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High-growth firms and intellectual property rights

IPR profile of high-potential SMEs in Europe, May 2019

A joint project between the European Patent Office and the European Union Intellectual Property Office

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Foreword

This report, produced jointly by economists from the EPO and EUIPO, examines the relationship between IP activity and the growth prospects of European SMEs.

It is often said that SMEs are the backbone of Europe's economy. Indeed, according to the European Commission, SMEs constitute 99% of EU businesses, employ two out of every three employees, and produce 57% of the Union's GDP.[1] However, a small proportion of those firms account for a disproportionate share of employment and turnover growth in the SME sector. Those high-growth firms represent a small share of European SMEs but they are the future of the European economy, and some of them will be the European industry champions of tomorrow.

Being innovative, these firms rely heavily on intellectual property rights. They grow internationally, primarily within the EU single market but also elsewhere, and therefore need to secure Europe-wide and international IP protection.

As shown in the study, these high-potential SMEs often turn towards the EPO and EUIPO to secure such protection. SMEs and individual entrepreneurs represent 20% of applications filed from Europe at the EPO, and an even higher share of the trade mark applications and design registrations filed with EUIPO. Like universities (9%), they are a major element of the European innovation ecosystem.

It is therefore a major goal for the EPO and EUIPO, as European offices, to support the growth and development of European SMEs by helping them obtain sound IP protection and thus enabling them to commercialise their intellectual assets across Europe and globally.

This report quantifies some of the benefits of doing so.

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President, EPO

1 COM (2018), Annual report on European SMEs. Accessed at https://ec.europa.eu/growth/smes/business-friendly-environment/performance-review_en#annual-report.

Executive summary

Small and medium-sized enterprises (SMEs) are often said to be the backbone of the European economy. However, a large proportion of their contribution to growth and job creation is in fact generated by a small fraction of SMEs. These high-growth firms (HGFs)[2] are a priority target for policy-makers. They include start-ups as well as more classical SMEs, some of which may become Europe's future industry champions. As compared with other SMEs, their success frequently stems from investment in innovation and intellectual assets, and their growth typically involves international development.

Formal intellectual property rights (IPRs) such as patents, trade marks and industrial designs can be instrumental for these innovative SMEs to appropriate the value of their ideas and secure a return on their investments in intangible assets. Small businesses can leverage IPRs to secure higher margins, license technology, establish collaboration agreements and attract investors. They can also depend on IPR protection in foreign markets to scale up their activities and compete with large, established enterprises in those markets.

The present study aims to determine the importance of IPR activities for HGFs in Europe. To this end, it assesses whether SMEs that make more frequent use of IPRs are more likely to become HGFs. It also examines the particular ways in which HGFs shape their IPR strategies prior to experiencing high growth.

These questions are of particular interest for policy-makers, potential investors and business partners wishing to identify future HGFs at an early stage of their development. Simple indicators of IPR activity can provide them with a signal of an SME's ability to create and appropriate intellectual assets. A thorough analysis of an SME's IPR portfolio may be even more informative of its ability to effectively exploit those assets to sustain a fast growth in future markets.

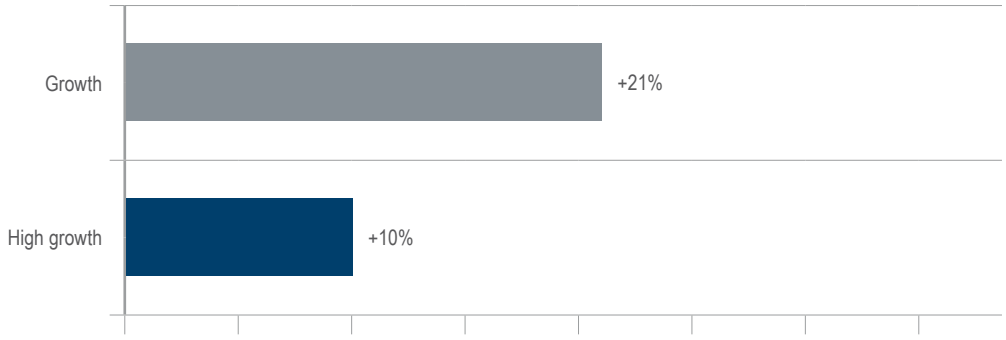
This study draws on a rich dataset linking demographic information on European SMEs in manufacturing industries from 2005 to 2010 with data stored in the national and European registers for patents, trade marks and industrial design rights. HGFs represent only 6% of the sample of European SMEs analysed in the study, but contribute 28% of net job creation. Investigation into the links between IPR activity and high turnover growth is pursued by means of descriptive statistics and econometric analysis of data.

The main findings that emerge from the analysis are as follows:

2 HGFs in this study are defined as companies that experience a growth rate in turnover of 20% or more for a three-year period.

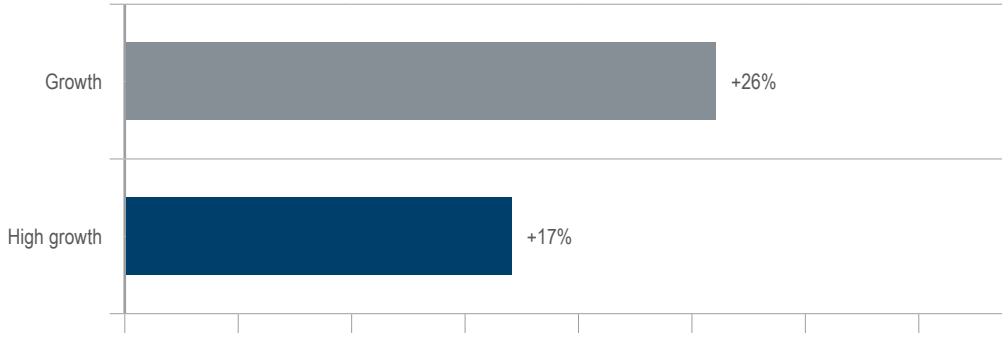
1. **SMEs with prior IPR activities are more likely to grow than other SMEs.**
   SMEs that have filed at least one IPR are 21% more likely to experience a subsequent growth period, and 10% more likely to become an HGF. The likelihood of experiencing a high growth period is 9% higher for SMEs that have filed at least one patent, and 13% higher for those that have filed at least one trade mark.

Figure 1:
Increase in odds of growth with prior IPR use



2. **The likelihood of becoming an HGF is even higher for SMEs that have filed a European IPR.**
   The likelihood of experiencing a high growth period is 17% higher for SMEs that have filed at least one European IPR. Filing a European IPR therefore provides a positive indicator of an SME's readiness to scale up business to European level.

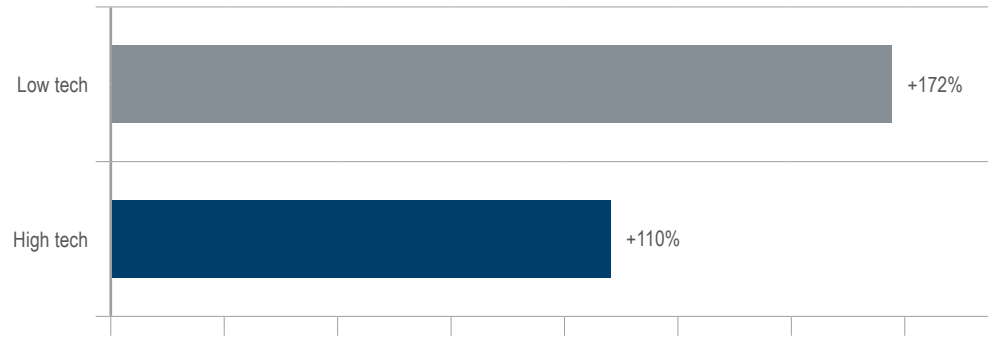
Figure 2:
Increase in odds of growth with prior use of a European IPR



3. **Prior patent filings perform best as HGF predictors in high-tech and low-tech industries.**

In high-tech industries, the likelihood of high growth is 110% higher for SMEs that have filed one or more European patents. Interestingly, the predictive power of European patents is particularly high in low-tech industries (+172%), where a patent filing can be a relatively rare event.

