B000304, E06B000306, E06B000308, E06B000314, E06B000316, E06B000320, E06B000322, E06B000324, E06B000332, E06B000334, E06B000336, E06B000338, E06B000340, E06B000342, E06B000344, E06B000346, E06B000348, E06B000350, E06B000352, E06B000354, E06B000356, E06B000358, E06B000360, E06B000362, E06B000364, E06B000366, E06B0003663, E06B0003667, E06B000367, E06B0003673, E06B0003677, E06B000368, E06B000370, E06B000372, E06B000380, E06B000382, E06B000388, E06B000390, E06B000392, E06B000394, E06B000396, E06B0003964, E06B0003968, E06B0003972, E06B0003976, E06B000398, E06B0003984, E06B0003988, E06B000399, E06B000501, E06B000502, E06B000510, E06B000511, E06B000512, E06B000514, E06B000516, E06B000518, E06B000520, E06B0007, E06B0009, E06B0011, E06C, F17D

Source: proprietary study.

Notes to Annexes No. 1 and 2

Despite all the best efforts for precise identification of the IPC codes which would most completely map the NACE codes, some imprecision of matching occurs. The main ones are presented below as a list of divergences:

1. B650006, B650008, B650013 – common to packages (containers) made solely or in major part of metal, plastics, wood or substitute materials; nevertheless they were categorised as metal containers, NACE: 28.2.
2. B65D0019 – includes pallets made of wood, paper or plastics; despite that it was categorised as wooden containers 20.4.
3. B65D0017 – includes rigid or semirigid containers designed be opened by cutting; the description identifies the material as mostly paper, so the group is classified as NACE 21.25.
4. B65D0021 – includes nestable, stackable or joinable containers; the material is not identified, so the group was classified as NACE 25.24.
5. B65D0025 – includes details of other kinds or types of rigid or semi-rigid containers without identification of their material. Rigid and semi-rigid containers were classified as NACE 21.25.
6. B65D0039 – the group includes closures arranged within necks. The material was not identified; since the description includes operations of threading and bush shapes, the group was classified as NACE 28.75.
7. B65D0053 – includes sealings formed by liquid or plastic material; hence the group was classified as NACE 24.30.
8. B65D0059 – the group includes finished details, e.g. plugs, sleeves, caps, screws, and corner protectors; the material they are made of is not specified, so the group was classified as NACE 28.74.
9. B65D0071 – the description specifies arrangements of flexible binders, so the group was classified as NACE 25.24.
10. A01G0017 – includes cultivation of hops, vines, fruit trees, or like trees, as well as means applicable to such cultivation; nevertheless, the group was classified as NACE 01.1.
11. Manufacture of jet-propulsion plants (F02C) was classified as NACE 29.1 because the classification has no separate category for this manufacture type.
12. B43 – writing or drawing implements; bureau accessories were classified as NACE 30.0 by treating this group as broad office equipment; NACE has no separate group dedicated for this purpose.
13. H02J – circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy were classified as NACE 31.2, because they are strictly related to switching and control apparatus for generation of electric power. Nevertheless, the group can be classified as NACE 40.1 concerning construction of transmission grids and related service activities, since it applies to distribution of electric power.
14. B09 – disposal of solid waste; reclamation of contaminated soil – it is not a strict waste management area of NACE 37; however due to the fact that this IPC class is dedicated to activity related to waste without specification of waste types, it was classified as NACE 37.

15. B24 – grinding; polishing includes subclass 57 – devices for feeding, applying, grading or recovering grinding, polishing or lapping agents. Recovery of grinding materials cannot be explicitly separated, so the subgroup was not separately classified as NACE 37.
16. B60L0007 – braking by supplying regenerated power to the prime mover was not classified as NACE 37.
17. B60M0003 – feeding power to the supply lines in contact with collector on vehicles; arrangements for consuming regenerative power were not classified as NACE 37 due to the fact that recovery cannot be separated from this group.
18. C25C – processes for the electrolytic production, recovery or refining of metals; apparatus therefor – the subclass partly includes recovery processes common to derivation of materials. This subclass was not included in NACE 37 because it is not possible to separate the processes.
19. C12C, C12G, C12H, C12J, C12L, C12M, C12N, C12P, C12Q, C12R, C12S – apart from preparation of beverages, they include preparation of conditions for the production of beverages and pasteurisation processes; this was not classified separately, so the subclasses listed here were classified as NACE 15.9.
20. B67 – opening or closing bottles, jars or similar containers, liquid handling were classified as NACE 29 because of the lack of a separate item.
21. E06B000508 – trap-doors with fixed frames made of concrete, stone-like material, or plastics. This subgroup was classified as NACE 26.66 since it is not possible to separate concrete from plastics.
22. A62C – fire-fighting includes structures and installation for fire protection, as well as equipment and tools for fire extinguishing. NACE Rev. 1.1 75.25 classifies fire protection under the section of public administration (code LA), which means that it is construed rather as an activity than manufacture of fire-fighting equipment. Since the division of NACE Rev. 1.1 does not provide a separate item for manufacture of fire-fighting equipment, class A62C was assigned to NACE 29.5 – Manufacture of other special purpose machinery.
23. The IPC features classes, subclasses and groups which cover "topics not elsewhere classified". The codes were respectively included where NACE is described by an entire class, subclass or group. The remaining ICP codes which have not been assigned due to the necessary precision in the representation of the ICP in NACE total 27 items (A01J0099, A99Z, A99Z0099, B29D0099, B99Z, B99Z0099, C99, C99Z, C10G0099, C99Z0099, D99, D99Z, D01G0099, D99Z0099, E99, E99Z, E99Z0099, F99, F99Z, F99Z0099, G99, G99Z, G99Z0099, H01J0099, H99, H99Z, H99Z0099). They make for 0.045% of all ICP codes. Moreover, the analysed database of patent applications features one patent application which falls into the specified ICP codes titled "Personal cryostatic chamber", filed in Spain in 2007. It is hence assumed that omitting this patent application does not affect the quality of analysis.

Annex No. 3

Table 35. Description of sections, classes and subclassess of the IPC

IPC code	Designation
Section A	Human necessities
A01	Agriculture; forestry; animal husbandry; hunting; trapping; fishing
A01B	Soil working in agriculture or forestry; parts, details, or accessories of agricultural machines or implements, in general
A01C	Planting; sowing; fertilising
A01D	Harvesting; mowing
A01F	Threshing; baling of straw, hay or the like; stationary apparatus or hand tools for forming or binding straw, hay or the like into bundles; cutting of straw, hay or the like; storing agricultural or horticultural produce
A01G	Horticulture; cultivation of vegetables, flowers, rice, fruit, vines, hops, or seaweed; forestry; watering
A01H	New plants or processes for obtaining them; plant reproduction by tissue culture techniques
A01J	Manufacture of dairy products
A01K	Animal husbandry; care of birds, fishes, insects; fishing; rearing or breeding animals, not otherwise provided for; new breeds of animals
A01L	Shoeing of animals
A01M	Catching, trapping or scaring of animals; apparatus for the destruction of noxious animals or noxious plants
A01N	Preservation of bodies of humans or animals or plants or parts thereof; biocides, e.g. as disinfectants, as pesticides or as herbicides; pest repellants or attractants; plant growth regulators
A01P	Biocidal, pest repellant, pest attractant or plant growth regulatory activity of chemical compounds or preparations
A21	Baking; equipment for making or processing doughs; doughs for baking
A21B	Bakers' ovens; machines or equipment for baking
A21C	Machines or equipment for making or processing doughs; handling baked articles made from dough
A21D	Treatment, e.g. preservation, of flour or dough for baking, e.g. by addition of materials; baking; bakery products; preservation thereof
A22	Butchering; meat treatment; processing poultry or fish
A22B	Slaughtering
A22C	Processing meat, poultry, or fish
A23	Foods or foodstuffs; their treatment, not covered by other classes
A23B	Preserving, e.g. by canning, meat, fish, eggs, fruit, vegetables, edible seeds; chemical ripening of fruit or vegetables; the preserved, ripened, or canned products
A23C	Dairy products, e.g. milk, butter, cheese; milk or cheese substitutes; making thereof
A23D	Edible oils or fats, e.g. margarines, shortenings, cooking oils
A23F	Coffee; tea; their substitutes; manufacture, preparation, or infusion thereof
A23G	Cocoa; cocoa products, e.g. chocolate; substitutes for cocoa or cocoa products; confectionery; chewing gum; ice-cream; preparation thereof
A23J	Protein compositions for foodstuffs; working-up proteins for foodstuffs; phosphatide compositions for foodstuffs
A23K	Feeding-stuffs
A23L	Foods, foodstuffs, or non-alcoholic beverages, not covered by subclasses a21d or a23b-a23j; their preparation or treatment, e.g. cooking, modification of nutritive qualities, physical treatment; preservation of foods or foodstuffs, in general
A23N	Machines or apparatus for treating harvested fruit, vegetables, or flower bulbs in bulk, not otherwise provided for; peeling vegetables or fruit in bulk; apparatus for preparing animal feeding-stuffs
A23P	Shaping or working of foodstuffs, not fully covered by a single other subclass
A24	Tobacco; cigars; cigarettes; smokers' requisites
A24B	Manufacture or preparation of tobacco for smoking or chewing; tobacco; snuff
A24C	Machines for making cigars or cigarettes
A24D	Cigars; cigarettes; tobacco smoke filters; mouthpieces for cigars or cigarettes; manufacture of tobacco smoke filters or mouthpieces
A24F	Smokers' requisites; match boxes

IPC code	Designation
A41	Wearing apparel
A41B	Shirts; underwear; baby linen; handkerchiefs
A41C	Corsets; brassières
A41D	Outerwear; protective garments; accessories
A41F	Garment fastenings; suspenders
A41G	Artificial flowers; wigs; masks; feathers
A41H	Appliances or methods for making clothes, e.g. for dress-making, for tailoring, not otherwise provided for
A42	Headwear
A42B	Hats; head coverings
A42C	Manufacturing or trimming hats or other head coverings
A43	Footwear
A43B	Characteristic features of footwear; parts of footwear
A43C	Fastenings or attachments for footwear; laces in general
A43D	Machines, tools, equipment or methods for manufacturing or repairing footwear
A44	Haberdashery; jewellery
A44B	Buttons, pins, buckles, slide fasteners, or the like
A44C	Jewellery; bracelets; other personal adornments; coins
A45	Hand or travelling articles
A45B	Walking sticks; umbrellas; ladies' or like fans
A45C	Purses; luggage; hand carried bags
A45D	Hairdressing or shaving equipment; manicuring or other cosmetic treatment
A45F	Travelling or camp equipment; sacks or packs carried on the body
A46	Brushware
A46B	Brushes
A46D	Manufacture of brushes
A47	Furniture; domestic articles or appliances; coffee mills; spice mills; suction cleaners in general
A47B	Tables; desks; office furniture; cabinets; drawers; general details of furniture
A47C	Chairs; sofas; beds
A47D	Furniture specially adapted for children
A47F	Special furniture, fittings, or accessories for shops, storehouses, bars, restaurants, or the like; paying counters
A47G	Household or table equipment
A47H	Furnishings for windows or doors
A47J	Kitchen equipment; coffee mills; spice mills; apparatus for making beverages
A47K	Sanitary equipment not otherwise provided for; toilet accessories
A47L	Domestic washing or cleaning; suction cleaners in general
A61	Medical or veterinary science; hygiene
A61B	Diagnosis; surgery; identification
A61C	Dentistry; apparatus or methods for oral or dental hygiene
A61D	Veterinary instruments, implements, tools, or methods
A61F	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body, e.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
A61G	Transport, personal conveyances, or accommodation specially adapted for patients or disabled persons; operating tables or chairs; chairs for dentistry; funeral devices
A61H	Physical therapy apparatus, e.g. devices for locating or stimulating reflex points in the body; artificial respiration; massage; bathing devices for special therapeutic or hygienic purposes or specific parts of the body
A61J	Containers specially adapted for medical or pharmaceutical purposes; devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms; devices for administering food or medicines orally; baby comforters; devices for receiving spittle
A61K	Preparations for medical, dental, or toilet purposes

