European Commission

FROM HORIZON 2020 TO HORIZON EUROPE

MONITORING FLASH

PATENTS IN FP

August 2020

This Monitoring Flash analyses the self-reported patenting activity of beneficiaries of the European Framework Programmes for Research and Innovation (FP) between 2009 and 2018; FP7 (2007-2014) and Horizon 2020 (2014-2020). It sheds light on the type of organisations that own FP patents, the types of inventions reported and their estimated market value.

FROM FP7 TO HORIZON 2020

Key overview data

10 920
self-reported patents linked to more than 50,000 FP projects

2 776
self-reported inventions protected by 10 920 patents

75%
of patents owned by EU organisations based on 50% ownership rule

622 (6%)
of self-reported patents related to COVID-19 pandemic

SELF-REPORTED INVENTIONS FROM FP PROJECTS

Key overall messages

- 97% of the FP inventions between 2009 and 2018 are results of FP7 projects. This indicates a considerable time-lag between FP activities and potential exploitation through patents. In the future, time-lag could be reduced through targeted interventions.
- The FP self-reported patents have in general higher average IPBI estimated market value which indicates the Added Value of the FP.
- The majority of FP self-reported inventions are related to the health sector in areas such as biotechnology, pharmaceuticals or organic chemistry, a limited number is related to environmental technologies. This could reflect the policy priorities of the past (in FP7) and a different picture is likely to emerge for Horizon 2020 and Horizon Europe, which put a more explicit focus on climate action
- FP self-reported patents are intended to be largely exploited at home in Europe and the United States. The majority of the innovations are owned by European organisations. More than half of them are owned by SMEs, but in comparison with the EU and the World this share is low. A comparatively large share of patents is owned by large and very large organisations.
- Patenting is only one of possible outputs of FP projects but remains the most widely used indicator of innovation. FP patent data face significant quality challenges which limits the analytical and policy conclusions of this Monitoring Flash.

Research and Innovation

Introduction

The EU Research and Innovation Framework Programmes (FP) aim to foster all forms of innovation, and particularly those that can tackle our biggest environmental, economic and societal challenges. By supporting pan-European collaborative research and innovation, small and medium-sized firms and individual researchers, the FPs strive to speed up the development of the technologies and innovations that will underpin tomorrow's businesses and help European companies to grow[1]. Once an innovation is developed, the inventor seeks to protect it either with a patent or other Intellectual Property Right (IPR), or by secrecy (Cohen et al., 2000; Hall et al., 2013). Whereas patents present only a small part of what results from R&I activities they are currently still one of the most widely used indicators of innovation.

Patents incentivise inventors to pursue R&I activity, codify newly created knowledge and help its diffusion[2]. Existing studies show, that public funding can increase patenting activity of firms (Howell, 2017; Wildmann, 2017), especially of small firms (Bronzini & Piselli, 2016). The Horizon 2020 Interim Evaluation gives some insights into the patenting activity of FP beneficiaries[3]. It suggests that the patents produced in the FPs are of higher quality and likely commercial value than patents produced elsewhere.

This Monitoring Flash sheds further light on patents and patenting activity of innovators benefiting from the two latest Framework Programmes – FP7 and Horizon 2020, based on self-reported project results. The analysis covers self-reported patents from more than 50,000 FP7 and Horizon 2020 projects funded until 2019. The data is stored in the Common Research Data Warehouse (CORDA), an internal database maintained by DG Research and Innovation. The analysis is based on a pilot matching of CORDA data with ORBIS Intellectual Property database[4]. This pilot activity tested the possibilities of gaining new analytical insights by enhancing internal EC data on patents with an external dataset.

The Monitoring Flash was prepared by the European Commission services, however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

[1] Knowledge transfer is one of the means through which the Framework Programmes aim to increase the innovative capability of firms, reinforce competitiveness and spur economic growth (European Commission, 2017).

[2] Other effects of patents are ambiguous and remain to be discussed in academic literature, see Pisano & Teece, 2007; Pries & Guild, 2011; Penin & Neicu, 2018.

[3] European Commission (2017) Interim Evaluation of Horizon 2020, Staff Working Document SWD(2017)2020 and PPMI, 'Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7 and Horizon 2020)

[4] https://www.bvdinfo.com/en-gb/our-products/data/international/orbis-intellectual-property

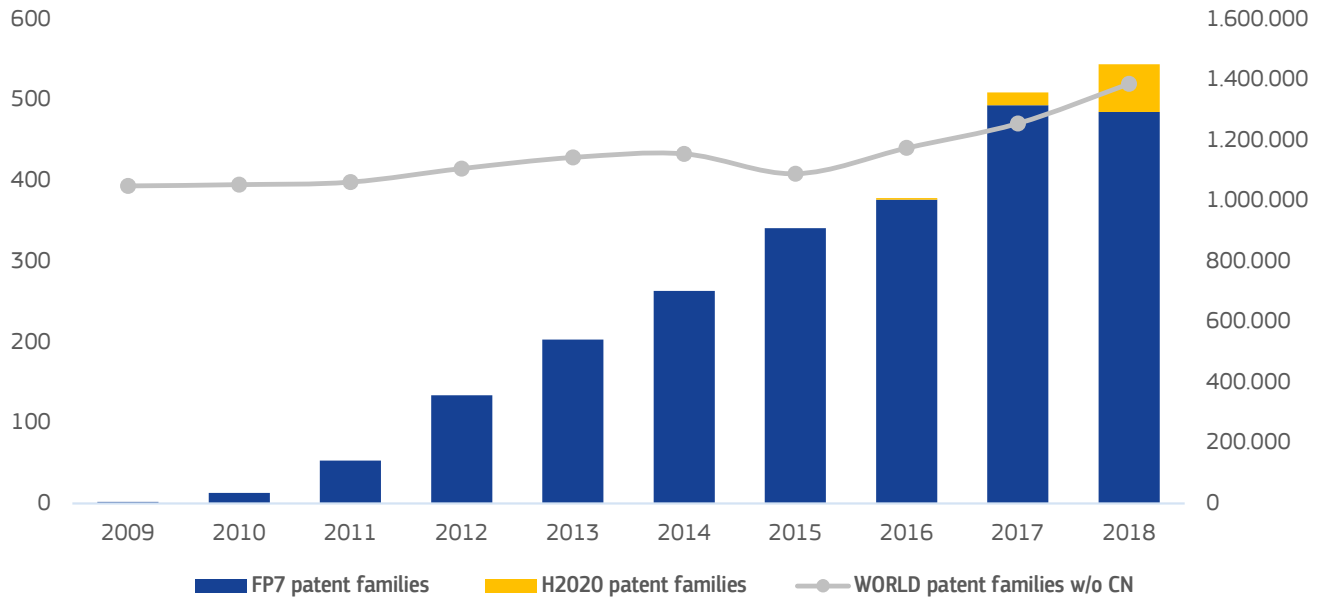
Framework Programme patents

How many inventions result from Framework Programme projects?