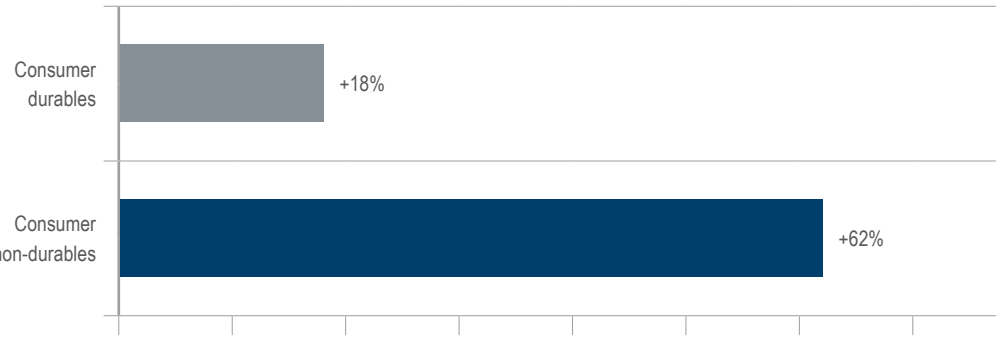
Figure 3:
Increase in odds of high growth with prior use of a European patent



4. **Prior trade mark filings perform best as HGF predictors in consumer-oriented industries.**

In consumer non-durable industries, SMEs are 62% more likely to experience high growth if they have filed a European trade mark. By contrast, the filing of a national trade mark is a better predictor (+49%) of the likelihood of high growth in consumer durable industries.

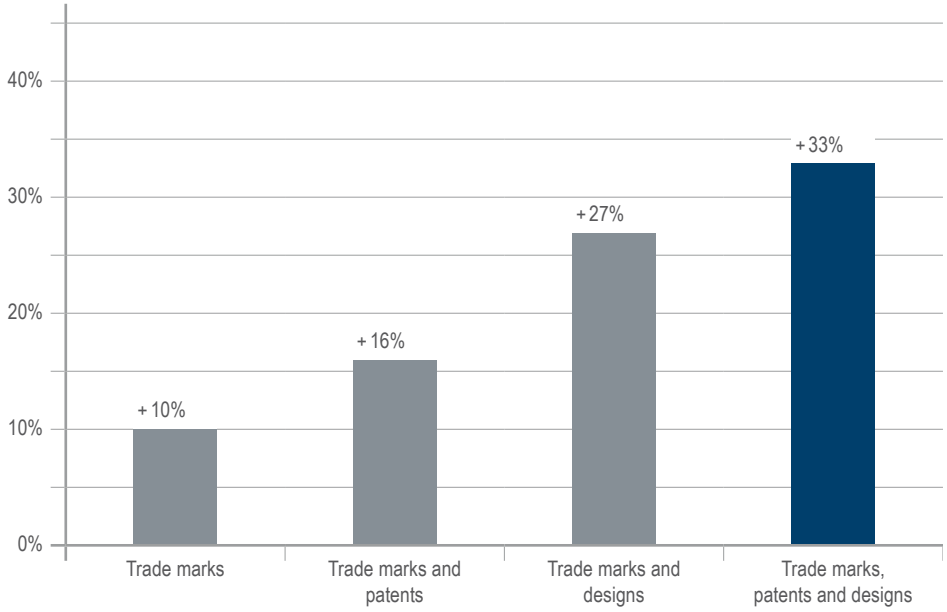
Figure 4:
Increase in odds of high growth with prior use of a European trade mark



5. SMEs that use bundles of trade marks, patents and designs instead of a single category of IPR are even more likely to achieve high growth.

IP bundles involving trade marks systematically outperform other bundles and single IPR categories, thus suggesting that trade marks are the basic building block of effective IP bundles. This is likely due to the fact that a trade mark registration is related to market entry and thus turnover growth.

Figure 5:
Increase in odds of high growth with prior use of an IPR bundle



The econometric analysis from which the main results are derived is designed to assess the predictive power of IPR indicators, by measuring the correlation between the IP activities of SMEs and the likelihood that they will experience a high growth period. Importantly, this correlation should not be interpreted as a direct causal effect: the mere filing of an IP right is not sufficient to trigger growth, but it can signal a firm's stronger ability to sustain growth through the creation, protection and exploitation of intellectual assets.

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List of abbreviations

CTM	Community trade mark. EUIPO maintains the register of European Union Trade Marks (known prior to 23 March 2016 as Community Trade Marks) and Registered Community Designs.
DUO	Domestic ultimate owner
EPO	European Patent Office
EU	European Union
EUIPO	European Union Intellectual Property Office
EUTM	European Union Trade Mark
FTO	Freedom to operate
GDP	Gross domestic product
GUO	Global ultimate owner
HGF	High-growth firm
IP	Intellectual property
IPR	Intellectual property rights
ISH	Immediate shareholder
LLC	Company with limited liability
MIG	Main industrial grouping
NACE	Nomenclature générale des activités économiques dans les Communautés Européennes (Statistical classification of economic activities in the European Community)
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
OR	Odds ratio
PATSTAT	Worldwide Patent Statistical Database (EPO)
R&D	Research and development
RCD	Registered Community Design. EUIPO maintains the register of European Union Trade Marks (known prior to 23 March 2016 as Community Trade Marks) and Registered Community Designs
SME	Small and medium-sized enterprises
VC	Venture capital
WIPO	World Intellectual Property Organization

Country codes:

AT	Austria
BE	Belgium
DE	Germany
DK	Denmark
ES	Spain
FR	France
GB	United Kingdom
HU	Hungary
IT	Italy
LT	Lithuania
NL	Netherlands
PT	Portugal

01 / Introduction

Small and medium-sized enterprises (SMEs) are often said to be the backbone of the European economy. SMEs represented more than 99% of enterprises which operated in the EU 28 non-financial business sector in 2016, and they accounted for 67% of total employment and 57% of value added in this sector (European Commission, 2018). European SMEs also significantly contribute to economic growth. Over the period 2008 to 2017, they generated 47% of the cumulative increase in gross value added of the EU 28 non-financial business sector, and 52% of its cumulative increase in employment. In light of these figures, support for entrepreneurship and creation of new firms is a legitimate objective of economic policy at both national and regional level.

However, it is important to bear in mind that the generic category of SMEs encompasses a broad variety of businesses – from local services such as the hairdresser's on the corner to high-tech firms – with different economic profiles. A further challenge for policy-makers is therefore to identify and adequately support the specific segments of SMEs that have the strongest economic potential. As summarised by Shane (2009) – *"[g]etting economic growth and jobs creation from entrepreneurs is not a numbers game. It is about encouraging the formation of high quality, high growth companies."*

1.1 High-growth firms

A report on European SMEs published by the European Commission (2018) provides valuable insights into the most promising segments of European SMEs. In the EU 28, in 2016, there were 179 060 SMEs with a three-year average growth rate in employment of at least 10%. These so-called high-growth firms (HGFs) include start-ups and more classical SMEs in a large variety of sectors. About two thirds of them were concentrated in six member states (Germany, the United Kingdom, Spain, France, Italy and Poland). In the EU overall, their number increased by 24% between 2014 and 2016.

These HGFs have diverse profiles and origins, but they also share a number of frequent characteristics. Human capital, R&D and intellectual assets are often critical factors in their development (Coad and Rao, 2008; KFW, 2017). Although SMEs are, on average, less innovative than large companies, the bulk of high-growth firms in industrialised countries consist of a significant proportion of SMEs that engage in all forms of innovation (OECD, 2018). These entrepreneurial SMEs are often ready to accept risks not acceptable to their larger counterparts and serve as *agents of change* providing sources of new ideas and experimentation that have been overlooked or not exploited by incumbents. They are therefore often seen as signposts to subsequent industry growth and development (Bos and Stam, 2014).

As compared with other SMEs, the success of high-growth firms is also often driven by their ability to develop internationally, within or even beyond the EU internal market. Available evidence shows, for instance, that in 2007-2008, more than 50% of SMEs that invested abroad or were involved

in international subcontracting reported increased turnover, while this rate was only 35% for all SMEs (European Commission, 2015). Empirical evidence further suggests that innovation and international development often go hand in hand in HGFs (Hollenstein, 2005). In 2007-2008, up to 26% of internationally active SMEs introduced products or services that were new for their sector in their country, as compared with only 8% for other SMEs (European Commission, 2015). These internationally active SMEs also develop more process innovations (11% vs 3% for SMEs without international activities).