IPC code	Designation
A61L	Methods or apparatus for sterilising materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles
A61M	Devices for introducing media into, or onto, the body; devices for transducing body media or for taking media from the body; devices for producing or ending sleep or stupor
A61N	Electrotherapy; magnetotherapy; radiation therapy; ultrasound therapy
A61P	Specific therapeutic activity of chemical compounds or medicinal preparations
A61Q	Specific use of cosmetics or similar toilet preparations
A62	Life-saving; fire-fighting
A62B	Devices, apparatus or methods for life-saving
A62C	Fire-fighting
A62D	Chemical means for extinguishing fires; processes for making harmful chemical substances harmless, or less harmful, by effecting a chemical change; composition of materials for coverings or clothing for protecting against harmful chemical agents; composition of materials for transparent parts of gas-masks, respirators, breathing bags or helmets; composition of chemical materials for use in breathing apparatus
A63	Sports; games; amusements
A63B	Apparatus for physical training, gymnastics, swimming, climbing, or fencing; ball games; training equipment
A63C	Skates; skis; roller skates; design or layout of courts, rinks or the like
A63D	Bowling-alleys; bowling games; boccia; bowls; bagatelle; billiards
A63F	Card, board, or roulette games; indoor games using small moving playing bodies; games not otherwise provided for
A63G	Merry-go-rounds; swings; rocking-horses; chutes; switchbacks; similar devices for public amusement
A63H	Toys, e.g. tops, dolls, hoops, building blocks
A63J	Devices for theatres, circuses, or the like; conjuring appliances or the like
A63K	Racing; riding sports; equipment or accessories therefor
A99	Subject matter not otherwise provided for in section A
A99Z	Subject matter not otherwise provided for in section A
Section B	Performing operations; Transporting
B01	Physical or chemical processes or apparatus in general
B01B	Boiling; boiling apparatus
B01D	Separation
B01F	Mixing, e.g. dissolving, emulsifying, dispersing
B01J	Chemical or physical processes, e.g. catalysis, colloid chemistry; their relevant apparatus
B01L	Chemical or physical laboratory apparatus for general use
B02	Crushing, pulverising, or disintegrating; preparatory treatment of grain for milling
B02B	Preparing grain for milling; refining granular fruit to commercial products by working the surface
B02C	Crushing, pulverising, or disintegrating in general; milling grain
B03	Separation of solid materials using liquids or using pneumatic tables or jigs; magnetic or electrostatic separation of solid materials from solid materials or fluids; separation by high-voltage electric fields
B03B	Separating solid materials using liquids or using pneumatic tables or jigs
B03C	Magnetic or electrostatic separation of solid materials from solid materials or fluids; separation by high-voltage electric fields
B03D	Flotation; differential sedimentation
B04	Centrifugal apparatus or machines for carrying-out physical or chemical processes
B04B	Centrifuges
B04C	Apparatus using free vortex flow, e.g. cyclones
B05	Spraying or atomising in general; applying liquids or other fluent materials to surfaces, in general
B05B	Spraying apparatus; atomising apparatus; nozzles
B05C	Apparatus for applying liquids or other fluent materials to surfaces, in general
B05D	Processes for applying liquids or other fluent materials to surfaces, in general
B06	Generating or transmitting mechanical vibrations in general

IPC code	Designation
B06B	Generating or transmitting mechanical vibrations in general
B07	Separating solids from solids; sorting
B07B	Separating solids from solids by sieving, screening, or sifting or by using gas currents; other separating by dry methods applicable to bulk material, e.g. loose articles fit to be handled like bulk material
B07C	Postal sorting; sorting individual articles, or bulk material fit to be sorted piece-meal, e.g. by picking
B08	Cleaning
B08B	Cleaning in general; prevention of fouling in general
B09	Disposal of solid waste; reclamation of contaminated soil
B09B	Disposal of solid waste
B09C	Reclamation of contaminated soil
B21	Mechanical metal-working without essentially removing material; punching metal
B21B	Rolling of metal
B21C	Manufacture of metal sheets, wire, rods, tubes, profiles or like semi-manufactured products otherwise than by rolling; auxiliary operations used in connection with metal-working without essentially removing material
B21D	Working or processing of sheet metal or metal tubes, rods or profiles without essentially removing material; punching
B21F	Working or processing of wire
B21G	Making needles, pins, or nails
B21H	Making particular metal objects by rolling, e.g. screws, wheels, rings, barrels, balls
B21J	Forging; hammering; pressing; riveting; forge furnaces
B21K	Making forged or pressed products, e.g. horse-shoes, rivets, bolts, wheels
B21L	Making chains
B22	Casting; powder metallurgy
B22C	Foundry moulding
B22D	Casting of metals; casting of other substances by the same processes or devices
B22F	Working metallic powder; manufacture of articles from metallic powder; making metallic powder
B23	Machine tools; metal-working not otherwise provided for
B23B	Turning; boring
B23C	Milling
B23D	Planning; slotting; shearing; broaching; sawing; filing; scraping; like operations for working metal by removing material, not otherwise provided for
B23F	Making gears or toothed racks
B23G	Thread cutting; working of screws, bolt heads, or nuts, in conjunction therewith
B23H	Working of metal by the action of a high concentration of electric current on a workpiece using an electrode which takes the place of a tool; such working combined with other forms of working of metal
B23K	Soldering or unsoldering; welding; cladding or plating by soldering or welding; cutting by applying heat locally, e.g. flame cutting; working by laser beam
B23P	Other working of metal; combined operations; universal machine tools
B23Q	Details, components, or accessories for machine tools, e.g. arrangements for copying or controlling; machine tools in general, characterised by the construction of particular details or components; combinations or associations of metal-working machines, not directed to a particular result
B24	Grinding; polishing
B24B	Machines, devices, or processes for grinding or polishing; dressing or conditioning of abrading surfaces; feeding of grinding, polishing, or lapping agents
B24C	Abrasive or related blasting with particulate material
B24D	Tools for grinding, buffing or sharpening
B25	Hand tools; portable power-driven tools; handles for hand implements; workshop equipment; manipulators
B25B	Tools or bench devices not otherwise provided for, for fastening, connecting, disengaging, or holding
B25C	Hand-held nailing or stapling tools; manually-operated portable stapling tools
B25D	Percussive tools

IPC code	Designation
B25F	Combination or multi-purpose tools not otherwise provided for; details or components of portable power-driven tools not particularly related to the operations performed and not otherwise provided for
B25G	Handles for hand implements
B25H	Workshop equipment, e.g. for marking-out work; storage means for workshops
B25J	Manipulators; chambers provided with manipulation devices
B26	Hand cutting tools; cutting; severing
B26B	Hand-held cutting tools not otherwise provided for
B26D	Cutting; details common to machines for severing, e.g. by cutting, perforating, punching, stamping-out
B26F	Perforating; punching; cutting-out; stamping-out; severing by means other than cutting
B27	Working or preserving wood or similar material; nailing or stapling machines in general
B27B	Saws; components or accessories therefor
B27C	Planning, drilling, milling, turning, or universal machines
B27D	Working veneer or plywood
B27F	Dovetailed work; tenons; slotting machines; nailing or stapling machines
B27G	Accessory machines or apparatus; tools; safety devices, e.g. for saws
B27H	Bending; cooperage; wheel-making
B27J	Mechanical working of cane, cork, or similar materials
B27K	Processes, apparatus or selection of substances for impregnating, staining, dyeing or bleaching of wood, or for treating of wood with permeant liquids, not otherwise provided for; chemical or physical treatment of cork, cane, reed, straw or similar materials
B27L	Removing bark or vestiges of branches; splitting wood; manufacture of veneer, wooden sticks, wood shavings, wood fibres or wood powder
B27M	Working of wood not provided for in subclasses B27B-B27L; manufacture of specific wooden articles
B27N	Manufacture by dry processes of articles, with or without organic binding agents, made from particles or fibres consisting of wood or other lignocellulosic or like organic material
B28	Working cement, clay, or stone
B28B	Shaping clay or other ceramic compositions, slag or mixtures containing cementitious material, e.g. plaster
B28C	Preparing clay; producing mixtures containing clay or cementitious material, e.g. plaster
B28D	Working stone or stone-like materials
B29	Working of plastics; working of substances in a plastic state in general
B29B	Preparation or pretreatment of the material to be shaped; making granules or preforms; recovery of plastics or other constituents of waste material containing plastics
B29C	Shaping or joining of plastics; shaping of substances in a plastic state, in general; after- treatment of the shaped products, e.g. repairing
B29D	Producing particular articles from plastics or from substances in a plastic state
B29K	Indexing scheme associated with subclasses B29B, B29C or B29D, relating to moulding materials or to materials for reinforcements, fillers or preformed parts, e.g. inserts
B29L	Indexing scheme associated with subclass B29C, relating to particular articles
B30	Presses
B30B	Presses in general; presses not otherwise provided for
B31	Making paper articles; working paper
B31B	Making boxes, cartons, envelopes, or bags
B31C	Making wound articles, e.g. wound tubes
B31D	Making other paper articles
B31F	Mechanical working or deformation of paper or cardboard
B32	Layered products
B32B	Layered products, i.e. products built-up of strata of flat or non-flat, e.g. cellular or honeycomb, form
B41	Printing; lining machines; typewriters; stamps
B41B	Machines or accessories for making, setting, or distributing type; type; photographic or photoelectronic composing devices
B41C	Processes for the manufacture or reproduction of printing surfaces