There are currently 2 776 inventions (patent families)[5] self-reported by FP7 and Horizon 2020 beneficiaries protected by 10 920 patents worldwide. The vast majority (97%) are results of FP7 projects.

Due to the considerable time lag between achieving research and innovation results, applying for patents and the length of the patenting procedure at different patenting offices (European Commission, 2017: p. 132) the expected coverage of FP self-reported patents remains low. Based on the data, the average project starts reporting patents 16 months after the project start. The maximum observed time for reporting a patent was 8 years after the project start. Whereas much of the FP7 patents that can be obtained through self-reporting have probably been collected by now, the number of Horizon 2020 reported patents is expected to increase significantly in the coming years. For instance, as seen in Figure 1 below, the first Horizon 2020 patents started to be reported only in 2016, two years after the official start of Horizon 2020 programme. The first Horizon 2020 patents come from the LEIT-ICT, ERC proof of concept and the Energy part of the programme.

Figure 1 **Number of self-reported FP inventions (left axis) and number of all reported inventions in the World (right axis) by publication year**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit based on ORBIS Intellectual Property (IP), CORDA.

The quality of self-reported patents remains low. After applying several steps of quality assurance process, only 42% of the self-reported patents remained for further analysis. The majority of self-reported patents were excluded due to the background rather than foreground nature of the patents. Foreground patents are results of the FP activity[6], whereas background patents are an input, a starting point for the FP activity. Around 50% of the self-reported patents were identified as background patents and some were very old, even from the 19th century. In addition, due to the voluntary reporting during the project lifetime, a large share of patents linked to FP projects remains unreported. The discovery of these is the object of a series of ongoing projects of the European Commission.

[5] A patent family is a set of patents that protect the same invention disclosed by the same inventor in different countries. The number of patent families hence indicates the number of distinct inventions protected.

[6] The patent application date or first priority date is later than one year after the start of the project. In doing so, we assume that it takes FP beneficiaries at least one year from starting the project to applying for a patent with one of the worldwide patent offices. See the methodological Annex for more information.

The present low patent data quality and tracing challenges indicate that the European Commission should increase its efforts in ensuring appropriate and robust monitoring of patenting activity of FP beneficiaries. This improve evidence base for future policy making. The current data limitations should be taken into account when reading the FP patent analysis that follows.

What type of Framework Programme inventions are patented?

The majority of the FP self-reported inventions (patent families) are patented in health-related areas such as biotechnology, pharmaceuticals, organic chemistry or medical technology. Only a limited number of inventions relate to environmental technology.

The highest share of FP self-reported inventions (patent families) is related to biotechnology[7] (14% of all self-reported inventions). This is 9 times higher than the worldwide average (1.5% of world inventions are in biotechnology). Pharmaceutical inventions follow with around 9% of FP inventions, more than 4 times the worldwide average (2% of world inventions are in this class) and 3 times more than inventions registered in the EU in this class (2.7% of all EPO and EU28 inventions). The FP has a relatively high share of inventions also in the Analysis of the biological materials and Micro-structural and nano-technologies; the share of FP inventions is these classes is more than ten times higher than the world average.

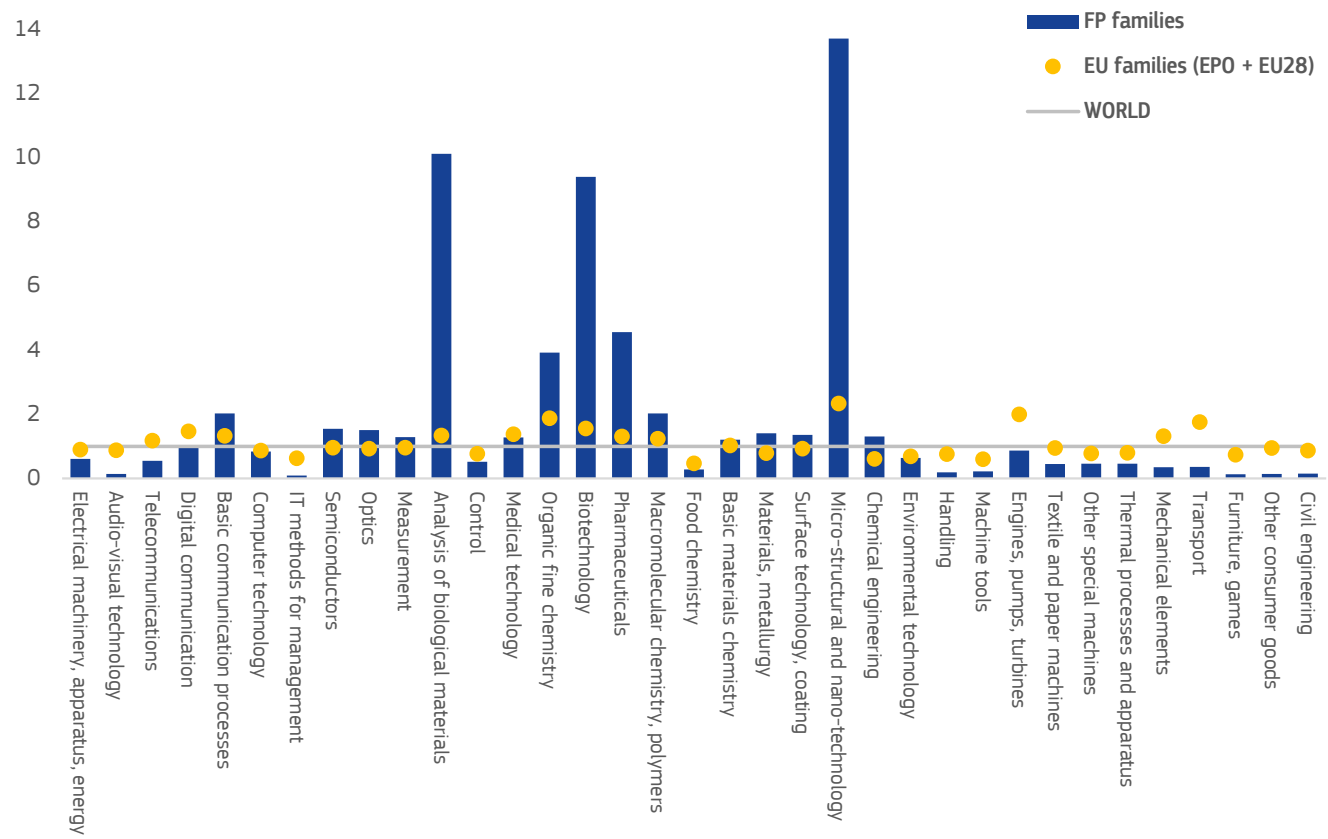
On the other hand, based on the data at hand, the Framework Programmes produce proportionately less inventions in the IT methods for management, as well as in Audio-visual technology classes, among others. If some of these results are in line with how Europe is performing – measured by the percentage of EPO and EU28 inventions in each of these classes – others seem to point to a lesser focus of the FP compared to the overall picture in Europe. This is especially the case for the transport and telecommunications areas. Environmental technology inventions are also under-represented in FP7 and Horizon 2020, but this follows a general European trend seen by lower percentages of inventions in this field registered at the EPO and EU28 patent offices if compared to the World.