Finally, HGFs are typically more exposed to resource constraints than average SMEs. SMEs may lack physical assets or non-core skills to fully exploit the potential of their innovations. Rapid growth through internationalisation and innovation also requires investing relatively large amounts of money, often at short notice, and is likely to stretch an SME's resources to the limits of its capacities. There is in particular a "scale-up" challenge for young European start-ups in succeeding at the later stages of the entrepreneurial development process (Duruflé et al., 2017). Against this background, HGFs are more reliant on risk-oriented finance such as equity capital or quasi-equity types of finance than on the classical bank loans typically secured by other SMEs. They are also more likely to face difficulty accessing finance because lenders and investors struggle to assess their growth potential (IPPR, 2017).

1.2 High-growth firms and IP rights

The key role of intellectual property rights (IPRs) in the success of start-ups and innovative SMEs has long been recognised (European Commission, 2012). Formal IPRs such as patents, trade marks and industrial designs allow SMEs to appropriate the results of their creativity, inventiveness and R&D investments and create an incentive for further investment in innovation. A study by the EU Intellectual Property Office (EUIPO, 2015) shows that businesses using IP rights perform better, and this is particularly true in the case of SMEs. A series of case studies published by the EPO in 2017 (EPO, 2017a) also illustrates the various ways in which SMEs can leverage their IP rights to grow, namely licensing in and out, establishing collaboration agreements, securing high margins and attracting investors and consumers.

IP rights are likewise instrumental in the international development of innovative SMEs. There is solid economic evidence that effective IP protection in foreign markets is a prerequisite to transferring and exploiting intellectual assets internationally.[3] This is especially the case for SMEs which, due to their small size, are often dependent on a limited number of core intellectual assets and on licensing agreements or co-operation partnerships with foreign entities to exploit these assets in foreign markets.

However, available evidence indicates that only a small proportion of SMEs in the EU actually make use of IP. Only 9% of SMEs have registered IP rights, compared with 40% of large companies (EUIPO, 2015). This low proportion corresponds to a segment of more innovative SMEs, but it also denotes a general lack of awareness and ability to exploit IP rights amongst EU SMEs. Moreover, even those SMEs that do use IP tend almost exclusively to rely on national titles and make little

3 For a recent overview see EPO, 2017b.

use of the EU trade mark or registered Community design, while only 0.3% of SMEs own European patents. The need to support SMEs in accessing, using and exploiting the IP system is thus an important challenge.

1.3 Purpose of the study

The goal of the present study is to investigate the importance of the use of registered IPRs[4] for future HGFs. For this purpose, the study documents the patent, trade mark and registered design filing activities of European SMEs, and of the high-growth firms among them. It aims in particular to determine whether IPR activities can be used by potential investors, business partners and policy-makers as a valuable source of information to detect SMEs with a high growth potential. Two main sets of questions are thus investigated:

- ➔ *Can the filing of IP rights be used as a reliable predictor of the likelihood that an SME will experience high growth?*
- ➔ *If so, what are the types of IPR strategies that perform best as a signal of SMEs' growth potential?*

To address these questions, the study draws on a rich dataset linking demographical information on European SMEs in manufacturing industries with the data stored in the national and European registers for patents, trade marks and industrial design rights. Investigation into the links between IPR strategy and high growth is pursued by means of descriptive statistics and econometric analysis of data.

The econometric analysis is designed to assess the predictive power of IPR indicators, by measuring the correlation between the IP activities of SMEs and the likelihood that they will experience a high growth period. Importantly, this correlation should not be interpreted as a direct causal effect. Indeed, the mere filing of an IP right is not sufficient to trigger growth, but it may signal a firm's stronger ability to sustain growth through the creation, protection and exploitation of intellectual assets.

4 Plant variety rights are another category of formal IPRs in Europe. They are not included in this study, because their use is highly concentrated on a few industries and including them would limit the scope of the analysis.

02 / The role of IPRs in SME growth

2.1 High-growth firms and innovation

As observed by Penrose (1968), "growth is not for long, if ever, simply a question of producing more of the same product on a larger scale; it involves innovation, changing techniques of distribution, and changing organization of production and management." Innovative SMEs represent a particularly impactful category of SMEs in this respect, with a high propensity to experiment and generate new inventions and processes.

While large incumbent companies often dominate in mature and stable markets (Bhide, 2003), small firms are likely to perform better in turbulent markets that are subject to technology uncertainty (National Academy of Engineering, 1995). Industrial settings that are undergoing constant technological changes are particularly challenging to the formal structures, routines and decision-making processes of large companies. By contrast, smaller firms have more flexibility to adapt to such challenges and transform them into entrepreneurial growth opportunities (Eckhardt and Shane, 2011).

Small and young firms may succeed by exploring new niches created by new technologies or new regulations. By offering differentiated products, they can avoid price competition (Porter, 1980) and create a new demand from clients whose needs have not been entirely satisfied with the existing offer. The work of the National Academy of Engineering (1995) on advanced displays shows, for instance, that small companies continue to exist in this industry because, "with few exceptions, there is little agreement regarding which technologies are likely to dominate which applications." Available evidence more generally shows that HGFs are often "early movers with respect to the recognition and realization of industry-specific growth opportunities" (Bos and Stam, 2014). Likewise, new ventures are found to benefit more from innovation than mature SMEs (Rosenbusch et al., 2011).

Innovation, however, requires substantial resource commitment and may ultimately exceed the possibilities of SMEs (Rosenbusch et al., 2011). Small companies may in particular lack financial resources, as well as scale, non-core skills, physical assets or distribution channels and marketing expertise (Lee et al., 2010; Diallo, 2012; WIPO, 2013). Due to such constraints, innovative SMEs tend to focus on a narrow technological scope and may become locked into their particular product design (Bayus and Agarwal, 2007), which increases their vulnerabilities and risk of failure.

Against this background, innovation increases the chances of both exceptional performance and failure of young entrepreneurial firms (Buddelmeyer et al., 2010; Coad et al., 2016). Uncertainty associated with innovation and market turbulence introduces "a skew into the distribution of profits", with only a small chance that the entrepreneur will earn a large return (Bhide, 2003). Smaller firms

may thus perform better when successfully exploiting opportunities emerging in new markets where demand is less predictable (Shane, 2004). But they are also particularly vulnerable to the risks involved in innovation activity.

2.2 Role of IPRs in the appropriation of innovation

Intellectual property rights (IPRs) are one of the factors that enable innovative businesses to capture the value of their ideas and bring them to market. As such, they can play a pivotal role in helping SMEs secure a return on risky investments. Three main categories of formal IPRs – patents, trade marks and industrial designs, each of which protects a different facet of intangible investments – can be distinguished from this perspective.[5] All three are formal IPRs that can only be granted by a relevant public authority after a formal application process. In Europe, they can be granted either as national rights that will be valid in a given national jurisdiction, or as European rights, subject to a centralised application procedure, spanning the different national jurisdictions into which an innovative SME may be planning to expand.

- Patents protect inventions intended to serve as new solutions to technical problems. To be patentable, inventions must be new, non-obvious (i.e. include an inventive step) and industrially applicable. For a patent to be fully valid and enforceable, it must be granted by a patent authority, following the examination of an application. All patent applications are published eighteen months after filing, ensuring the disclosure of information about the underlying technical solution. Once granted, the patent confers on its owner the right to prevent any other entity from commercially exploiting the invention. This exclusive right is limited in time: typically, patent protection lasts 20 years from the date of the application, subject to the payment of renewal fees. It is also limited in space, as the exclusionary power of patents can be enforced only within the jurisdiction of the granting state.

- Trade marks protect the distinctive signs that identify certain goods, services, persons or organisations. Common signs eligible for trade mark protection include words, pictures, stylised words, logos, a colour or colour combination, a shape or a sound, or some combination of those signs. Distinctiveness means that consumers can recognise the sign as a trade mark and distinguish it from other trade marks in the same field. Trade marks can be protected on the basis of either registration through a trade mark office (i.e. registered trade marks) or, in some countries, through their actual use in the marketplace (i.e. unregistered trade marks). The owner of a registered trade mark has the exclusive right to use it and prevent others from exploiting, in the same fields, any sign that is similar or identical to it. The term of protection of a registered trade mark is typically ten years, but it can be renewed indefinitely, subject to the payment of fees, for successive periods (typically ten years).