IPC code	Designation
B41D	Apparatus for the mechanical reproduction of printing surfaces for stereotype printing; shaping elastic or deformable material to form printing surfaces
B41F	Printing machines or presses
B41G	Apparatus for bronze printing, line printing, or for bordering or edging sheets or like articles; auxiliary apparatus for perforating in conjunction with printing
B41J	Typewriters; selective printing mechanisms, i.e. mechanisms printing otherwise than from a forme; correction of typographical errors
B41K	Stamps; stamping or numbering apparatus or devices
B41L	Apparatus or devices for manifolding, duplicating, or printing for office or other commercial purposes; addressing machines or like series-printing machines
B41M	Printing, duplicating, marking, or copying processes; colour printing
B41N	Printing plates or foils; materials for surfaces used in printing machines for printing, inking, damping, or the like; preparing such surfaces for use or conserving them
B42	Bookbinding; albums; files; special printed matter
B42B	Permanently attaching together sheets, quires, or signatures, or permanently attaching objects thereto
B42C	Bookbinding
B42D	Books; book covers; loose leaves; printed matter of special format or style not otherwise provided for; devices for use therewith; movable-strip writing or reading apparatus
B42F	Sheets temporarily attached together; filing appliances; file cards; indexing
B43	Writing or drawing implements; bureau accessories
B43K	Implements for writing or drawing
B43L	Articles for writing or drawing upon; accessories for writing or drawing
B43M	Bureau accessories not otherwise provided for
B44	Decorative arts
B44B	Machines, apparatus, or tools for artistic work, e.g. for sculpturing, guilloching, carving, branding, inlaying
B44C	Producing decorative effects
B44D	Painting or artistic drawing, not otherwise provided for; preserving paintings; surface treatment to obtain special artistic surface effects or finishes
B44F	Special designs or pictures
B60	Vehicles in general
B60B	Vehicle wheels; castors; axles; increasing wheel adhesion
B60C	Vehicle tyres; tyre inflation; tyre changing; connecting valves to inflatable elastic bodies in general; devices or arrangements related to tyres
B60D	Vehicle connections
B60F	Vehicles for use both on rail and on road; vehicles capable of travelling in or on different media, e.g. amphibious vehicles
B60G	Vehicle suspension arrangements
B60H	Arrangements or adaptations of heating, cooling, ventilating, or other air-treating devices specially for passenger or goods spaces of vehicles
B60J	Windows, windscreens, non-fixed roofs, doors, or similar devices for vehicles; removable external protective coverings specially adapted for vehicles
B60K	Arrangement or mounting of propulsion units or of transmissions in vehicles; arrangement or mounting of plural diverse prime-movers; auxiliary drives; instrumentation or dashboards for vehicles; arrangements in connection with cooling, air intake, gas exhaust, or fuel supply, of propulsion units, in vehicles
B60L	Propulsion of electrically-propelled vehicles; supplying electric power for auxiliary equipment of electrically-propelled vehicles; electrodynamic brake systems for vehicles in general; magnetic suspension or levitation for vehicles; monitoring operating variables of electrically-propelled vehicles; electric safety devices for electrically-propelled vehicles
B60M	Power supply lines, or devices along rails, for electrically-propelled vehicles
B60N	Vehicle passenger accommodation not otherwise provided for
B60P	Vehicles adapted for load transportation or to transport, to carry, or to comprise special loads or objects
B60Q	Arrangement of signalling or lighting devices, the mounting or supporting thereof or circuits therefor, for vehicles in general

IPC code	Designation
B60R	Vehicles, vehicle fittings, or vehicle parts, not otherwise provided for
B60S	Servicing, cleaning, repairing, supporting, lifting, or manoeuvring of vehicles, not otherwise provided for
B60T	Vehicle brake control systems or parts thereof; brake control systems or parts thereof, in general; arrangement of braking elements on vehicles in general; portable devices for preventing unwanted movement of vehicles; vehicle modifications to facilitate cooling of brakes
B60V	Air-cushion vehicles
B60W	Conjoint control of vehicle sub-units of different type or different function; control systems specially adapted for hybrid vehicles; road vehicle drive control systems for purposes not related to the control of a particular sub-unit
B61	Railways
B61B	Railway systems; equipment therefor not otherwise provided for
B61C	Locomotives; motor railcars
B61D	Body details or kinds of railway vehicles
B61F	Rail vehicle suspensions, e.g. underframes, bogies, arrangements of wheel axles; rail vehicles for use on tracks of different width; preventing derailing; wheels guards; obstruction removers or the like
B61G	Couplings specially adapted for railway vehicles; draught or buffing appliances specially adapted for railway vehicles
B61H	Brakes or other retarding apparatus peculiar to rail vehicles; arrangements or dis-positions of brakes or other retarding apparatus in rail vehicles
B61J	Shifting or shunting of rail vehicles
B61K	Other auxiliary equipment for railways
B61L	Guiding railway traffic; ensuring the safety of railway traffic
B62	Land vehicles for travelling otherwise than on rails
B62B	Hand-propelled vehicles, e.g. hand carts or perambulators; sledges
B62C	Vehicles drawn by animals
B62D	Motor vehicles; trailers
B62H	Cycle stands; supports or holders for parking or storing cycles; appliances preventing or indicating unauthorised use or theft of cycles; locks integral with cycles; devices for learning to ride cycles
B62J	Cycle saddles or seats; accessories peculiar to cycles and not otherwise provided for, e.g. article carriers or cycle protectors
B62K	Cycles; cycle frames; cycle steering devices; rider-operated terminal controls specially adapted for cycles; cycle axle suspensions; cycle sidecars, forecars, or the like
B62L	Brakes specially adapted for cycles
B62M	Rider propulsion of wheeled vehicles or sledges; powered propulsion of sledges or cycles; transmissions specially adapted for such vehicles
B63	Ships or other waterborne vessels; related equipment
B63B	Ships or other waterborne vessels; equipment for shipping
B63C	Launching, hauling-out, or dry-docking of vessels; life-saving in water; equipment for dwelling or working under water; means for salvaging or searching for underwater objects
B63G	Offensive or defensive arrangements on vessels; mine-laying; mine-sweeping; submarines; aircraft carriers
B63H	Marine propulsion or steering
B63J	Auxiliaries on vessels
B64	Aircraft; aviation; cosmonautics
B64B	Lighter-than-air aircraft
B64C	Aeroplanes; helicopters
B64D	Equipment for fitting in or to aircraft; flying suits; parachutes; arrangements or mounting of power plants or propulsion transmissions
B64F	Ground or aircraft-carrier-deck installations
B64G	Cosmonautics; vehicles or equipment therefor
B65	Conveying, packing, storing, handling thin or filamentary material
B65B	Machines, apparatus or devices for, or methods of, packaging articles or materials; unpacking
B65C	Labelling or tagging machines, apparatus, or processes

IPC code	Designation
B65D	Containers for storage or transport of articles or materials, e.g. bags, barrels, bottles, boxes, cans, cartons, crates, drums, jars, tanks, hoppers, forwarding containers; accessories, closures, or fittings therefor; packaging elements; packages
B65F	Gathering or removal of domestic or like refuse
B65G	Transport or storage devices, e.g. conveyers for loading or tipping; shop conveyer systems; pneumatic tube conveyers
B65H	Handling thin or filamentary material, e.g. sheets, webs, cables
B66	Hoisting; lifting; hauling
B66B	Elevators; escalators or moving walkways
B66C	Cranes; load-engaging elements or devices for cranes, capstans, winches, or tackles
B66D	Capstans; winches; tackles, e.g. pulley blocks; hoists
B66F	Hoisting, lifting, hauling, or pushing, not otherwise provided for, e.g. devices which apply a lifting or pushing force directly to the surface of a load
B67	Opening or closing bottles, jars or similar containers; liquid handling
B67B	Applying closure members to bottles, jars, or similar containers; opening closed containers
B67C	Filling with liquids or semiliquids, or emptying, of bottles, jars, cans, casks, barrels, or similar containers, not otherwise provided for; funnels
B67D	Dispensing, delivering, or transferring liquids, not otherwise provided for
B68	Saddlery; upholstery
B68B	Harness; devices used in connection therewith; whips or the like
B68C	Saddles; stirrups
B68F	Making articles from leather, canvas, or the like
B68G	Methods, equipment, or machines for use in upholstering; upholstery not otherwise provided for
B81	Micro-structural technology
B81B	Micro-structural devices or systems, e.g. micro-mechanical devices
B81C	Processes or apparatus specially adapted for the manufacture or treatment of micro-structural devices or systems
B82	Nano-technology
B82B	Nano-structures formed by manipulation of individual atoms, molecules, or limited collections of atoms or molecules as discrete units; manufacture or treatment thereof
B82Y	Specific uses or applications of nano-structures; measurement or analysis of nano-structures; manufacture or treatment of nano-structures
B99	Subject matter not otherwise provided for in section B
B99Z	Subject matter not otherwise provided for in section B
Section C	Chemistry; metallurgy
C01	Inorganic chemistry
C01B	Non-metallic elements; compounds thereof
C01C	Ammonia; cyanogen; compounds thereof
C01D	Compounds of alkali metals, i.e. lithium, sodium, potassium, rubidium, caesium, or francium
C01F	Compounds of the metals beryllium, magnesium, aluminium, calcium, strontium, barium, radium, thorium, or of the rare-earth metals
C01G	Compounds containing metals not covered by subclasses C01D or C01F
C02	Treatment of water, waste water, sewage, or sludge
C02F	Treatment of water, waste water, sewage, or sludge
C03	Glass; mineral or slag wool
C03B	Manufacture or shaping of glass, or of mineral or slag wool; supplementary processes in the manufacture or shaping of glass, or of mineral or slag wool
C03C	Chemical composition of glasses, glazes, or vitreous enamels; surface treatment of glass; surface treatment of fibres or filaments from glass, minerals or slags; joining glass to glass or other materials
C04	Cements; concrete; artificial stone; ceramics; refractories
C04B	Lime; magnesia; slag; cements; compositions thereof, e.g. mortars, concrete or like building materials; artificial stone; ceramics; refractories; treatment of natural stone