Bearing in mind the highlighted data limitations, such an analysis hints to the fact that the FP is highly specialised in health and medicine-related technological areas also when compared to the World and to the European average. In some fields, this follows the European comparative areas of specialisation including biotechnology, organic and macromolecular chemistry and nano-technology. However, in other fields, the FP seems to have some niche specialisations (not observed for Europe) including analysis of bio-materials. The analysis also indicates that the past FPs contributed little to the environmental technology inventions. This is a particularly important message, given the future policy ambition of the new Commission for Europe to become the first climate-neutral continent by 2050. There are several potential explanations for such observation: the WIPO technology class *'environmental technologies'* is a too narrow indicator for climate related patents[8]; the past investment in climate related research and innovation was limited (in FP7) or not focused on producing innovations; or the time-lags for development of climate related technologies are much longer than those in health-related areas and hence not captured by self-reporting during the project lifetime. With the increased role of EU R&I in enabling the transition to climate-neutrality, it is important that FP project results and impacts are indentified in a more comprehensive and systematic way compared to the current status.

[7] Note that WIPO technology classes are counted only for the main patent of each FP foreground patent family, due to data constraints. Worldwide figures are, nevertheless, at patent-level, rather than patent family (invention) level. Given that the patents covering an invention are very similar, one can assume that they are registered in the same WIPO class.

[8] The WIPO environmental technology classification does not cover all relevant 'green patents'. The OECD developed Green Patents methodology to find patents in environment-related technologies which draws on more than 200,000 classification symbols. The search strategies encompass a broad spectrum of technologies related to environmental pollution, water scarcity, climate change mitigation. A comparable methodology would need to be applied to appropriately asses the FP contribution to green innovation.

Figure 2 **Technological specialisation index of FP inventions, EPO published in 2009-2018 (Worldwide=1)**



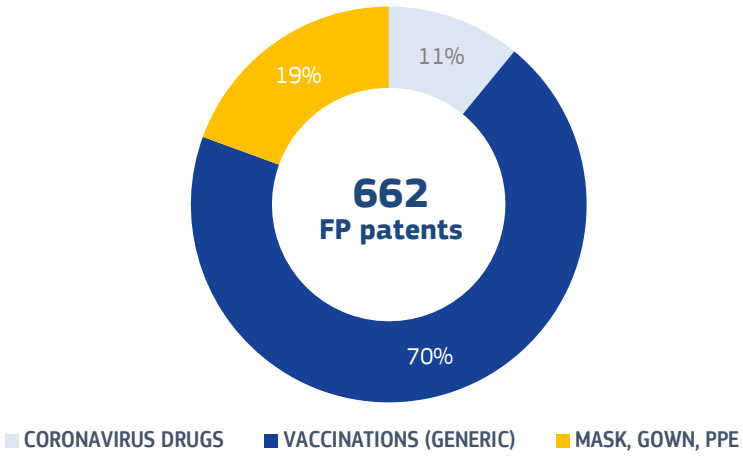
Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit based on ORBIS Intellectual Property (IP), CORDA.

Notes: Based on main patents a) Values are normalised so that worldwide percentage of patents in each WIPO technology class equals 1. A value of 2 indicates a percentage (of FP or EU patent families) twice as high as the worldwide percentage of patents in that class.

Have the Framework Programmes supported inventions relevant to the COVID-19?

622 (6%) of self-reported FP patents between 2009 – 2018 seem relevant to the current fight against the COVID-19 pandemic[9]. 68 (11%) of these patents relate to coronavirus or respiratory drugs and 121 (19%) to personal protective equipment including masks and gowns.

Figure 3 **FP COVID-19 related self-reported patens published in 2009-2018, by type**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit based on ORBIS Intellectual Property (IP), CORDA.

[9] A key word methodology based on patent abstract, claims and titles.