- Design protection covers the visual appearance of a product, part of a product or its ornamentation. A product can be any industrial or handicraft item, including packaging, graphic symbols and typefaces. A design covers the appearance of a product, but it cannot

5 Copyright is also relevant in this context, but it is not included in the present study because of its particular nature, in particular the fact that registration is not mandatory.

protect its functions, which fall under the regime of patent protection. For a design to be registered in the EU, it must be new and have an individual character. Industrial design protection is usually granted pursuant to a procedure for its registration (i.e. registered design), but unregistered designs are also protected in the EU. Protection may be automatically acquired by disclosing the design in a document or product (i.e. unregistered design). Owners of designs have exclusive rights to use the design and can prevent any third parties from using it. In the EU, the rights conferred by registered designs can apply for a maximum of 25 years, subject to the payment of fees, for successive periods, while unregistered designs are protected for three years from first disclosure.

Patents are typically used to protect the results of R&D activities. They play, for instance, a critical role in regulated sectors with long product cycles (such as pharmaceuticals), where product innovations may be reverse-engineered and copied. Trade marks and industrial designs protect the investments (in product quality, service or advertising) on which the reputation of firms is based. As such, they are used in a wider range of industries, and matter in particular for businesses that are in direct contact with consumers.

Depending on the industry in which they operate, firms frequently use a bundle of these categories of IPRs – together with trade secrets or complementary assets – to appropriate their intellectual assets (Teece, 1986; Hall and Sena, 2014; Block et al., 2015; EPO and EUIPO, 2016; Seip et al., 2019). A survey of IP-focused SMEs in Europe (EUIPO, 2016) indicates for instance that they may combine formal IPRs with confidentiality (42% of surveyed SMEs), complexity of product design (29%), a faster time-to-market (24%), or complementary assets (23%) to protect the intellectual assets. Such additional protection measures, all based on secrecy, are also found to be strongly correlated with the use of formal IPRs in the protection strategies of European SMEs (EUIPO, 2017).

2.3 Leveraging IPRs to support SME growth

There are various ways in which formal IPRs can support the development of innovative SMEs (EPO, 2017a). The protection that they confer is primarily needed to secure the exclusive exploitation of innovative ideas in the market, thereby enabling SMEs to generate sufficient returns on risky investments (Arora et al., 2008). Results from surveys of European patent applicants show for instance that “commercial exploitation” and the “prevention of imitation” are the two most important motives for filing a patent, and that these two motives are even more important to small and medium-sized enterprises (Torrisi et al., 2016; EUIPO, 2016). Importantly, IPRs also ensure freedom to operate (FTO) for on-going or future development, thereby mitigating the risk of unnecessary licensing costs and litigation in the case of infringement of third-party IPRs (Torrisi et al., 2016; Walsh et al, 2016).

Besides these fundamental functions, well-managed IPRs can generate an even wider range of benefits, such as setting up collaborations and licensing arrangements, securing investment and facilitating technology transactions (Brant and Lohse, 2013, Castaldi, 2019, de Rassenfosse et al., 2016). These benefits are particularly significant for innovative SMEs, as a means to compensate for their resource constraints.

Engaging in collaborations with other companies or research organisations is one way for SMEs to leverage their strengths while using their partners' assets to fill gaps in expertise and resources (Park et al., 2002; Lee et al., 2010; Zeng et al., 2010). IPRs play a pivotal role for this purpose. Besides protecting the intellectual assets initially contributed by the parties, they are used to organise the exploitation of joint results and to share the corresponding benefits. Licensing-out IPRs is likewise an effective means for small businesses to leverage the partners' assets and expertise with a view to rapidly scaling up their activities, reaching out to new markets and generating additional revenues from innovation (Arora and Ceccagnoli, 2008). Available evidence indicates, for instance, that European SMEs are willing to license up to 48% of their patented inventions, as compared with 16% for large companies, and that they actually license about a third of these inventions, while large companies license only 9% of theirs (Gambardella et al., 2005).

Technology start-ups and innovative SMEs also increasingly use IPRs to attract investors (OECD, 2014). Public information on IPRs granted by independent authorities provides a signal to financial actors that SMEs have valuable intangible assets, thereby helping them overcome information asymmetries in the financial markets (Long, 2002; Hottenrott et al., 2016; Farre-Mensa et al., 2016). In addition, IPRs survive to bankruptcy, and therefore provide security to investors and lenders (de Rassenfosse and Fischer, 2016). A recent study shows that in the US, patent-secured venture debt was used to finance 36% of technology start-ups in the sectors of computer software, semiconductors and medical devices, and that start-ups with patent-backed loans tend to raise more equity capital than those without (Hochberg et al., 2018; Serrano and Ziedonis, 2018). Another recent study finds that almost 70% of patents from failed US start-ups have been sold (Serrano and Ziedonis, 2018), thus highlighting the need for a market for IPRs to enable IPR-backed loans for start-ups. Studies likewise found that venture capitalists are more likely to fund, or value highly, those ventures that could already claim (plans for) the commercialisation of their product through trade mark ownership (Block et al., 2014a; Zhou et al., 2016).

Appropriating an SME's intellectual assets and leveraging them to seize growth opportunities requires a pro-active and resource-effective approach to IPR management (Friesike, 2011; EPO, 2017a). Rather than focusing on the short term, an SME must anticipate the interplay between IP management and commercial success in order to formulate an effective IP strategy early on (Neuhäusler, 2012). Failure to do so can create problems subsequently, such as foreclosing partnership or funding opportunities, or exposing the SME to litigation risks. Developing an IPR strategy is especially challenging for smaller firms that are scaling up their activities beyond their domestic market (OECD, 2010; ICC, 2013; Hall et al., 2013). To secure effective protection in future strategic markets, they must indeed be prepared to invest significant resources in building an international IPR portfolio at an early stage of their development process.

2.4 Registered IPRs and the performance of SMEs

SMEs across sectors and markets consistently report lower reliance on registered IPRs, compared with larger companies (OECD, 2010; Neuhäusler, 2012; Thomä and Bizer, 2013). In the European Union, available evidence indicates that only 9% of SMEs have registered IP rights, compared with 40% of large companies (EUIPO, 2015). The same pattern prevails for each category of IPR: trade marks are owned by 8.6% of European SMEs and 38.1% of large companies, patents by 0.8% of SMEs and 10.4% of large companies, and industrial designs by 0.7% of SMEs and 6.4% of large companies. The difference is even more pronounced for European IP rights: SMEs are about ten times less likely than large companies to own European patents, EU trade marks or designs.

The main reason for these discrepancies lies in the broad diversity of European SMEs. According to the Community Innovation Survey (CIS, 2012), only 34.9% of SMEs in the EU 28 reported innovation in 2010-2012, compared with 65.3% for large companies. Only a minority of SMEs are therefore engaged in innovative activities and in creating intellectual assets that may require IPR protection.

In addition, the use of registered IPRs by SMEs is subject to specific barriers, such as the lack of awareness of the benefits of IPR protection, the cost, length and complexity of the related procedures, or the risk of potential litigation and difficulties enforcing IPRs (EUIPO, 2016). As a result, not all innovative SMEs are registered IPR users. The Community Innovation Survey (CIS, 2012) shows, for instance, that 30.4% of innovative SMEs are using patents, compared with 52.8% for large companies. Conversely, the use of IPRs can be a strong signal of innovativeness. According to the SME Scoreboard (EUIPO, 2016), nearly 80% of European SMEs that have registered IPRs think they are innovative, whereas only 53% of the companies that do not register an IPR consider themselves as innovative.

There is also consistent evidence of a correlation between the use of registered IPRs by SMEs and their economic performance. A study carried out across 12 EU member states shows that the small proportion of SMEs that own registered IPRs have almost 32% higher revenue per employee than SMEs that do not own registered IPRs at all (EUIPO, 2015). Interestingly, this difference is much more pronounced than for large companies, for whom the revenue per employee is 4% higher for IP owners than for non-owners. In a study focused on UK-based SMEs, Hall and Sena (2014) find that SMEs that innovate and consider formal IPRs as an effective protection method are more productive than other firms. An empirical study carried out across nine countries concludes that although SMEs file fewer international patent applications than multinational firms, those SMEs which file such applications even outperform their larger counterparts in terms of internationalisation (Frietsch et al., 2013).