IPC code	Designation
C05	Fertilisers; manufacture thereof
C05B	Phosphatic fertilisers
C05C	Nitrogenous fertilisers
C05D	Inorganic fertilisers not covered by subclasses C05B, C05C; fertilisers producing carbon dioxide
C05F	Organic fertilisers not covered by subclasses C05B, C05C, e.g. fertilisers from waste or refuse
C05G	Mixtures of fertilisers covered individually by different subclasses of class C05; mixtures of one or more fertilisers with materials not having a specific fertilising activity, e.g. pesticides, soil-conditioners, wetting agents; fertilisers characterised by their form
C06	Explosives; matches
C06B	Explosive or thermic compositions; manufacture thereof; use of single substances as explosives
C06C	Detonating or priming devices; fuses; chemical lighters; pyrophoric compositions
C06D	Means for generating smoke or mist; gas-attack compositions; generation of gas for blasting or propulsion (chemical part)
C06F	Matches; manufacture of matches
C07	Organic chemistry
C07B	General methods of organic chemistry; apparatus therefor
C07C	Acyclic or carbocyclic compounds
C07D	Heterocyclic compounds
C07F	Acyclic, carbocyclic, or heterocyclic compounds containing elements other than carbon, hydrogen, halogen, oxygen, nitrogen, sulfur, selenium or tellurium
C07G	Compounds of unknown constitution
C07H	Sugars; derivatives thereof; nucleosides; nucleotides; nucleic acids
C07J	Steroids
C07K	Peptides
C08	Organic macromolecular compounds; their preparation or chemical working-up; compositions based thereon
C08B	Polysaccharides; derivatives thereof
C08C	Treatment or chemical modification of rubbers
C08F	Macromolecular compounds obtained by reactions only involving carbon-to-carbon unsaturated bonds
C08G	Macromolecular compounds obtained otherwise than by reactions only involving carbon-to-carbon unsaturated bonds
C08H	Derivatives of natural macromolecular compounds
C08J	Working-up; general processes of compounding; after-treatment not covered by subclasses C08B, C08C, C08F, C08G or C08H
C08K	Use of inorganic or non-macromolecular organic substances as compounding ingredients
C08L	Compositions of macromolecular compounds
C09	Dyes; paints; polishes; natural resins; adhesives; compositions not otherwise provided for; applications of materials not otherwise provided for
C09B	Organic dyes or closely-related compounds for producing dyes; mordants; lakes
C09C	Treatment of inorganic materials, other than fibrous fillers, to enhance their pigmenting or filling properties; preparation of carbon black
C09D	Coating compositions, e.g. paints, varnishes or lacquers; filling pastes; chemical paint or ink removers; inks; correcting fluids; woodstains; pastes or solids for colouring or printing; use of materials therefor
C09F	Natural resins; french polish; drying-oils; driers (siccatives); turpentine
C09G	Polishing compositions other than french polish; ski waxes
C09H	Preparation of glue or gelatine
C09J	Adhesives; non-mechanical aspects of adhesive processes in general; adhesive processes not provided for elsewhere; use of materials as adhesives
C09K	Materials for applications not otherwise provided for; applications of materials not otherwise provided for
C10	Petroleum, gas or coke industries; technical gases containing carbon monoxide; fuels; lubricants; peat
C10B	Destructive distillation of carbonaceous materials for production of gas, coke, tar, or similar materials
C10C	Working-up tar, pitch, asphalt, bitumen; pyroligneous acid

IPC code	Designation
C10F	Drying or working-up of peat
C10G	Cracking hydrocarbon oils; production of liquid hydrocarbon mixtures, e.g. by destructive hydrogenation, oligomerisation, polymerisation; recovery of hydrocarbon oils from oil-shale, oil-sand, or gases; refining mixtures mainly consisting of hydrocarbons; reforming of naphtha; mineral waxes
C10H	Production of acetylene by wet methods
C10J	Production of gases containing carbon monoxide and hydrogen from solid carbonaceous materials by partial oxidation processes involving oxygen or steam ; carburetting air or other gases
C10K	Purifying or modifying the chemical composition of combustible gases containing carbon monoxide
C10L	Fuels not otherwise provided for; natural gas; synthetic natural gas obtained by processes not covered by subclasses C10G or C10K; liquefied petroleum gas; use of additives to fuels or fires; fire-lighters
C10M	Lubricating compositions; use of chemical substances either alone or as lubricating ingredients in a lubricating composition
C10N	Indexing scheme associated with subclass C10M
C11	Animal or vegetable oils, fats, fatty substances or waxes; fatty acids therefrom; detergents; candles
C11B	Producing, e.g. by pressing raw materials or by extraction from waste materials, refining or preserving fats, fatty substances, e.g. lanolin, fatty oils or waxes; essential oils; perfumes
C11C	Fatty acids from fats, oils or waxes; candles; fats, oils or fatty acids by chemical modification of fats, oils, or fatty acids obtained therefrom
C11D	Detergent compositions; use of single substances as detergents; soap or soap-making; resin soaps; recovery of glycerol
C12	Biochemistry; beer; spirits; wine; vinegar; microbiology; enzymology; mutation or genetic engineering
C12C	Brewing of beer
C12F	Recovery of by-products of fermented solutions; denaturing of, or denatured, alcohol
C12G	Wine; other alcoholic beverages; preparation thereof
C12H	Pasteurisation, sterilisation, preservation, purification, clarification, ageing of alcoholic beverages or removal of alcohol therefrom
C12J	Vinegar; its preparation
C12L	Pitching or depitching machines; cellar tools
C12M	Apparatus for enzymology or microbiology
C12N	Micro-organisms or enzymes; compositions thereof; propagating, preserving, or maintaining micro-organisms; mutation or genetic engineering; culture media
C12P	Fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture
C12Q	Measuring or testing processes involving enzymes or micro-organisms; compositions or test papers therefor; processes of preparing such compositions; condition-responsive control in microbiological or enzymological processes
C12R	Indexing scheme associated with subclasses C12C-C12Q or C12S, relating to micro-organisms
C12S	Processes using enzymes or micro-organisms to liberate, separate or purify a pre-existing compound or composition; processes using enzymes or micro-organisms to treat textiles or to clean solid surfaces of materials
C13	Sugar industry
C13B	Production of sucrose; apparatus specially adapted therefor
C13C	Cutting mills; shredding knives; pulp presses
C13D	Production or purification of sugar juices
C13F	Preparation or processing of raw sugar, sugar, or syrup
C13G	Evaporation apparatus; boiling pans
C13H	Cutting machines for sugar; combined cutting, sorting and packing machines for sugar
C13J	Extraction of sugar from molasses
C13K	Glucose; invert sugar; lactose; maltose; synthesis of sugars by hydrolysis of di- or polysaccharides
C14	Skins; hides; pelts; leather
C14B	Mechanical treatment or processing of skins, hides, or leather in general; pelt-shearing machines; intestine-splitting machines
C14C	Chemical treatment of skins, hides or leather, e.g. tanning, impregnating, finishing; apparatus therefor; compositions for tanning

IPC code	Designation
C21	Metallurgy of iron
C21B	Manufacture of iron or steel
C21C	Processing of pig-iron, e.g. refining, manufacture of wrought-iron or steel; treatment in molten state of ferrous alloys
C21D	Modifying the physical structure of ferrous metals; general devices for heat treatment of ferrous or non-ferrous metals or alloys; making metal malleable by decarburisation, tempering, or other treatments
C22	Metallurgy (of iron C21); ferrous or non-ferrous alloys; treatment of alloys or non-ferrous metals
C22B	Production or refining of metals; pretreatment of raw materials
C22C	Alloys
C22F	Changing the physical structure of non-ferrous metals or non-ferrous alloys
C23	Coating metallic material; coating material with metallic material; chemical surface treatment; diffusion treatment of metallic material; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general; inhibiting corrosion of metallic material or incrustation in general
C23C	Coating metallic material; coating material with metallic material; surface treatment of metallic material by diffusion into the surface, by chemical conversion or substitution; coating by vacuum evaporation, by sputtering, by ion implantation or by chemical vapour deposition, in general
C23D	Enamelling of, or applying a vitreous layer to, metals
C23F	Non-mechanical removal of metallic material from surfaces; inhibiting corrosion of metallic material; inhibiting incrustation in general; multi-step processes for surface treatment of metallic material involving at least one process provided for in class C23 and at least one process covered by subclass C21D or C22F or class C25
C23G	Cleaning or de-greasing of metallic material by chemical methods other than electrolysis
C25	Electrolytic or electrophoretic processes; apparatus therefor
C25B	Electrolytic or electrophoretic processes for the production of compounds or non- metals; apparatus therefor
C25C	Processes for the electrolytic production, recovery or refining of metals; apparatus therefor
C25D	Processes for the electrolytic or electrophoretic production of coatings; electroforming; joining workpieces by electrolysis; apparatus therefor
C25F	Processes for the electrolytic removal of materials from objects; apparatus therefor
C30	Crystal growth
C30B	Single-crystal growth; unidirectional solidification of eutectic material or unidirectional demixing of eutectoid material; refining by zone-melting of material; production of a homogeneous polycrystalline material with defined structure; single crystals or homogeneous polycrystalline material with defined structure; after-treatment of single crystals or a homogeneous polycrystalline material with defined structure; apparatus therefor
C40	Combinatorial technology
C40B	Combinatorial chemistry; libraries, e.g. chemical libraries, *in silico* libraries
C99	Subject matter not otherwise provided for in section C
C99Z	Subject matter not otherwise provided for in section C
Section D	Textiles; paper
D01	Natural or artificial threads or fibres; spinning
D01B	Mechanical treatment of natural fibrous or filamentary material to obtain fibres or filaments, e.g. for spinning
D01C	Chemical treatment of natural filamentary or fibrous material to obtain filaments or fibres for spinning; carbonising rags to recover animal fibres
D01D	Mechanical methods or apparatus in the manufacture of artificial filaments, threads, fibres, bristles, or ribbons
D01F	Chemical features in the manufacture of artificial filaments, threads, fibres, bristles, or ribbons; apparatus specially adapted for the manufacture of carbon filaments
D01G	Preliminary treatment of fibres, e.g. for spinning
D01H	Spinning or twisting
D02	Yarns; mechanical finishing of yarns or ropes; warping or beaming
D02G	Crimping or curling fibres, filaments, yarns, or threads; yarns or threads
D02H	Warping, beaming, or leasing
D02J	Finishing or dressing of filaments, yarns, threads, cords, ropes, or the like
D03	Weaving
D03C	Shedding mechanisms; pattern cards or chains; punching of cards; designing patterns