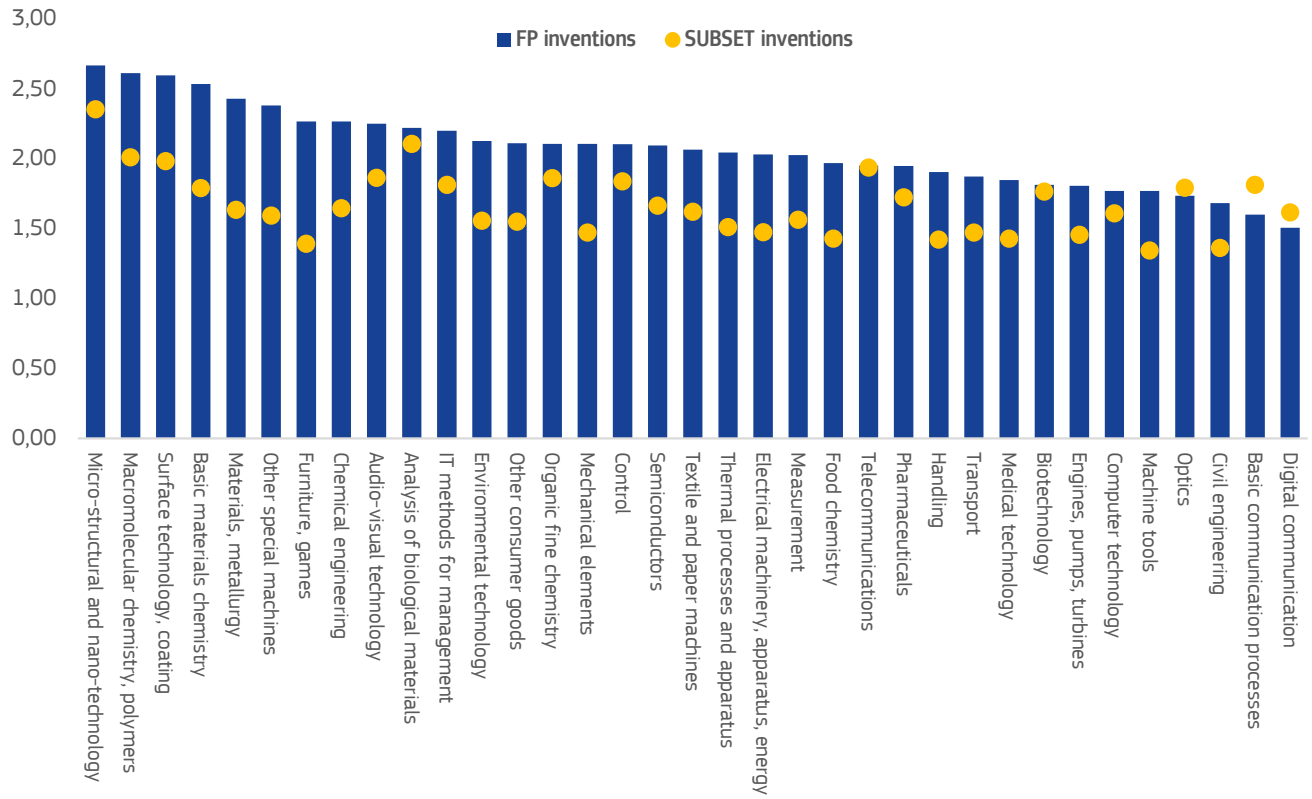
Are FP self-reported inventions interdisciplinary?

FP self-reported inventions (patent families) are more interdisciplinary compared to a random subset of world patents. This can be a marker for higher market value[10], but also – and maybe more importantly – higher societal value.

Primary and secondary WIPO classes are analysed as a proxy of interdisciplinary of invention (Ejermo, 2005). More than half of FP inventions (1,080 patent families) are classified in more than one WIPO technology class. The figure is twice as high as the average for the random sample of world patents (25%). This could imply that FP self-reported inventions (patent families) are more interdisciplinary than non FP inventions, or that the FP self-reported inventions are focused on more interdisciplinary technologies (i.e. WIPO classes). For example, Pharmaceutical, Biotechnology and Organic fine chemistry patent classes are strongly connected, and they also represent the highest share of FP self-reported inventions (patent families).

Figure 4 shows the average number of secondary technological classes covered by the invention (patent family), aggregated by WIPO technological class. As seen from the Figure, FP self-reported inventions cover more secondary technology classes than the worldwide random subset of inventions. The average FP self-reported invention covers 2.07 secondary classes, compared to the 1.67 secondary classes covered by the average random invention[11].

Figure 4 **Average number of secondary technology classes per inventions published in 2009-2018, by priority technology class**



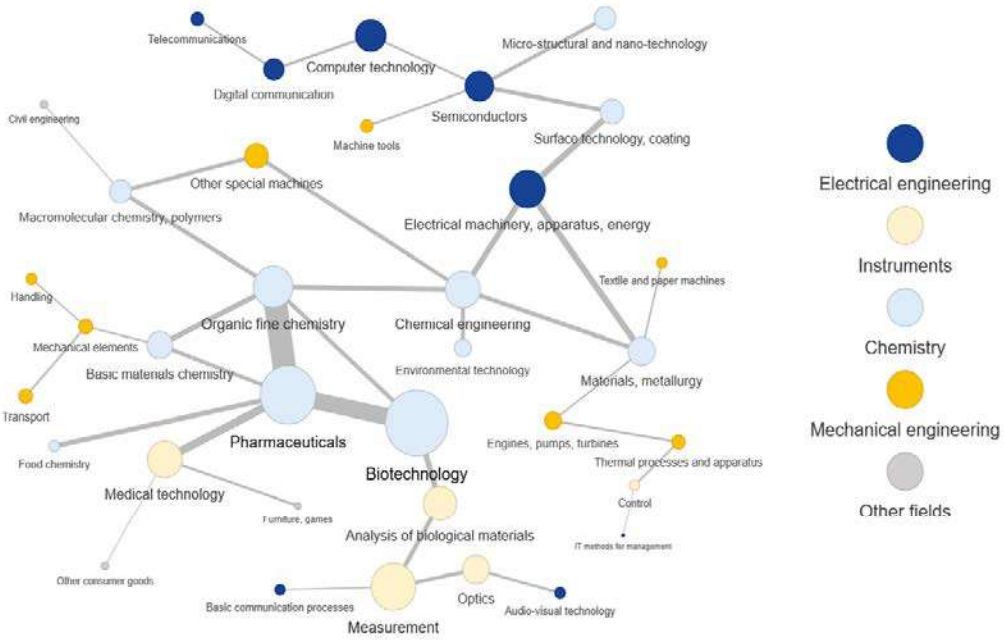
Note: SUBSET inventions refer to the random sample of world main patents (inventions).
Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA

[10] (Miller, 2006)

[11] This differences might be affected by different practices of patent offices. For example, if FP patents tend to be, on average, published more at the EPO than worldwide patents, and if these patent office has a habit of classifying patents in more technology classes, then this would partially explain the results. The data does not allow to analyse such an effect.