A few studies establish a more specific link between the use of IPRs and the subsequent development of SMEs engaged in risky innovative activities. Cockburn and Wagner (2007) show that patenting has been positively associated with the survival of internet-related firms listed in Nasdaq after the bursting of the dotcom bubble in 2000-2001. Other studies found positive effects of trade mark counts on the probability of organisational survival (Giarratana and Fosfuri, 2007), employment growth (Link and Scott, 2012), an initial public offering (IPO) event (Guzman and Stern, 2015) and the actual IPO value (Xiong and Bharadwaj, 2001). Helmers and Rogers (2010) measure how the patent and trade mark portfolios of the 162 000 LLC companies created in the United Kingdom in 2001 influenced their survival rate after five years. In both cases less than half of companies owned

patents, and these patent-owning companies have a significantly higher survival rate (34% in the first study, and 16% in the second). Interestingly, survival rates are even higher in the case of patents with international extensions. Another study (Ménière et al., 2014) finds a similar correlation between the patent positions of European start-ups prior to venture capital (VC) investment and the likelihood of successful eventual exit by the VC investors. This correlation is particularly strong in the sectors of biotechnology and software, and it increases with the strength and geographical scope of the start-ups' patent portfolios. Closer to the present study, Helmers and Rogers (2011) use data on all high- and medium-tech start-ups in the UK in 2000 to assess the effect associated with a firm's decision to patent on its subsequent growth between 2001 and 2005. Their findings confirm the positive impact of prior IPR activities, and suggest that patentees have higher asset growth than non-patentees of between 8% and 27% per annum.

EU policy perspective

Horizon 2020 recognises SMEs as a key source of jobs and innovation and aims to increase the chances of European innovative entrepreneurs to create world-leading companies. The European Commission estimates that raising the share of scale-ups to the US level would result in up to 1 million new jobs created and up to EUR 2 000bn added to GDP in the EU over the next 20 years. The number of new firms created is similar for the EU and the US (Commission, 2016b), but newly created enterprises founded in Europe grow more slowly in comparison with the US, and they are also less likely to challenge incumbents (Bravo-Biosca, 2011).

According to the European Commission, too few EU firms survive the critical period of 2-3 years after set-up, and too few of them grow into large firms. A recent strategic document – *Europe's next leaders: the Start-up and Scale-up Initiative* – therefore emphasised the need to support ambitious start-ups highly reliant on innovation and new technological developments and exhibiting high growth rates (Commission, 2016b). Accordingly, the Commission made changes to the Horizon 2020 programme to place more focus on support for market-creating, breakthrough innovations with scale-up potential.

The key instrument of support for SMEs' R&D efforts is the "SME instrument" of Horizon 2020, which assigned EUR 3bn to promoting technology-based start-ups and R&D investment (Commission, 2014). Within Horizon 2020 objectives, approximately 20% of the funds are earmarked for SMEs (Röhl, 2017).

Another key area of intervention is support for ambitious start-ups and SMEs in accessing, using and enforcing intellectual property rights (Commission, 2016a). The Commission designed a package of IP support measures for this purpose, including information and awareness campaigns, the provision of individual advice on the potential benefits of using IPRs, subsidies to partially cover pre-grant costs of European patents and attorneys' fees, the provision of tools and services facilitating avoidance of infringement of IP rights, and encouragement of the development of IP litigation insurance and IP valuation schemes.

The Small Business Act for Europe invites member states to encourage the efforts of SMEs to internationalise and become high-growth enterprises, among others through their participation in innovative clusters and the development of their competences in research and innovation. This strategic document recognises that active intellectual property management can be an important factor in enhancing the probability of SMEs achieving better growth performance.

03 / Data

3.1 Demographic and growth information on firms

The demographic variables of firms used in the study are derived from the ORBIS database (April 2012). ORBIS includes information on the industry sectors in which the firms operate (NACE industry codes), the number of employees and the firms' turnover.[6]

HGF definition

In accordance with the OECD and Eurostat definitions (Eurostat, 2007), the HGF status of a firm can be determined based on the growth in turnover or number of employees, or both. For this study, only the criterion of turnover growth has been applied. A firm is therefore considered to be high-growth if it has an average annualised growth rate greater than 20% per annum over three consecutive years.

The binary indicator of HGFs takes the value of 1 in accordance with the following equation:

$$\sqrt[3]{\frac{turnover_t}{turnover_{t-3}}} - 1 \geq 0.2 \qquad (1)$$

In addition, for a firm to be considered high-growth, the OECD/Eurostat definition sets a threshold of at least 10 employees at the beginning of the growth period.

SME definition

A firm is an SME if it meets the criteria set out in EU recommendation 2003/61, taking into account the turnover and, if this information is available, the number of employees. If the classification based on the number of employees differs from that based on the turnover, it is assumed to be of a larger size. In order to align the dataset with the OECD/Eurostat definition, the final dataset contains only firms employing more than 10 people (meaning that micro firms are excluded). The final dataset is further limited to independent firms which are not part of a larger enterprise group.[7]

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6 The advantage of using ORBIS is that it contains data on all firms listed in the company registers of the countries covered. In contrast to other data sources, ORBIS contains data on private and public firms. In practice, however, due to low reporting rates for some categories, depending on their size, sector of activity and country, information on variables such as employment or turnover may not always be included.

7 This was determined on the basis of the ORBIS data: domestic ultimate owner (DUO), global ultimate owner (GUO) and shareholder at first level who is the immediate shareholder (ISH). Any firm with those fields marked in the ORBIS database is considered to be part of a larger economic group and was eliminated from the final dataset.

In accordance with Eurostat/OECD recommendations, firms for which the growth in turnover may be due to mergers or take-overs are therefore excluded from the sample.

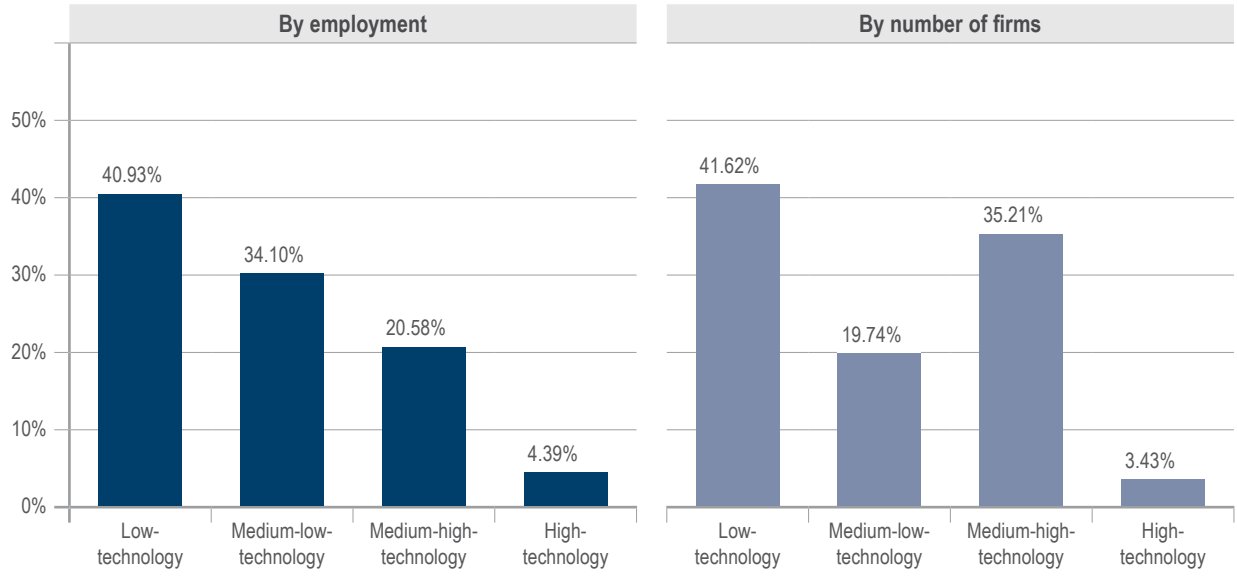
The threshold for HGFs may be easier to reach depending on the size of the company, its area of activity or the geographical location. These different factors are therefore taken into account in all econometric specifications aiming to assess the likelihood of high growth. Besides the binary indicator of HGFs, similar econometric analyses are carried out to estimate the likelihood of growth. In those cases, the dependent variable *positive growth* takes the value of 1 if the turnover in year t is bigger than the turnover in year t-3, and is otherwise 0.