IPC code	Designation
D03D	Woven fabrics; methods of weaving; looms
D03J	Auxiliary weaving apparatus; weavers' tools; shuttles
D04	Braiding; lace-making; knitting; trimmings; non-woven fabrics
D04B	Knitting
D04C	Braiding or manufacture of lace, including bobbin-net or carbonised lace; braiding machines; braid; lace
D04D	Trimmings; ribbons, tapes, or bands, not otherwise provided for
D04G	Making nets by knotting of filamentary material; making knotted carpets or tapestries; knotting not otherwise provided for
D04H	Making textile fabrics, e.g. from fibres or filamentary material; fabrics made by such processes or apparatus, e.g. felts, non-woven fabrics; cotton-wool; wadding
D05	Sewing; embroidering; tufting
D05B	Sewing
D05C	Embroidering; tufting
D06	Treatment of textiles or the like; laundering; flexible materials not otherwise provided for
D06B	Treating textile materials by liquids, gases, or vapours
D06C	Finishing, dressing, tentering, or stretching textile fabrics
D06F	Laundering, drying, ironing, pressing or folding textile articles
D06G	Mechanical or pressure cleaning of carpets, rugs, sacks, hides, or other skin or textile articles or fabrics; turning inside-out flexible tubular or other hollow articles
D06H	Marking, inspecting, seaming, or severing textile materials
D06J	Pleating, kilting, or goffering textile fabrics or wearing apparel
D06L	Bleaching, e.g. optical bleaching, dry-cleaning, or washing fibres, threads, yarns, fabrics, feathers, or made-up fibrous goods; bleaching leather or furs
D06M	Treatment, not provided for elsewhere in class d06, of fibres, threads, yarns, fabrics, feathers, or fibrous goods made from such materials
D06N	Wall, floor, or like covering materials, e.g. linoleum, oilcloth, artificial leather, roofing felt, consisting of a fibrous web coated with a layer of macromolecular material; flexible sheet material not otherwise provided for
D06P	Dyeing or printing textiles; dyeing leather, furs, or solid macromolecular substances in any form
D06Q	Decorating textiles
D07	Ropes; cables other than electric
D07B	Ropes or cables in general
D21	Paper-making; production of cellulose
D21B	Fibrous raw materials or their mechanical treatment
D21C	Production of cellulose by removing non-cellulose substances from cellulose- containing materials; regeneration of pulping liquors; apparatus therefor
D21D	Treatment of the materials before passing to the paper-making machine
D21F	Paper-making machines; methods of producing paper thereon
D21G	Calenders; accessories for paper-making machines
D21H	Pulp compositions; preparation thereof not covered by subclasses D21C, D21D; impregnating or coating of paper; treatment of finished paper not covered by class B31 or subclass D21G; paper not otherwise provided for
D21J	Fibreboard; manufacture of articles from cellulosic fibrous suspensions or from papier-mâché
D99	Subject matter not otherwise provided for in section D
D99Z	Subject matter not otherwise provided for in section D
Section E	Fixed constructions
E01	Construction of roads, railways, or bridges
E01B	Permanent way; permanent-way tools; machines for making railways of all kinds
E01C	Construction of, or surfaces for, roads, sports grounds, or the like; machines or auxiliary tools for construction or repair
E01D	Bridges
E01F	Additional work, such as equipping roads or the construction of platforms, helicopter landing stages, signs, snow fences, or the like

IPC code	Designation
E01H	Street cleaning; cleaning of permanent ways; cleaning beaches; cleaning land; dispersing fog in general
E02	Hydraulic engineering; foundations; soil-shifting
E02B	Hydraulic engineering
E02C	Ship-lifting devices or mechanisms
E02D	Foundations; excavations; embankments; underground or underwater structures
E02F	Dredging; soil-shifting
E03	Water supply; sewerage
E03B	Installations or methods for obtaining, collecting, or distributing water
E03C	Domestic plumbing installations for fresh water or waste water; sinks
E03D	Water-closets or urinals with flushing devices; flushing valves therefor
E03F	Sewers; cesspools
E04	Building
E04B	General building constructions; walls, e.g. partitions; roofs; floors; ceilings; insulation or other protection of buildings
E04C	Structural elements; building materials
E04D	Roof coverings; sky-lights; gutters; roof-working tools
E04F	Finishing work on buildings, e.g. stairs, floors
E04G	Scaffolding; forms; shuttering; building implements or other building aids, or their use; handling building materials on the site; repairing, breaking-up or other work on existing buildings
E04H	Buildings or like structures for particular purposes; swimming or splash baths or pools; masts; fencing; tents or canopies, in general
E05	Locks; keys; window or door fittings; safes
E05B	Locks; accessories therefor; handcuffs
E05C	Bolts or fastening devices for wings, specially for doors or windows
E05D	Hinges or other suspension devices for doors, windows, or wings
E05F	Devices for moving wings into open or closed position; checks for wings; wing fittings not otherwise provided for, concerned with the functioning of the wing
E05G	Safes or strong-rooms for valuables; bank protection devices; safety transaction partitions
E06	Doors, windows, shutters, or roller blinds, in general; ladders
E06B	Fixed or movable closures for openings in buildings, vehicles, fences, or like enclosures, in general, e.g. doors, windows, blinds, gates
E06C	Ladders
E21	Earth or rock drilling; mining
E21B	Earth or rock drilling; obtaining oil, gas, water, soluble or meltable materials or a slurry of minerals from wells
E21C	Mining or quarrying
E21D	Shafts; tunnels; galleries; large underground chambers
E21F	Safety devices, transport, filling-up, rescue, ventilation, or drainage in or of mines or tunnels
E99	Subject matter not otherwise provided for in section E
E99Z	Subject matter not otherwise provided for in section E
Section F	Mechanical engineering; lighting; heating; weapons; blasting
F01	Machines or engines in general; engine plants in general; steam engines
F01B	Machines or engines, in general or of positive-displacement type, e.g. steam engines
F01C	Rotary-piston or oscillating-piston machines or engines
F01D	Non-positive-displacement machines or engines, e.g. steam turbines
F01K	Steam engine plants; steam accumulators; engine plants not otherwise provided for; engines using special working fluids or cycles
F01L	Cyclically operating valves for machines or engines
F01M	Lubricating of machines or engines in general; lubricating internal-combustion engines; crankcase ventilating
F01N	Gas-flow silencers or exhaust apparatus for machines or engines in general; gas-flow silencers or exhaust apparatus for internal-combustion engines
F01P	Cooling of machines or engines in general; cooling of internal-combustion engines

IPC code	Designation
F02	Combustion engines; hot-gas or combustion-product engine plants
F02B	Internal-combustion piston engines; combustion engines in general
F02C	Gas-turbine plants; air intakes for jet-propulsion plants; controlling fuel supply in air-breathing jet-propulsion plants
F02D	Controlling combustion engines
F02F	Cylinders, pistons, or casings for combustion engines; arrangements of sealings in combustion engines
F02G	Hot-gas or combustion-product positive-displacement engine plants; use of waste heat of combustion engines, not otherwise provided for
F02K	Jet-propulsion plants
F02M	Supplying combustion engines in general with combustible mixtures or constituents thereof
F02N	Starting of combustion engines; starting aids for such engines, not otherwise provided for
F02P	Ignition, other than compression ignition, for internal-combustion engines; testing of ignition timing in compression-ignition engines
F03	Machines or engines for liquids; wind, spring, or weight motors; producing mechanical power or a reactive propulsive thrust, not otherwise provided for
F03B	Machines or engines for liquids
F03C	Positive-displacement engines driven by liquids
F03D	Wind motors
F03G	Spring, weight, inertia, or like motors; mechanical-power-producing devices or mechanisms, not otherwise provided for or using energy sources not otherwise provided for
F03H	Producing a reactive propulsive thrust, not otherwise provided for
F04	Positive-displacement machines for liquids; pumps for liquids or elastic fluids
F04B	Positive-displacement machines for liquids; pumps
F04C	Rotary-piston, or oscillating-piston, positive-displacement machines for liquids; rotary-piston, or oscillating-piston, positive-displacement pumps
F04D	Non-positive-displacement pumps
F04F	Pumping of fluid by direct contact of another fluid or by using inertia of fluid to be pumped; siphons
F15	Fluid-pressure actuators; hydraulics or pneumatics in general
F15B	Systems acting by means of fluids in general; fluid-pressure actuators, e.g. servomotors; details of fluid-pressure systems, not otherwise provided for
F15C	Fluid-circuit elements predominantly used for computing or control purposes
F15D	Fluid dynamics, i.e. methods or means for influencing the flow of gases or liquids
F16	Engineering elements or units; general measures for producing and maintaining effective functioning of machines or installations; thermal insulation in general
F16B	Devices for fastening or securing constructional elements or machine parts together, e.g. nails, bolts, circlips, clamps, clips or wedges; joints or jointing
F16C	Shafts; flexible shafts; elements of crankshaft mechanisms; rotary bodies other than gearing elements; bearings
F16D	Couplings for transmitting rotation
F16F	Springs; shock-absorbers; means for damping vibration
F16G	Belts, cables, or ropes, predominantly used for driving purposes; chains; fittings predominantly used therefor
F16H	Gearing
F16J	Pistons; cylinders; pressure vessels in general; sealings
F16K	Valves; taps; cocks; actuating-floats; devices for venting or aerating
F16L	Pipes; joints or fittings for pipes; supports for pipes, cables or protective tubing; means for thermal insulation in general
F16M	Frames, casings, or beds, of engines or other machines or apparatus, not specific to an engine, machine, or apparatus provided for elsewhere; stands or supports
F16N	Lubricating
F16P	Safety devices in general
F16S	Constructional elements in general; structures built-up from such elements, in general
F16T	Steam traps or like apparatus for draining-off liquids from enclosures predominantly containing gases or vapours

IPC code	Designation
F17	Storing or distributing gases or liquids
F17B	Gas-holders of variable capacity
F17C	Vessels for containing or storing compressed, liquefied, or solidified gases; fixed-capacity gas-holders; filling vessels with, or discharging from vessels, compressed, liquefied, or solidified gases
F17D	Pipe-line systems; pipe-lines
F21	Lighting
F21H	Incandescent mantles; other incandescent bodies heated by combustion
F21K	Light sources not otherwise provided for
F21L	Lighting devices or systems thereof, being portable or specially adapted for transportation
F21S	Non-portable lighting devices or systems thereof
F21V	Functional features or details of lighting devices or systems thereof; structural combinations of lighting devices with other articles, not otherwise provided for
F21W	Indexing scheme associated with subclasses F21L, F21S and F21V, relating to uses or applications of lighting devices or systems
F21Y	Indexing scheme associated with subclasses F21L, F21S and F21V, relating to the form of the light sources
F22	Steam generation
F22B	Methods of steam generation; steam boilers
F22D	Preheating, or accumulating preheated, feed-water; feed-water supply; controlling water level; auxiliary devices for promoting water circulation within boilers
F22G	Superheating of steam
F23	Combustion apparatus; combustion processes
F23B	Methods or apparatus for combustion using only solid fuel
F23C	Methods or apparatus for combustion using fluent fuel
F23D	Burners
F23G	Cremation furnaces; consuming waste or low grade fuels by combustion
F23H	Grates; cleaning or raking grates
F23J	Removal or treatment of combustion products or combustion residues; flues
F23K	Feeding fuel to combustion apparatus
F23L	Air supply; draught-inducing; supplying non-combustible liquid or gas
F23M	Constructional details of combustion chambers, not otherwise provided for
F23N	Regulating or controlling combustion
F23Q	Ignition
F23R	Generating combustion products of high pressure or high velocity, e.g. gas-turbine combustion chambers
F24	Heating; ranges; ventilating
F24B	Domestic stoves or ranges for solid fuels; implements for use in connection with stoves or ranges
F24C	Other domestic stoves or ranges; details of domestic stoves or ranges, of general application
F24D	Domestic- or space-heating systems, e.g. central heating systems; domestic hot-water supply systems; elements or components therefor
F24F	Air-conditioning; air-humidification; ventilation; use of air currents for screening
F24H	Fluid heaters, e.g. water or air heaters, having heat-generating means, in general
F24J	Production or use of heat not otherwise provided for
F25	Refrigeration or cooling; combined heating and refrigeration systems; heat pump systems; manufacture or storage of ice; liquefaction or solidification of gases
F25B	Refrigeration machines, plants, or systems; combined heating and refrigeration systems; heat pump systems
F25C	Production, working, storing or distribution of ice
F25D	Refrigerators; cold rooms; ice-boxes; cooling or freezing apparatus not covered by any other subclass
F25J	Liquefaction, solidification, or separation of gases or gaseous mixtures by pressure and cold treatment
F26	Drying
F26B	Drying solid materials or objects by removing liquid therefrom
F27	Furnaces; kilns; ovens; retorts