Figure 5 further visualizes the interdisciplinary of FP self-reported inventions. Close connections are observed in areas of biotechnology, pharmaceuticals and organic fine chemistry. Overall the majority of FP self-reported inventions are 'interdisciplinary' within a common sector such as chemistry. There are few unexpected cross-sector connections such as machine tools, semiconductors and surface technology, coating. The analysis paves the way towards a better understanding of how or to what extend FP self-reported patents bridge gaps between technology areas.

Figure 5 **Network structure of links between technology classes of FP inventions published in**



Source: *DG Research and Innovation,* Programme Analysis & Regulatory Reform Unit *ORBIS Intellectual Property (IP), CORDA and own calculations.*

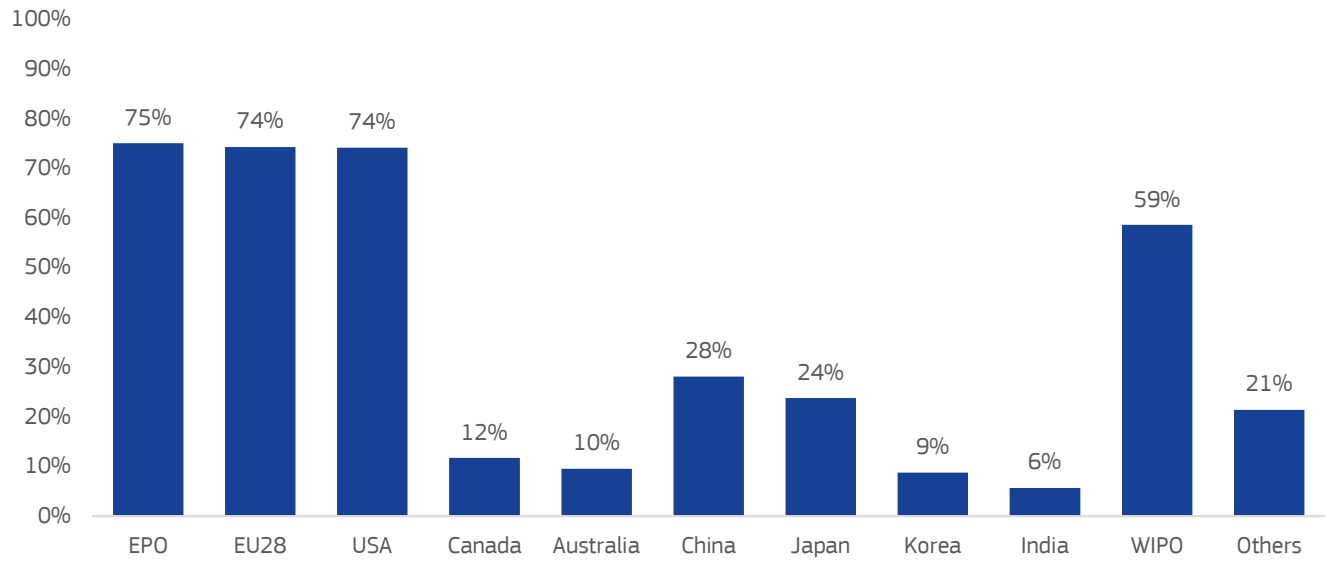
Notes: *a) The graph shows the structure of interdisciplinary connections in FP self-reported inventions. Two kinds of connections are visualized: 1) maximum spanning tree, 2) N-1 strongest links (N = 35, the total number of fields). Size of nodes reflects the total number of inventions in a technology class. Width of connections reflects the total number of inventions in the two classes they connect (connections in each graph are normalized by the total size of nodes to make them comparable).*
b) Colours reflect sectors defined at http://www.wipo.int/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf

Where are FP self-reported inventions protected?

FP inventions are protected by 61 different patent offices worldwide. The European markets are the main markets targeted for exploitation (75% of all FP inventions are protected by EPO, 74% in one of the EU28 Member State) followed by United States of America (74% of FP inventions are protected in the USA). 28% of the self-reported FP inventions are protected in China. On average each FP self-reported invention is protected in 3.7 different markets.

The choice of patenting office reflects the intention to use or license an invention for commercial application in a certain market. Inventions are more likely to be patented in large potential markets. The majority of FP self-reported patents are patented in Europe (75% at the European Patent Office, 74% in individual EU Member States). In Europe, apart from the EPO, FP inventions are mostly patented in the United Kingdom (19%), Spain, France, Poland and Germany (around 10% each). In addition to the home market, most FP inventions are protected in the United States of America (74%) and some on the Asian markets (28% of FP inventions are patented in China, 24% in Japan). 59% of the inventions are patented through the World Intellectual Property Organization (WIPO), an agency of the United Nations.

Figure 6 **Share of FP self-reported inventions patented between 2009 and 2018, by patenting office**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA.
Note: a) FP patents published in 2009-2018, in all technology classes at the largest patent offices.

What is the market value of FP self-reported inventions?

The estimated average market value of an FP patent is between EUR 72 000 and 334 000 depending on the market. In general FP patents are valued more than average patents in these markets with the exeption of the EPO and the USA. An average patent registered in the USA is valued higher than a patent registered in Europe, but the FP patents reach the highest valuation on the markets in Asia.

Patent market valuation is a method to compare the quality of inventions against each other in terms of its market attractiveness, technical quality, transferability to different industry etc. There are several such methods to determine patent values. ORBIS IP database, the database tested for the analysis of this Monitoring Flash, uses the method developed by IPBI[12] which takes into account 26 indicators[13] to estimate the market value of patents. Other valuation methods should be tested and compared in the future.

Based on IPBI estimates, the average value of FP self-reported patent is between EUR 72 000 and 334 000 depending on the market, higher than values of average patent in these markets. Patents registered in the US are, on average, valued much higher than those registered in Europe or Asia. The FP patents reach the highest valuation on the markets in Asia (i.e. in Korea, China and Japan).