Industry groupings

In the present report only firms which are active in manufacturing industries are analysed. Wherever appropriate, controls for the narrower set of industries, either on the basis of NACE division level (two-digit industry) or on the basis of broader Eurostat classifications, are included in the analyses.

The first industry classification used in the report is based on the technology intensity of the industry. In accordance with this classification, firms are grouped into industries with the following characteristics: high-technology, medium-high-technology, medium-low-technology, low-technology[8]. As reported in Figure 3.1, a majority of the SMEs in the sample used for the study are operating in low-tech industries. Only 3.4% of these SMEs, representing 4.4% of employment in the sample, belong to high-tech industries.

Figure 3.1:
Share of industry groupings in manufacturing (by technology intensity)

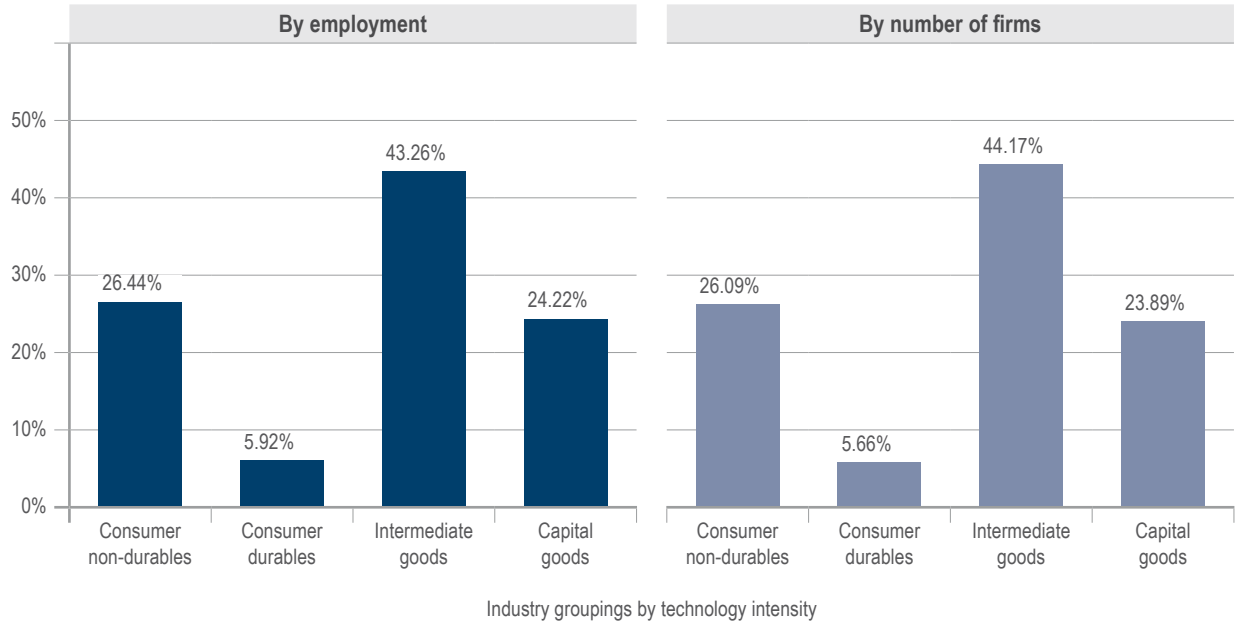


Note: The share in manufacturing industries is calculated from sample data, as a mean over the period 2005-2010.
N = 181 803 observations for 56 912 individual firms.

8 https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries.

A second classification, the main industrial groupings (MIG) classification, is also used to group industries into producers of capital goods, intermediate goods, consumer durable goods, consumer non-durable goods and energy.[9] Due to the small number of observations for energy producers, this group is not included in the analyses in this report. Whenever the analysis focuses on MIG sectors, however, they are included in all the other parts of the descriptive and econometric analyses. More details on both classifications are presented in Annex I. As reported in Figure 3.2, a large share (44%) of the SMEs analysed in the study are operating in intermediate goods industries. Capital goods and consumer non-durables are represented in roughly equal proportions. Consumer durable industries have the smallest weight in the sample, with about 6% of all SMEs and 6% of total employment by those SMEs.

Figure 3.2: Share of industry groupings in manufacturing (by final product type)



Note: The share in manufacturing industries is calculated from sample data, as a mean over the period 2005-2010.
N = 181 803 observations for 56 912 individual firms. Statistics for the energy group are not shown in this figure.

9 The legal base for the definitions of the MIGs is Commission Regulation (EC) No 656/2007. More information on the MIG classification is available at https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Main_industrial_grouping_(MIG).

3.2 Definition of IP activity of firms

In addition to the variables available in ORBIS, such as turnover, number of employees and industry classification, information about firms' intellectual property rights portfolios, i.e. patenting activity and trade mark and design registrations at either the EPO, EUIPO or national IP office of the country of residence, has been added to the dataset.

The IPR registers used for the present study are the following:

- **PATSTAT** – the Worldwide Patent Statistical Database maintained by the EPO. It contains all records of published patent applications filed with the EPO and the majority of national patent offices around the world. The PATSTAT version used for the present report is PATSTAT April 2013. PATSTAT is the source of data on European and national patent applications made by SMEs.

- **EUIPO registers** – EUIPO maintains the register of European Union Trade Marks (before 23 March 2016 – Community Trade Marks) and Registered Community Designs.

- **National IPR registers** – data on ownership of national trade marks and national registered designs used for the study was obtained from national IP offices direct. Whenever necessary, additional information on those IP rights has been supplemented by data from TMView and DesignView.

Figure 3.3 illustrates the time windows considered for the analysis of IP activity and growth performance of firms on the basis of the 2005 subset. For this subset of observations the binary variables denoting IP activity are calculated based on IP rights filed between 2000 and 2002 (IP activity time window). The corresponding mean annual growth rate is calculated based on the period 2002 to 2004 (growth time window). The methodological choice of taking only IPR activity prior to the growth period into consideration has the advantage of limiting the endogeneity problem that may arise from the possible positive impact that higher growth may have on the propensity to apply for IPR protection. The final dataset consist of six yearly subsets of data in total, with T0 corresponding to the years 2005 to 2010.

Figure 3.3:
Definitions of IP activity and growth time windows

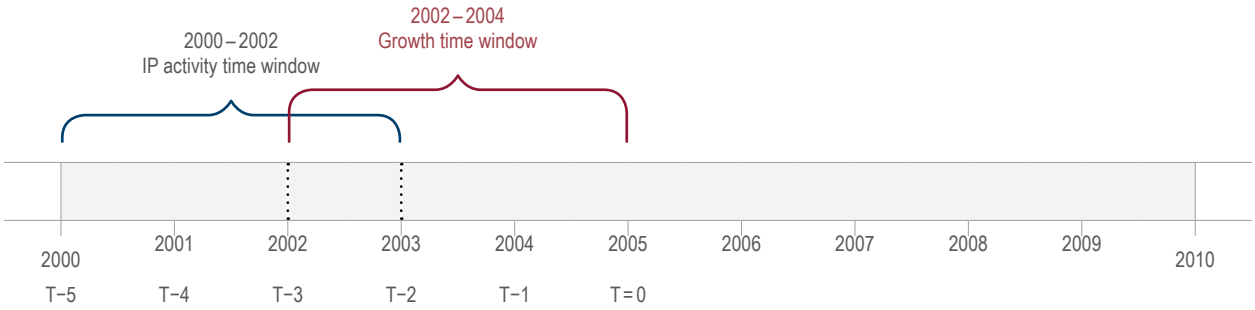


Table 3.1 shows the definitions of the binary variables used in the subsequent analyses.