IPC code	Designation
F27B	Furnaces, kilns, ovens, or retorts in general; open sintering or like apparatus
F27D	Details or accessories of furnaces, kilns, ovens, or retorts, in so far as they are of kinds occurring in more than one kind of furnace
F28	Heat exchange in general
F28B	Steam or vapour condensers
F28C	Heat-exchange apparatus, not provided for in another subclass, in which the heat-exchange media come into direct contact without chemical interaction
F28D	Heat-exchange apparatus, not provided for in another subclass, in which the heat-exchange media do not come into direct contact; heat storage plants or apparatus in general
F28F	Details of heat-exchange or heat-transfer apparatus, of general application
F28G	Cleaning of internal or external surfaces of heat-exchange or heat-transfer conduits, e.g. water tubes of boilers
F41	Weapons
F41A	Functional features or details common to both smallarms and ordnance, e.g. cannons; mountings for smallarms or ordnance
F41B	Weapons for projecting missiles without use of explosive or combustible propellant charge; weapons not otherwise provided for
F41C	Smallarms, e.g. pistols, rifles; accessories therefor
F41F	Apparatus for launching projectiles or missiles from barrels, e.g. cannons; launchers for rockets or torpedoes; harpoon guns
F41G	Weapon sights; aiming
F41H	Armour; armoured turrets; armoured or armed vehicles; means of attack or defence, e.g. camouflage, in general
F41J	Targets; target ranges; bullet catchers
F42	Ammunition; blasting
F42B	Explosive charges, e.g. for blasting; fireworks; ammunition
F42C	Ammunition fuzes; arming or safety means therefor
F42D	Blasting
F99	Subject matter not otherwise provided for in section F
F99Z	Subject matter not otherwise provided for in section F
Section G	Physics
G01	Measuring; testing
G01B	Measuring length, thickness or similar linear dimensions; measuring angles; measuring areas; measuring irregularities of surfaces or contours
G01C	Measuring distances, levels or bearings; surveying; navigation; gyroscopic instruments; photogrammetry or videogrammetry
G01D	Measuring not specially adapted for a specific variable; arrangements for measuring two or more variables not covered by a single other subclass; tariff metering apparatus; measuring or testing not otherwise provided for
G01F	Measuring volume, volume flow, mass flow, or liquid level; metering by volume
G01G	Weighing
G01H	Measurement of mechanical vibrations or ultrasonic, sonic or infrasonic waves
G01J	Measurement of intensity, velocity, spectral content, polarisation, phase or pulse characteristics of infra-red, visible or ultra-violet light; colorimetry; radiation pyrometry
G01K	Measuring temperature; measuring quantity of heat; thermally-sensitive elements not otherwise provided for
G01L	Measuring force, stress, torque, work, mechanical power, mechanical efficiency, or fluid pressure
G01M	Testing static or dynamic balance of machines or structures; testing structures or apparatus not otherwise provided for
G01N	Investigating or analysing materials by determining their chemical or physical properties
G01P	Measuring linear or angular speed, acceleration, deceleration, or shock; indicating presence, absence, or direction, of movement
G01Q	Scanning-probe techniques or apparatus; applications of scanning-probe techniques, e.g. scanning-probe microscopy
G01R	Measuring electric variables; measuring magnetic variables

IPC code	Designation
G01S	Radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection or reradiation of radio waves; analogous arrangements using other waves
G01T	Measurement of nuclear or x-radiation
G01V	Geophysics; gravitational measurements; detecting masses or objects; tags
G01W	Meteorology
G02	Optics
G02B	Optical elements, systems, or apparatus
G02C	Spectacles; sunglasses or goggles insofar as they have the same features as spectacles; contact lenses
G02F	Devices or arrangements, the optical operation of which is modified by changing the optical properties of the medium of the devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light, e.g. switching, gating, modulating or demodulating; techniques or procedures for the operation thereof; frequency-changing; non-linear optics; optical logic elements; optical analogue/digital converters
G03	Photography; cinematography; analogous techniques using waves other than optical waves; electrography; holography
G03B	Apparatus or arrangements for taking photographs or for projecting or viewing them; apparatus or arrangements employing analogous techniques using waves other than optical waves; accessories therefor
G03C	Photosensitive materials for photographic purposes; photographic processes, e.g. cine, x-ray, colour, stereo-photographic processes; auxiliary processes in photography
G03D	Apparatus for processing exposed photographic materials; accessories therefor
G03F	Photomechanical production of textured or patterned surfaces, e.g. for printing, for processing of semiconductor devices; materials therefor; originals therefor; apparatus specially adapted therefor
G03G	Electrography; electrophotography; magnetography
G03H	Holographic processes or apparatus
G04	Horology
G04B	Mechanically-driven clocks or watches; mechanical parts of clocks or watches in general; time-pieces using the position of the sun, moon, or stars
G04C	Electromechanical clocks or watches
G04D	Apparatus or tools specially designed for making or maintaining clocks or watches
G04F	Time-interval measuring
G04G	Electronic time-pieces
G05	Controlling; regulating
G05B	Control or regulating systems in general; functional elements of such systems; monitoring or testing arrangements for such systems or elements
G05C	Electromechanical clocks or watches
G05D	Systems for controlling or regulating non-electric variables
G05F	Systems for regulating electric or magnetic variables
G05G	Control devices or systems insofar as characterised by mechanical features only
G06	Computing, calculating, counting
G06C	Digital computers in which all the computation is effected mechanically
G06D	Digital fluid-pressure computing devices
G06E	Optical computing devices
G06F	Electric digital data processing
G06G	Analogue computers
G06J	Hybrid computing arrangements
G06K	Recognition of data; presentation of data; record carriers; handling record carriers
G06M	Counting mechanisms; counting of objects not otherwise provided for
G06N	Computer systems based on specific computational models
G06Q	Data processing systems or methods, specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes; systems or methods specially adapted for administrative, commercial, financial, managerial, supervisory or forecasting purposes, not otherwise provided for
G06T	Image data processing or generation, in general

IPC code	Designation
G07	Checking-devices
G07B	Ticket-issuing apparatus; fare-registering apparatus; franking apparatus
G07C	Time or attendance registers; registering or indicating the working of machines; generating random numbers; voting or lottery apparatus; arrangements, systems, or apparatus for checking not provided for elsewhere
G07D	Sorting, testing, changing, delivering, or otherwise handling coins; testing or changing paper currency; testing securities, bonds, or similar valuable papers
G07F	Coin-freed or like apparatus
G07G	Registering the receipt of cash, valuables, or tokens
G08	Signalling
G08B	Signalling or calling systems; order telegraphs; alarm systems
G08C	Transmission systems for measured values, control or similar signals
G08G	Traffic control systems
G09	Educating; cryptography; display; advertising; seals
G09B	Educational or demonstration appliances; appliances for teaching, or communicating with, the blind, deaf or mute; models; planetaria; globes; maps; diagrams
G09C	Ciphering or deciphering apparatus for cryptographic or other purposes involving the need for secrecy
G09D	Railway or like time or fare tables; perpetual calendars
G09F	Displaying; advertising; signs; labels or name-plates; seals
G09G	Arrangements or circuits for control of indicating devices using static means to present variable information
G10	Musical instruments; acoustics
G10B	Organs; harmoniums or like wind-actuated musical instruments
G10C	Pianos, harpsichords, spinets or similar stringed musical instruments with one or more keyboards
G10D	Stringed musical instruments; wind-actuated musical instruments; accordions or concertinas; percussion musical instruments; musical instruments not otherwise provided for
G10F	Automatic musical instruments
G10G	Aids for music; supports for musical instruments; other auxiliary devices or accessories for music or musical instruments
G10H	Electrophonic musical instruments; instruments in which the tones are generated by electromechanical means or electronic generators, or in which the tones are synthesised from a data store
G10K	Sound-producing devices; methods or devices for protecting against, or for damping, noise or other acoustic waves in general; acoustics not otherwise provided for
G10L	Speech analysis or synthesis; speech recognition; audio analysis or processing
G11	Information storage
G11B	Information storage based on relative movement between record carrier and transducer
G11C	Static stores
G12	Instrument details
G12B	Details of instruments, or comparable details of other apparatus, not otherwise provided for
G21	Nuclear physics; nuclear engineering
G21B	Fusion reactors
G21C	Nuclear reactors
G21D	Nuclear power plant
G21F	Protection against x-radiation, gamma radiation, corpuscular radiation or particle bombardment; treating radioactively contaminated material; decontamination arrangements therefor
G21G	Conversion of chemical elements; radioactive sources
G21H	Obtaining energy from radioactive sources; applications of radiation from radioactive sources; utilising cosmic radiation
G21J	Nuclear explosives; applications thereof
G21K	Techniques for handling particles or electromagnetic radiation not otherwise provided for; irradiation devices; gamma- or x-ray microscopes
G99	Subject matter not otherwise provided for in section G
G99Z	Subject matter not otherwise provided for in section G