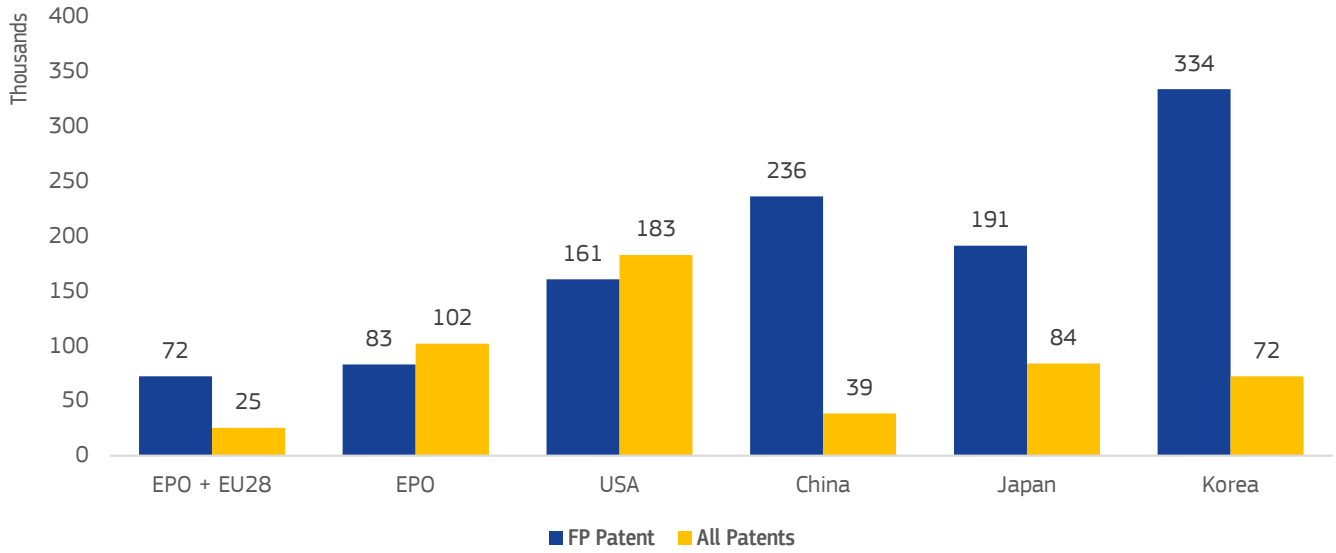
Even if the analysis is descriptive in nature and cannot unpack the specific reasons behind the differences in estimated values, the figures reinforce the findings of the interim evaluation of Horizon 2020, that FP-funded research produces high-quality and valuable patents[14]

[12] https://www.ip-bi.com/ The details of the evaluation methodology are not publicly available and were not assessed for the purpose of this Monitoring Flash.

[13] Community application, R&D strength of the invention, R&D applicant ratio, Technology in different term trend, Sustainability of technology trend, Total size of activity, Family size, Transferability to different industries, Heterogeneity of potential applications, Exploitation in different technologies, Total amount of exploitation possibilities, Evidence of use, Relevance for other technologies/applications, Differentiation to the state of the art, Differentiation from direct competitor-technologies, Interfering with competitors technologies, Validity level, Patent maturity, Claim width and coverage, Validity in certain countries, Intended worldwide protection, Procedural State and Grant lag.

[14] European Commission, 2017: p. 133

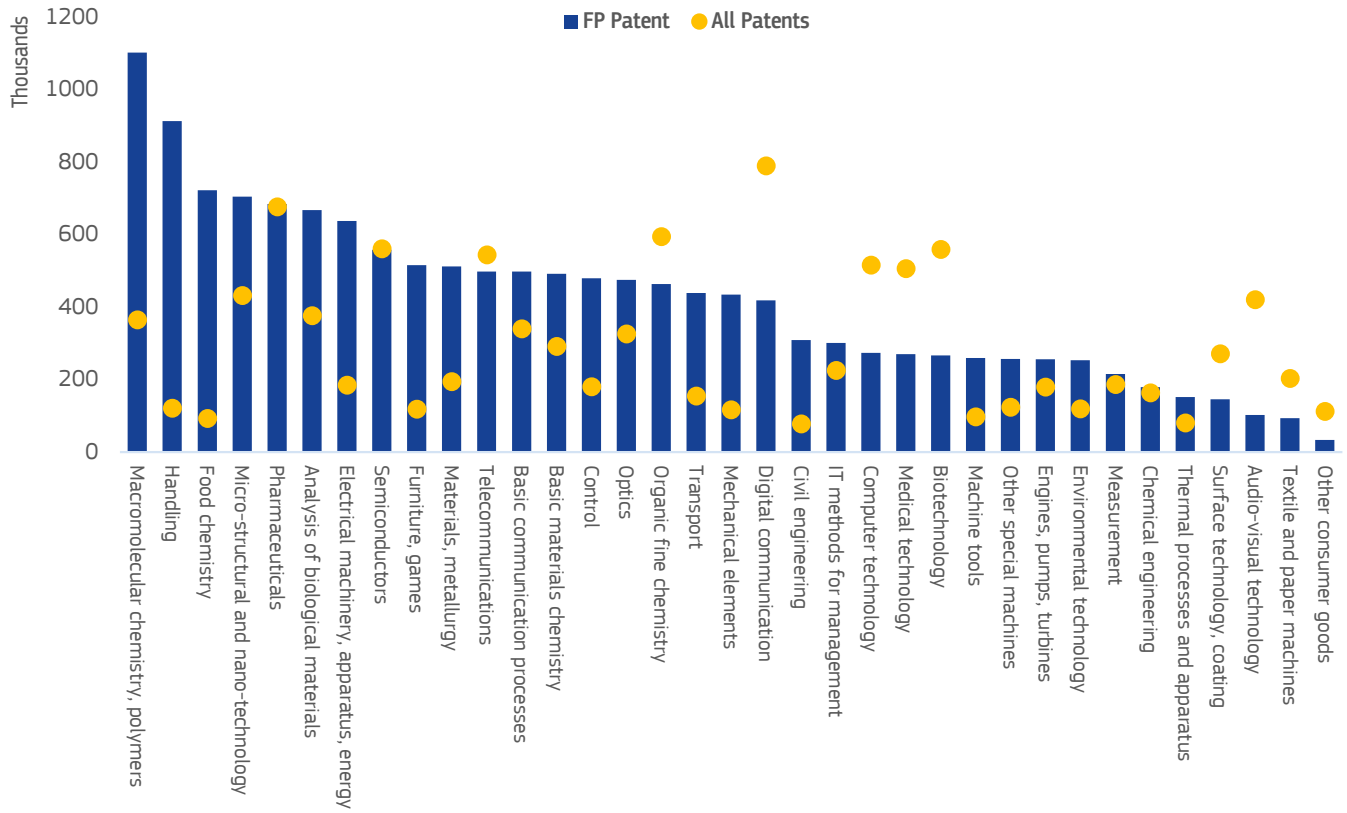
Figure 7 **Average FP patent values compared to all patent values by major patenting office between 2009-2018 (IPBI estimated market value in thousands EUR)**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA.
Notes: a) Average value of all the patents from patent families (invention) as calculated in the ORBIS Intellectual Property database.