Table 3.1:
Definition of IP variables

Variable	Definition
Prior national patent applicant (nat_pat_app_prior)	Firm with patent applications filed with the relevant IP office of its seat country in the years t-5, t-4 or t-3
Prior European patent applicant (EP_pat_app_prior)	Firm with patent applications filed with the European Patent Office in years t-5, t-4 or t-3
Prior patent applicant (pat_prior)	Firm with positive values for variables nat_pat_app_prior or EP_pat_app_prior
Prior national trade mark applicant (nat_tm_app_prior)	Firm with trade mark applications registered at the relevant IP office of its seat country in the years t-5, t-4 or t-3
Prior Community trade mark (EUTM) applicant (ctm_app_prior)	Firm with CTM applications filed with EUIPO in the years t-5, t-4 or t-3
Prior trade mark applicant (tm_prior)	Firm with positive values for variables nat_tm_app_prior or ctm_app_prior
Prior national design applicant (nat_des_app_prior)	Firm with design applications filed with the relevant national IP office of its seat country in the years t-5, t-4 or t-3
Prior applicant for Registered Community Design (RCD) (rcd_app_prior)	Firm with RCD applications filed with EUIPO in the years t-5, t-4 or t-3
Prior design applicant (des_prior)	Firm with positive values for variables nat_des_app_prior or rcd_app_prior
Prior IP applicant (ip_prior)	Firm with positive values for variables pat_prior, tm_prior or des_prior
Prior IP bundle (IP_cat)	Firm with a certain combination of patents, trade marks and/or designs (calculated based on the variables pat_prior, tm_prior or des_prior).

3.3 Matching data sources and description of final dataset

The study is based on a dataset that contains ORBIS company level data matched with IPR data. This makes it possible to examine the correlation between the growth performance of the companies and the main IP-related variables of interest. The data from various sources has been matched with the algorithm, taking into account similarity of names of firms, their legal forms and geographical location. The algorithm is described in detail in previous EPO/EUIPO publications (EPO and EUIPO, 2016; EUIPO, 2017).

The final dataset consists of 208 084 observations for 64 998 unique small and medium-sized enterprises for which information about at least one three-year period of turnover growth is available. Overall, six subsets of data are available spanning the years 2005 to 2010. Every firm in the dataset has a seat in one of the 12 member states of the European Union[10]. There are 11 475 records of firms which met the threshold of high turnover growth during one of the six years of the analysis, representing 7 831 unique firms.

As a result of incomplete availability of turnover data in ORBIS, the distribution of firms by country in the sample does not reflect the distribution of firms in the entire population of SMEs (see Annex II, Table 9.2). The econometric analysis therefore controls for the country of origin of the SME.

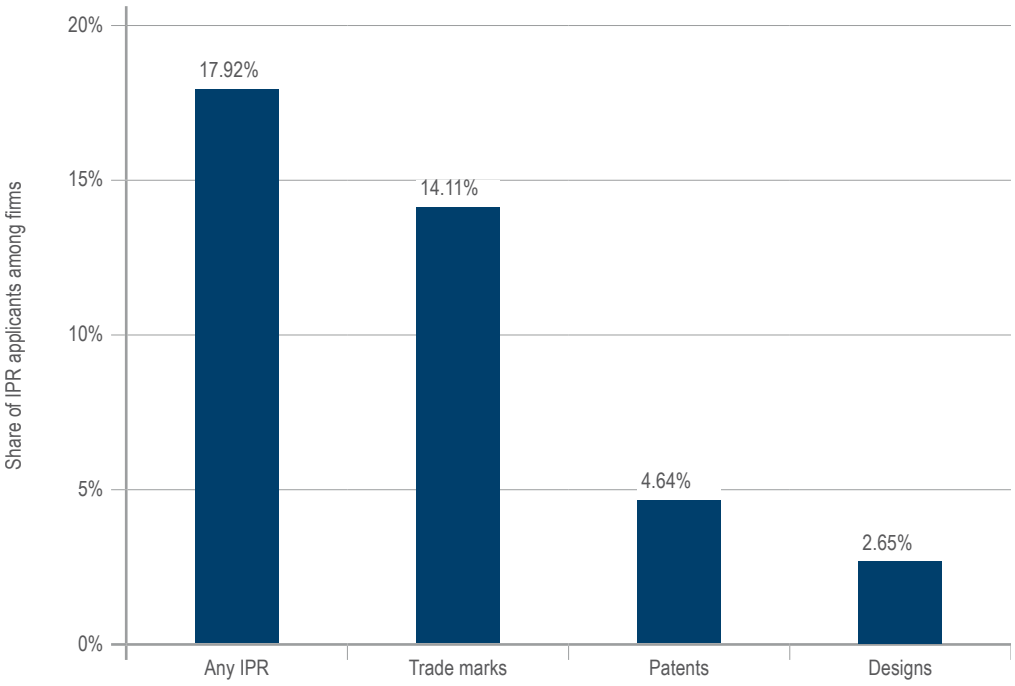
10 The 12 member states are: Austria, Belgium, Germany, Denmark, Spain, France, Hungary, Italy, Lithuania, the Netherlands, Portugal and the United Kingdom. Those are the countries for which register data was matched with ORBIS for use in the EUIPO (2015) study. For logistical reasons, it was not possible to carry out the matching for all 28 EU member states.

04 / A window on European SMEs: descriptive statistics

4.1 General profile of IPR applicants

About 18% of the European SMEs considered in this study filed for patents, trade marks or design rights, or a combination thereof, during the period of analysis.[11] Trade marks were filed by 14% of all SMEs, and are therefore by far the most frequently used category of IPR among them. The share of patent-using SMEs is limited to 4.6%, and only 2.6% of SMEs filed design rights.

Figure 4.1:
Frequency of IPR use by European SMEs in the sample

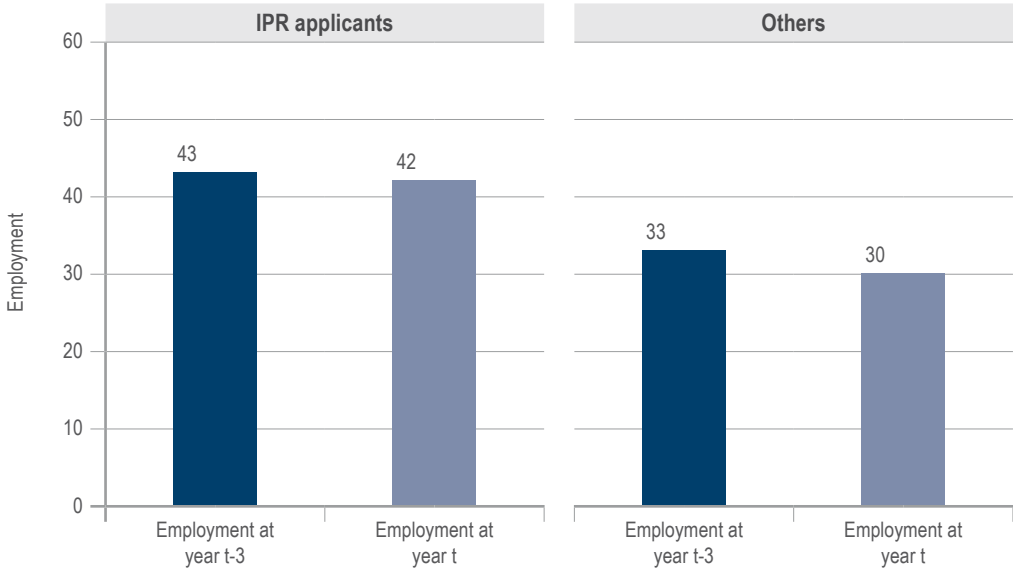


11 Note that in contrast to previous EPO and EUIPO studies, the sample in this study is limited to manufacturing industries. Micro firms and firms that are part of a larger enterprise are also not included. The propensity of firms included in the sample to use IPRs is therefore higher than the equivalent propensity within the entire sample of SMEs as reported in previous studies (see EPO and EUIPO, 2016; EUIPO, 2015).

As can be seen in Figures 4.2 and 4.3, SMEs that file for IPR protection tend to be larger than those that don't. IPR-using SMEs had a median size of 43 employees at the beginning of the period of analysis, compared with 33 employees for the other SMEs. Likewise, they had a median turnover of about EUR 7 million, which is about 50% higher than the median initial turnover observed for the other SMEs.