IPC code	Designation
Section H	Electricity
H01	Basic electric elements
H01B	Cables; conductors; insulators; selection of materials for their conductive, insulating, or dielectric properties
H01C	Resistors
F01H	Magnets; inductances; transformers; selection of materials for their magnetic properties
H01G	Capacitors; capacitors, rectifiers, detectors, switching devices, light-sensitive or temperature-sensitive devices of the electrolytic type
H01H	Electric switches; relays; selectors; emergency protective devices
H01J	Electric discharge tubes or discharge lamps
H01K	Electric incandescent lamps
H01L	Semiconductor devices; electric solid state devices not otherwise provided for
H01M	Processes or means, e.g. batteries, for the direct conversion of chemical energy into electrical energy
H01P	Waveguides; resonators, lines or other devices of the waveguide type
H01Q	Aerials
H01R	Electrically-conductive connections; structural associations of a plurality of mutually-insulated electrical connecting elements; coupling devices; current collectors
H01S	Devices using stimulated emission
H01T	Spark gaps; overvoltage arresters using spark gaps; sparking plugs; corona devices; generating ions to be introduced into non-enclosed gases
H02	Generation, conversion, or distribution of electric power
H02B	Boards, substations, or switching arrangements for the supply or distribution of electric power
H02G	Installation of electric cables or lines, or of combined optical and electric cables or lines
H02H	Emergency protective circuit arrangements
H02J	Circuit arrangements or systems for supplying or distributing electric power; systems for storing electric energy
H02K	Dynamo-electric machines
H02M	Apparatus for conversion between ac and ac, between ac and dc, or between dc and dc, and for use with mains or similar power supply systems; conversion of dc or ac input power into surge output power; control or regulation thereof
H02N	Electric machines not otherwise provided for
H02P	Control or regulation of electric motors, generators, or dynamo-electric converters; controlling transformers, reactors or choke coils
H03	Basic electronic circuitry
H03B	Generation of oscillations, directly or by frequency-changing, by circuits employing active elements which operate in a non-switching manner; generation of noise by such circuits
H03C	Modulation
H03D	Demodulation or transference of modulation from one carrier to another
H03F	Amplifiers
H03G	Control of amplification
H03H	Impedance networks, e.g. resonant circuits; resonators
H03J	Tuning resonant circuits; selecting resonant circuits
H03K	Pulse technique
H03L	Automatic control, starting, synchronisation, or stabilisation of generators of electronic oscillations or pulses
H03M	Coding, decoding or code conversion, in general
H04	Electric communication technique
H04B	Transmission
H04H	Broadcast communication
H04J	Multiplex communication
H04K	Secret communication; jamming of communication
H04L	Transmission of digital information, e.g. telegraphic communication
H04M	Telephonic communication

IPC code	Designation
H04N	Pictorial communication, e.g. television
H04Q	Selecting
H04R	Loudspeakers, microphones, gramophone pick-ups or like acoustic electromechanical transducers; deaf-aid sets; public address systems
H04S	Stereophonic systems
H04W	Wireless communication networks
H05	Electric techniques not otherwise provided for
H05B	Electric heating; electric lighting not otherwise provided for
H05C	Electric circuits or apparatus specially designed for use in equipment for killing, stunning, enclosing or guiding living beings
H05F	Static electricity; naturally-occurring electricity
H05G	X-ray technique
H05H	Plasma technique; production of accelerated electrically- charged particles or of neutrons; production or acceleration of neutral molecular or atomic beams
H05K	Printed circuits; casings or constructional details of electric apparatus; manufacture of assemblages of electrical components
H99	Subject matter not otherwise provided for in section H
H99Z	Subject matter not otherwise provided for in section H

Annex No. 4

Table 36. Total of granted patents in ICP subclasses in the years 1995-2009

IPC subclass / country	Spain	Ireland	Hungary	Poland
A01B	12	1	5	0
A01C	7	1	3	0
A01D	26	5	5	4
A01F	4	15	0	1
A01G	66	5	17	2
A01H	13	0	2	2
A01J	3	3	2	2
A01K	111	27	10	10
A01L	0	0	0	0
A01M	44	4	1	4
A01N	69	8	29	3
A01P	0	0	0	0
A21B	3	5	5	0
A21C	10	5	2	0
A21D	16	0	7	3
A22B	2	1	0	0
A22C	35	1	0	1
A23B	43	3	6	2
A23C	18	8	6	3
A23D	9	4	1	0
A23F	3	0	2	0
A23G	27	2	5	1
A23J	8	4	0	2
A23K	29	7	5	6
A23L	103	13	19	4
A23N	18	3	4	0
A23P	2	0	0	0
A24B	3	0	0	4
A24C	3	0	2	6
A24D	3	0	4	1
A24F	21	2	5	0
A41B	20	1	0	0
A41C	1	1	0	0
A41D	39	2	5	1
A41F	6	1	0	0
A41G	2	0	0	0
A41H	3	0	0	0
A42B	16	2	1	0
A42C	0	0	0	0
A43B	63	1	8	1
A43C	5	0	3	0
A43D	7	0	0	0
A44B	13	1	3	0
A44C	9	1	1	0
A45B	8	1	2	1

IPC subclass / country	Spain	Ireland	Hungary	Poland
A45C	29	4	1	3
A45D	23	2	0	4
A45F	13	4	4	0
A46B	19	3	3	2
A46D	0	0	0	0
A47B	55	7	5	9
A47C	83	5	5	9
A47D	8	0	2	0
A47F	24	11	3	3
A47G	46	7	8	11
A47H	5	3	0	2
A47J	50	4	10	5
A47K	49	6	3	8
A47L	42	9	2	2
A61B	175	139	39	36
A61C	66	2	6	2
A61D	8	4	0	0
A61F	85	81	22	5
A61G	39	12	6	2
A61H	27	2	11	10
A61J	22	3	4	0
A61K	447	182	280	82
A61L	43	23	10	11
A61M	69	53	18	8
A61N	24	10	8	7
A61P	22	11	23	8
A61Q	1	1	0	0
A62B	14	2	0	1
A62C	32	1	2	3
A62D	6	0	0	0
A63B	74	26	14	6
A63C	17	1	5	3
A63D	0	3	1	0
A63F	52	5	16	8
A63G	2	0	2	1
A63H	26	3	6	4
A63J	0	0	0	0
A63K	0	0	0	0
A99Z	0	0	0	0
B01B	1	0	0	0
B01D	103	19	14	14
B01F	17	7	5	4
B01J	107	11	25	19
B01L	5	29	4	10
B02B	0	0	0	0
B02C	6	1	1	3
B03B	4	4	1	0
B03C	3	0	4	0
B03D	0	0	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
B04B	0	0	0	0
B04C	0	1	0	0
B05B	43	2	1	5
B05C	15	7	0	0
B05D	10	0	3	3
B06B	0	0	1	0
B07B	1	0	1	0
B07C	5	2	0	0
B08B	18	2	0	1
B09B	7	2	5	5
B09C	3	0	6	0
B21B	1	0	2	1
B21C	4	1	0	1
B21D	25	0	1	2
B21F	1	0	0	0
B21G	0	0	0	0
B21H	0	0	0	0
B21J	4	0	0	2
B21K	0	0	0	0
B21L	0	0	0	0
B22C	16	0	0	1
B22D	11	0	1	2
B22F	7	4	0	2
B23B	10	0	5	1
B23C	3	0	1	0
B23D	5	1	1	0
B23F	1	0	0	0
B23G	0	0	4	0
B23H	5	0	1	0
B23K	20	15	7	3
B23P	5	0	0	1
B23Q	22	1	0	0
B24B	11	0	4	2
B24C	1	1	0	0
B24D	2	0	1	0
B25B	21	7	1	1
B25C	0	2	0	1
B25D	1	0	0	0
B25F	0	0	0	0
B25G	4	0	0	0
B25H	1	0	1	0
B25J	18	0	2	0
B26B	8	4	2	0
B26D	15	2	1	1
B26F	3	0	0	0
B27B	1	0	0	0
B27C	0	0	0	0
B27D	0	0	2	0
B27F	1	1	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
B27G	0	0	0	0
B27H	1	0	0	0
B27J	0	0	0	0
B27K	5	0	0	0
B27L	0	2	0	0
B27M	2	1	0	0
B27N	4	0	0	1
B28B	26	4	2	4
B28C	4	0	0	0
B28D	13	0	1	0
B29B	8	3	11	4
B29C	97	14	17	12
B29D	9	0	0	0
B29K	0	0	0	0
B29L	0	0	0	0
B30B	11	1	2	3
B31B	17	0	0	0
B31C	2	0	0	0
B31D	0	1	0	0
B31F	2	0	1	0
B32B	33	9	11	2
B41B	0	0	0	0
B41C	2	0	0	0
B41D	0	0	0	2
B41F	32	2	0	0
B41G	0	0	0	0
B41J	6	2	1	0
B41K	0	0	0	1
B41L	2	0	0	0
B41M	10	0	4	0
B41N	0	0	0	0
B42B	1	0	0	0
B42C	2	1	0	0
B42D	27	6	2	6
B42F	9	0	0	3
B43K	1	0	0	0
B43L	1	2	1	0
B43M	2	0	0	0
B44B	1	0	0	0
B44C	9	1	3	5
B44D	0	0	0	0
B44F	0	0	0	0
B60B	19	2	5	1
B60C	12	1	4	3
B60D	1	0	1	1
B60F	1	0	3	4
B60G	14	2	5	2
B60H	8	1	0	3
B60J	57	0	2	1