The same is observed when analysing FP inventions by technology classes and comparing to worldwide averages. Figure 8 below shows that FP self-reported inventions are, on average, of higher value than the worldwide average in the majority of technology classes. Among the different classes, the biggest 'FP Added Value' (the additional FP patent value compared to the worldwide average) seems to be in the Handling (part of Mechanical engineering), Macromolecular chemistry fields and Food chemistry. However some FP patents are valued less than the average in particular in technologies related to Digital communication, Computer technology, Medical technology and Biotechnology.

Figure 8 **Average market values of FP patents compared to all patents by technology class between 2009-2018 (IPBI estimated market value Thousands EUR)**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA and own calculations.
Notes: a) Average value of all the patents from patent families (invention) as calculated in the ORBIS Intellectual Property database

Framework Programme Patent Owners

Who owns an FP invention?

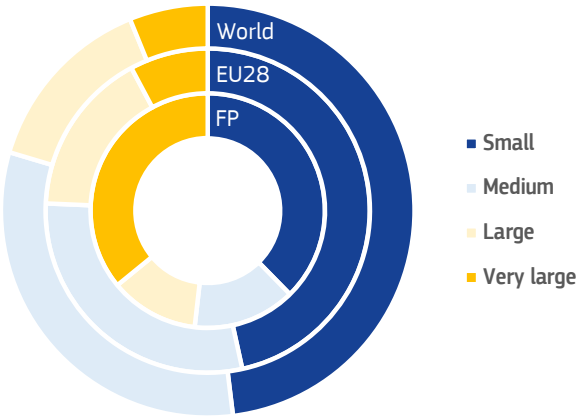
More than half (52%) of FP patent owners are small and medium-sized organisations (SMEs). This is much higher than the overall share of SME participation in the FP (around 20%), but much lower if compared to the World and the EU. 36% of FP patent owners are very large organisations. The majority of FP patent owners are located in Europe (75%).

A study by the EPO and EUIPO (Meniere et al., 2019) shows that companies that hold patents or other forms of intellectual property rights (IPR) are more likely to grow and experience high growth than those that do not. These indicates that the Framework Programmes can increase the competitiveness of the European economy by funding companies with high chances of innovating and patenting.

The owner of FP invention is the organisation that currently owns the self-reported patent in FP7 or Horizon 2020. When an organization is a subsidiary, the owner is the parent organization if holding the majority of shares. 52% of the FP patent owners are SMEs. The share is high if compared to the overall share of SME participation in FP, around 20%. However, the share is low if compared to the overall picture of patenting in Europe and the World where SMEs represent close to 80% of all patent owners. At the same time a high share of FP patent owners are very large organisations (36%) compared to the rest of Europe and the World (8% and 6%)[15].

[15] Organisations include commercial companies, but also universities and research centres for which information is available in ORBIS Europe dataset. The data contains at least 211 universities – based on their official names, of which 146 small and medium-sized, 9 large and 56 very large.

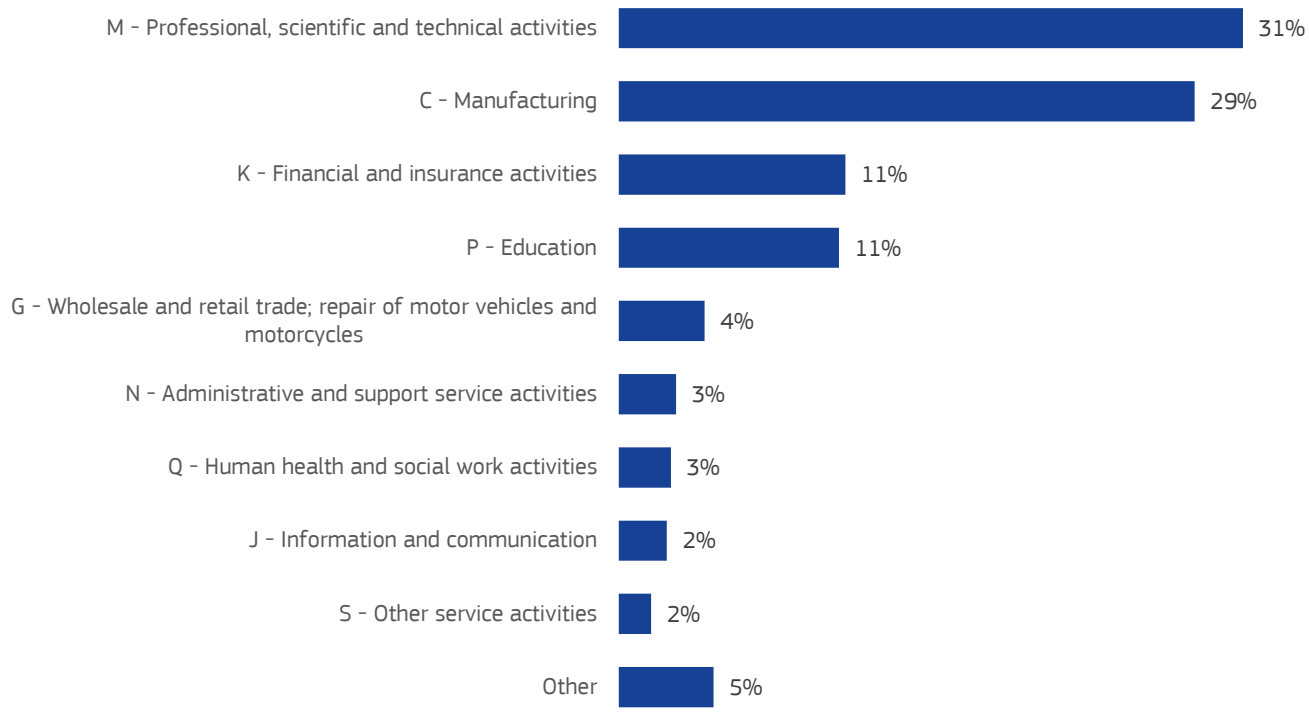
Figure 9 **FP patent owners, by size of organisations**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA.
Notes: Percentages are calculated based on 1,2 million entities for which data is available.

Further analysis shows that 31% of FP inventors are owned by organisations active in professional, scientific and technical sector, followed by manufacturing (29%), financial and insurance sector (11%) and education sector (11%) (Figure 11).

Figure 10 **Share of FP invention owners by industry classification (main NACE rev. 2)**



Source: DG Research and Innovation, Programme Analysis & Regulatory Reform Unit ORBIS Intellectual Property (IP), CORDA.
Notes: a) The figure shows the percentage of applicants for the main patents from each FP patent family (invention).
b) Calculations are based on 1549 entities for which industry and patent data was available.
c) Other relates to Electricity, gas, steam and air conditioning supply, Real estate activities, Construction, Human health and social work activities, Information and communication, Administrative and support service activities, Wholesale and retail trade; repair of motor vehicles and motorcycles, Water supply; sewerage; waste managment and remediation activities, Mining, Transporting and storage, Arts, entertainment and recreation, Agriculture, Accommodation and food service activities, Forestry, Activities of extraterritorial organisations and bodies*

In terms of location, the majority of FP inventions are owned by organisations located in Europe (75%): 16% in Germany, 11% in Spain, 11% in the UK, 6% in France, 6% in Italy and 5% the Netherlands. 7% of the FP inventions are owned by organisations located in the US. 90% of the FP funding goes to organisations and individuals located in EU Member States.

Key messages

This Monitoring Flash tested the possibilities of new analytical insights into how the Framework Programmes foster innovation through increased patenting activity. It aimed to do so by enhancing the internal EC data on patents with an external ORBIS Intellectual Property dataset. The key learning of this endeavour is that at present original FP patent data face significant quality and tracing challenges which limit the relevance of the analysis for wider policy. Data on FP patenting is rather patchy and a streamlined process of registering patents and other IP protection mechanisms and inventions stemming from FP-funded research is still needed. A large number of patents reported by beneficiaries were granted or applied for before the projects had started (background patents). In the future, the EC should increase its efforts and capacity to ensure appropriate and robust monitoring of IP protection mechanisms of FP beneficiaries for better informed policy.

Nevertheless, the exercise proved that a much more comprehensive analysis and understanding of the FP and its contribution to the patenting landscape can be conducted when EC data are enhanced with external company and patent databases. For instance, the analysis allows to conclude that FP self-reported inventions:

- Mainly relate to health sector in areas such as biotechnology, pharmaceuticals or organic chemistry;
- Are more interdisciplinary than random patents;
- Have in general a higher estimated values compared to the market averages;
- Are intended to be largely exploited in Europe and the United States;
- 31% are owend by organisations active in professional, scientific and technical sector;
- The majority of FP inventions are owned by organisations located in Europe (75%).
- For the future R&I policy this analysis:
- Confirms a considerable time-lag between FP activities and potential exploitation which should be taken into account with the future Horizon Europe programming focused on the targeted impacts. Attention should be given to the results of the past programmes;
- Identifies a need of a much deeper analysis to better understand and monitor the existing patent and other IPR classifications against the EU policy objectives in particular related to climate objectives;
- Highlights the value that evidence can bring to design better policies in the future.

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ANNEX Methodological Note

Datasets

The main dataset used for our analysis originates from CORDA, the European Commission's common research data warehouse. CORDA is the Framework Programmes' central repository of data collected and derived during the course of FP implementation.

Data obtained from CORDA includes patent publication numbers, which allow linking to the ORBIS Intellectual Property database.[16] Following this link, information on the valuation of patents, application and publication dates, patent offices, WIPO technology classes and IPC classifications, as well as identification numbers of the patents' applicants and owners were collected and analysed. Information on patent applicants and owners was retrieved from ORBIS Europe.[17]

FP patents

The main patent dataset containes 4,616 patent families (20,821 individual patents) reported by FP7 and H2020 projects, extended to include all their family members by linking with ORBIS Intellectual Property. Only EC-verified patents are included. The verification process includes several steps, after which 68% of reported patents are included in the analysis dataset: 90% of reported patents were checked, out of which 81% were validated. Finally, 92% of the validated patents were found in ORBIS Intellectual Property.

In the last step, only foreground patents were selected for present analysis. Foreground patents are those with application or first priority date later than one year after the start of the first project in which a patent was reported. 2 776 foreground patent families (inventions), comprising 10 920, foreground patents we used for the analysis.

Data on the owners of FP patents (FP inventors) was obtained from ORBIS Intellectual Property and ORBIS Europe. The databases offers information on 1 860 current FP patent owners. Depending on the information analysed, the samples can be smaller by 10%.

Random sample of worldwide patents

To compare FP-reported patents to the worldwide IPR environment, we have proceeded in two ways. First, where worldwide data is available from ORBIS Intellectual Property, we compare FP patents to the aggregated figures. For sections where such data is not available, we compare FP patents with a random sample of 11,998 patent families (48,131 patents) selected from ORBIS Intellectual Property and matching the distribution of FP patents by publication year.[18]

Other monitoring flash reports available here:
https://ec.europa.eu/info/publications/horizon-2020-monitoring-flash_en

#1 Country Participation
#2 Dynamic Network Analysis
#3 International Cooperation
#5 Sustainable Development Goals

[16] https://orbisintellectualproperty.bvdinfo.com

[17] https://orbiseurope.bvdinfo.com

[18] The random patent sample was constructed in four steps i)random subset of 500,528 patents from the Google Patents database was downloaded (publication numbers and publication dates); ii) out of these patents, a random subset of 20,000 patents was selected, such that the probability of selection was higher for years with higher number of FP patents; iii) this dataset was then extended by all the family members from ORBIS Intellectual Property; iv) finally, a random subset of 12,000 families (inventions) was drawn to match the publication year distribution of foreground FP patents.