IPC subclass / country	Spain	Ireland	Hungary	Poland
B60K	28	1	5	1
B60L	8	0	1	1
B60M	2	1	0	0
B60N	33	0	3	35
B60P	25	1	2	0
B60Q	27	0	2	4
B60R	96	11	9	13
B60S	22	0	4	2
B60T	21	0	0	0
B60V	2	0	0	0
B60W	1	0	0	0
B61B	7	0	0	1
B61C	0	0	0	0
B61D	16	0	2	0
B61F	4	0	0	2
B61G	0	0	0	2
B61H	0	0	0	0
B61J	0	0	0	0
B61K	0	0	0	0
B61L	6	0	2	0
B62B	13	3	0	2
B62C	0	2	0	0
B62D	30	6	5	3
B62H	11	0	0	0
B62J	18	1	1	0
B62K	25	0	6	1
B62L	0	0	0	0
B62M	20	0	3	3
B63B	44	4	3	7
B63C	19	2	0	1
B63G	0	0	0	0
B63H	23	0	1	4
B63J	0	0	0	0
B64B	1	0	2	1
B64C	20	3	1	5
B64D	16	0	2	2
B64F	7	1	0	0
B64G	4	0	0	0
B65B	58	9	6	4
B65C	5	0	0	1
B65D	279	43	30	38
B65F	10	6	1	1
B65G	44	3	5	5
B65H	24	4	0	1
B66B	40	0	1	0
B66C	11	2	1	0
B66D	2	0	0	0
B66F	9	5	3	1
B67B	26	1	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
B67C	1	0	1	0
B67D	15	12	0	0
B68B	1	0	0	0
B68C	1	1	0	0
B68F	0	0	0	0
B68G	0	0	0	0
B81B	2	1	0	0
B81C	5	1	5	0
B82B	5	1	0	0
B82Y	0	0	0	0
B99Z	0	0	0	0
C01B	44	3	6	9
C01C	0	0	0	0
C01D	1	0	0	0
C01F	7	0	0	1
C01G	3	4	0	0
C02F	63	8	17	11
C03B	5	0	0	3
C03C	13	2	0	0
C04B	65	6	13	8
C05B	1	0	0	0
C05C	0	0	0	0
C05D	7	1	0	3
C05F	14	2	6	0
C05G	1	0	0	1
C06B	3	0	0	0
C06C	0	0	0	1
C06D	0	0	0	0
C06F	0	0	0	0
C07B	12	1	12	0
C07C	76	19	69	25
C07D	103	11	173	45
C07F	14	0	3	4
C07G	0	0	0	0
C07H	13	7	2	9
C07J	5	0	19	2
C07K	133	34	17	28
C08B	6	4	0	2
C08C	0	0	0	0
C08F	3	8	2	1
C08G	12	6	5	6
C08H	2	0	0	0
C08J	10	7	5	2
C08K	4	5	0	5
C08L	6	1	4	2
C09B	6	0	0	0
C09C	3	2	1	0
C09D	13	7	1	1
C09F	0	0	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
C09G	0	0	0	0
C09H	1	0	0	1
C09J	4	17	0	0
C09K	6	2	8	0
C10B	2	0	4	7
C10C	4	0	0	0
C10F	0	0	0	0
C10G	4	0	3	3
C10H	0	0	0	0
C10J	2	0	1	0
C10K	0	0	0	0
C10L	8	0	9	4
C10M	4	0	3	2
C10N	0	0	0	0
C11B	7	0	0	2
C11C	2	0	0	1
C11D	8	3	0	3
C12C	1	1	0	0
C12F	1	0	0	0
C12G	12	1	0	0
C12H	2	0	0	0
C12J	0	0	0	0
C12L	1	0	0	0
C12M	12	6	4	3
C12N	190	27	10	27
C12P	21	3	3	0
C12Q	107	23	8	11
C12R	0	0	0	0
C12S	0	0	0	0
C13B	0	0	0	0
C13K	0	0	0	0
C14B	1	0	0	0
C14C	2	0	0	1
C21B	3	0	0	1
C21C	0	0	2	2
C21D	4	0	0	0
C22B	11	0	5	1
C22C	10	0	2	0
C22F	0	0	0	0
C23C	21	5	3	3
C23D	0	0	0	0
C23F	1	0	0	0
C23G	0	0	0	1
C25B	10	0	1	0
C25C	0	0	0	0
C25D	5	1	0	0
C25F	0	0	0	0
C30B	12	1	0	6
C40B	0	0	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
C99Z	0	0	0	0
D01B	0	0	0	2
D01C	0	0	0	4
D01D	4	1	0	0
D01F	2	0	0	1
D01G	0	0	0	0
D01H	9	0	0	0
D02G	7	0	0	1
D02H	0	0	0	0
D02J	0	0	0	0
D03C	0	0	0	0
D03D	10	0	1	0
D03J	0	0	0	0
D04B	4	0	0	0
D04C	1	0	0	0
D04D	0	0	0	0
D04G	0	0	0	0
D04H	1	0	0	2
D05B	1	0	0	0
D05C	0	0	0	0
D06B	4	0	0	0
D06C	1	0	0	0
D06F	42	1	4	1
D06G	0	0	0	0
D06H	1	0	0	0
D06J	0	0	0	0
D06L	2	0	0	0
D06M	2	0	0	2
D06N	1	0	0	0
D06P	3	0	0	0
D06Q	1	0	0	0
D07B	3	0	0	0
D21B	0	1	0	2
D21C	2	0	0	1
D21D	0	0	0	0
D21F	1	0	0	1
D21G	3	0	0	1
D21H	10	0	3	0
D21J	2	0	0	0
D99Z	0	0	0	0
E01B	6	1	2	1
E01C	21	4	5	5
E01D	7	0	2	0
E01F	57	7	3	4
E01H	21	1	2	1
E02B	14	2	0	4
E02C	0	0	0	0
E02D	21	7	4	2
E02F	19	4	0	1

IPC subclass / country	Spain	Ireland	Hungary	Poland
E03B	10	0	1	0
E03C	13	2	4	5
E03D	32	2	4	5
E03F	3	1	11	2
E04B	83	18	12	21
E04C	24	10	7	7
E04D	10	11	0	10
E04F	66	17	5	21
E04G	69	8	3	2
E04H	43	1	8	2
E05B	45	3	13	8
E05C	4	1	1	4
E05D	22	0	2	5
E05F	35	1	1	6
E05G	6	0	0	0
E06B	62	7	2	12
E06C	4	3	0	0
E21B	5	9	0	0
E21C	0	0	0	3
E21D	3	0	0	1
E21F	0	0	0	0
E99Z	0	0	0	0
F01B	6	2	1	4
F01C	9	0	4	8
F01D	4	0	0	1
F01K	7	0	1	2
F01L	8	0	4	1
F01M	2	0	0	0
F01N	2	0	0	2
F01P	0	0	0	0
F02B	7	3	3	10
F02C	2	0	3	0
F02D	3	0	2	0
F02F	1	0	2	0
F02G	0	1	0	2
F02K	1	0	0	0
F02M	17	1	6	1
F02N	0	0	0	0
F02P	0	0	0	2
F03B	31	6	3	8
F03C	1	0	0	0
F03D	112	1	5	5
F03G	24	0	6	2
F03H	0	0	0	0
F04B	10	1	0	2
F04C	2	0	2	1
F04D	10	2	1	1
F04F	1	0	0	1
F15B	9	1	0	3

IPC subclass / country	Spain	Ireland	Hungary	Poland
F15C	0	0	0	0
F15D	1	0	0	0
F16B	33	2	1	4
F16C	14	0	1	0
F16D	13	0	1	4
F16F	15	0	2	1
F16G	1	0	0	2
F16H	27	0	9	3
F16J	1	0	4	4
F16K	30	2	10	12
F16L	44	8	8	6
F16M	1	0	1	4
F16N	0	0	0	0
F16P	1	0	0	0
F16S	0	1	0	0
F16T	0	0	0	0
F17B	0	0	0	0
F17C	6	0	2	4
F17D	1	0	1	0
F21H	0	0	0	0
F21K	1	3	0	0
F21L	1	0	1	0
F21S	18	3	1	0
F21V	7	7	1	3
F21W	0	0	0	0
F21Y	0	0	0	0
F22B	0	0	0	1
F22D	0	0	0	0
F22G	0	0	0	0
F23B	0	1	2	0
F23C	0	3	1	1
F23D	2	5	1	0
F23G	3	0	6	3
F23H	0	0	0	2
F23J	1	0	1	0
F23K	0	0	0	0
F23L	1	0	0	0
F23M	0	0	0	0
F23N	4	1	0	1
F23Q	12	0	0	0
F23R	0	0	0	0
F24B	0	0	2	1
F24C	5	0	0	2
F24D	6	15	6	4
F24F	10	1	1	4
F24H	5	1	3	1
F24J	69	4	7	6
F25B	9	1	2	1
F25C	3	0	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
F25D	11	3	0	0
F25J	0	0	0	0
F26B	8	2	1	2
F27B	2	0	1	1
F27D	2	0	1	1
F28B	0	0	5	0
F28C	0	0	0	0
F28D	8	2	0	4
F28F	1	1	2	0
F28G	1	0	0	0
F41A	13	2	3	1
F41B	4	0	1	2
F41C	2	0	1	0
F41F	0	0	0	0
F41G	3	0	0	0
F41H	3	0	2	2
F41J	3	0	0	2
F42B	5	1	0	3
F42C	1	0	0	0
F42D	2	0	0	0
F99Z	0	0	0	0
G01B	21	11	3	6
G01C	18	3	4	2
G01D	12	1	0	0
G01F	8	5	9	3
G01G	9	2	1	0
G01H	1	2	0	1
G01J	11	3	2	2
G01K	6	1	0	2
G01L	9	2	2	0
G01M	13	3	1	2
G01N	151	77	55	22
G01P	4	1	0	0
G01Q	9	0	0	2
G01R	49	19	5	9
G01S	23	3	2	2
G01T	8	0	1	0
G01V	3	3	0	0
G01W	0	1	0	0
G02B	63	18	30	6
G02C	9	0	4	0
G02F	12	8	4	1
G03B	7	0	1	0
G03C	2	0	0	0
G03D	0	0	0	0
G03F	4	0	0	0
G03G	1	7	0	0
G03H	0	4	5	0
G04B	12	0	1	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
G04C	1	0	0	0
G04D	0	0	0	0
G04F	2	3	0	0
G04G	1	0	0	0
G05B	7	8	1	2
G05D	15	0	2	2
G05F	4	4	2	0
G05G	6	0	1	0
G06C	0	0	0	0
G06D	0	0	0	0
G06E	0	0	0	0
G06F	94	121	25	30
G06G	0	0	0	0
G06J	0	0	0	0
G06K	29	5	11	4
G06M	0	0	0	0
G06N	4	4	3	0
G06Q	46	74	37	13
G06T	19	11	8	3
G07B	4	3	0	5
G07C	24	2	1	3
G07D	19	5	0	0
G07F	80	7	9	6
G07G	0	4	0	0
G08B	28	4	8	1
G08C	6	0	0	0
G08G	21	6	6	0
G09B	0	0	0	0
G09C	0	0	0	0
G09D	0	0	0	0
G09F	0	0	0	0
G09G	0	0	0	0
G10B	0	0	0	0
G10C	0	0	0	0
G10D	10	1	1	0
G10F	0	0	0	0
G10G	2	0	0	0
G10H	5	3	1	0
G10K	8	0	1	1
G10L	8	1	1	1
G11B	21	22	10	1
G11C	4	1	4	1
G12B	0	0	0	0
G21B	2	0	0	0
G21C	2	0	0	0
G21D	0	0	0	0
G21F	0	0	2	0
G21G	0	0	0	0
G21H	0	0	3	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
G21J	0	0	0	0
G21K	0	0	3	0
G99Z	0	0	0	0
H01B	8	3	1	2
H01C	5	4	2	1
H01F	13	8	5	3
H01G	0	1	0	0
H01H	34	6	1	6
H01J	7	2	4	3
H01K	1	0	1	0
H01L	49	30	0	10
H01M	12	0	11	4
H01P	11	0	0	1
H01Q	18	0	0	1
H01R	42	1	3	6
H01S	3	23	2	1
H01T	2	0	0	2
H02B	7	2	2	0
H02G	17	2	3	2
H02H	5	6	1	4
H02J	29	2	13	1
H02K	25	3	13	7
H02M	11	12	2	4
H02N	2	0	0	2
H02P	4	0	0	1
H03B	2	0	0	0
H03C	0	0	0	0
H03D	0	2	0	0
H03F	3	1	0	4
H03G	4	0	1	0
H03H	7	0	0	0
H03J	0	0	0	0
H03K	6	3	1	0
H03L	0	0	0	0
H03M	5	13	0	5
H04B	45	17	7	3
H04H	6	0	0	2
H04J	13	2	0	0
H04K	1	0	0	0
H04L	72	93	10	8
H04M	32	15	14	3
H04N	29	6	6	8
H04Q	4	10	3	0
H04R	8	1	4	0
H04S	2	0	0	0
H04W	23	16	4	4
H05B	12	6	3	3
H05C	0	0	0	0
H05F	0	0	0	0

IPC subclass / country	Spain	Ireland	Hungary	Poland
H05G	0	0	0	0
H05H	0	3	1	0
H05K	20	5	2	5
H99Z	0	0	0	0
Total	8,881	2,272	2,026	1,388

Source: proprietary study.