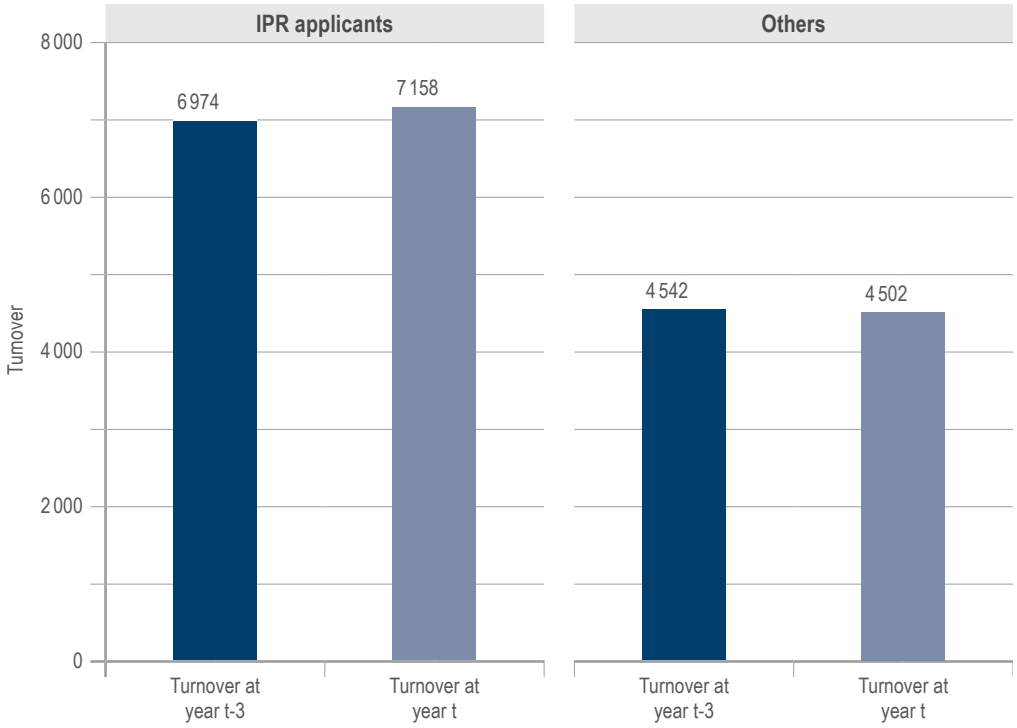
IPR-using SMEs also seem to perform better than the other SMEs. Median employment decreased in both groups of firms during the three-year periods of analysis. However, this reduction was lower for IPR applicants than for other firms (Figure 4.2). The median turnover for IPR applicants rose during the three-year periods of analysis (Figure 4.3). In the same time the median turnover of other firms not applying for IPR protection slightly declined. Overall, the observation of trends in employment and turnover therefore indicates a higher performance of IPR-using SMEs during the period of analysis.

Figure 4.2: Comparison of median employment growth for IPR applicants and other firms



Note: The figure shows the median employment at year t-3 and t calculated as a mean of values for years (t) 2005 to 2010.
Median employment has been calculated separately for IPR applicants (any of the categories explained in Table 3.1) and firms that did not apply for IPR protection between years t-5 and t-3. N = 181 803 observations for 56 912 individual firms.
Differences in medians (both between groups and between different time periods within the same group) are statistically significant at a 95% confidence level, based on Kruskal-Wallis pairwise tests.

Figure 4.3: Comparison of median turnover growth for IPR applicants and other firms

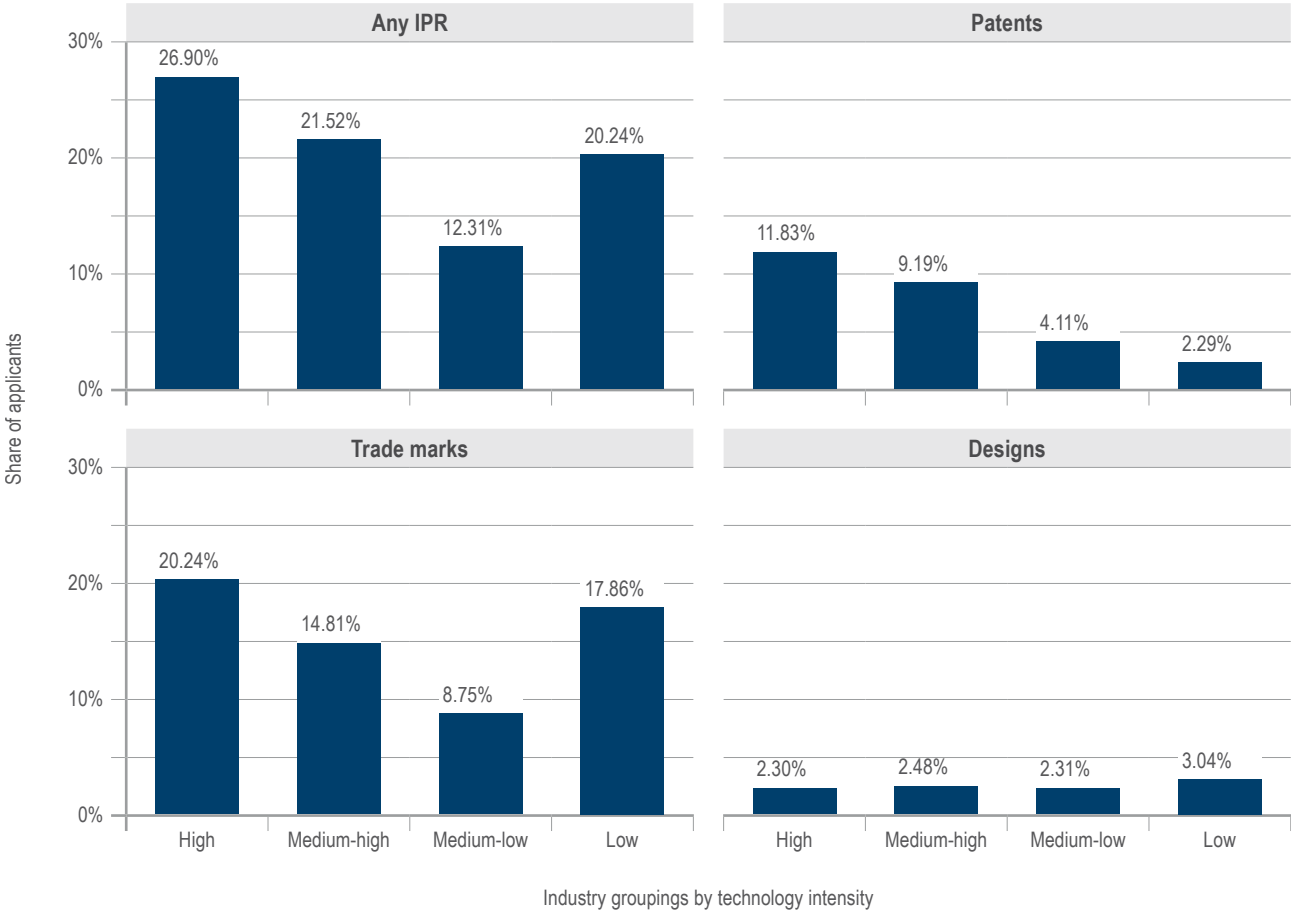


Note: The figure shows the median turnover at year t-3 and t calculated as a mean of values for years (t) 2005 to 2010.
Median employment has been calculated separately for IPR applicants (any of the categories explained in Table 3.1) and firms that did not apply for IPR protection between years t-5 and t-3. N = 208 084 observations for 64 998 individual firms.
Differences in medians between IPR applicants and non-applicants are statistically significant at a 95% confidence level. The difference between turnover at year t-3 and turnover at year t is significant only for the non-IPR group. The difference between turnover at year t-3 and turnover at year t for IPR applicants is not statistically significant at a 95% confidence level, with p-value of 0.78. Kruskal-Wallis pairwise tests were used to determine the statistical significance of medians.

The category of IPR-using firms is, however, very broad. A closer analysis is therefore necessary to better understand the distribution of these firms between different categories of industry as well as their propensity to use one or other category of formal IPRs.

As shown in Figure 4.4 the distribution of IPR-using firms is very skewed towards technology-intensive industries, although those industries represent only a small share of the population of SMEs analysed in the study (see Figure 3.1 for a comparison). Both the share of IPR use and the share of HGFs are increasing from medium-low to high-technology industries, due to a more frequent use of both patents and trade marks. Low-technology industries appear as an exception. Despite a very low share of patent-using firms, they have a high (20%) share of IPR-using SMEs due to the frequent use of trade marks. Low-technology industries are also those where SMEs make the most frequent use of design rights.

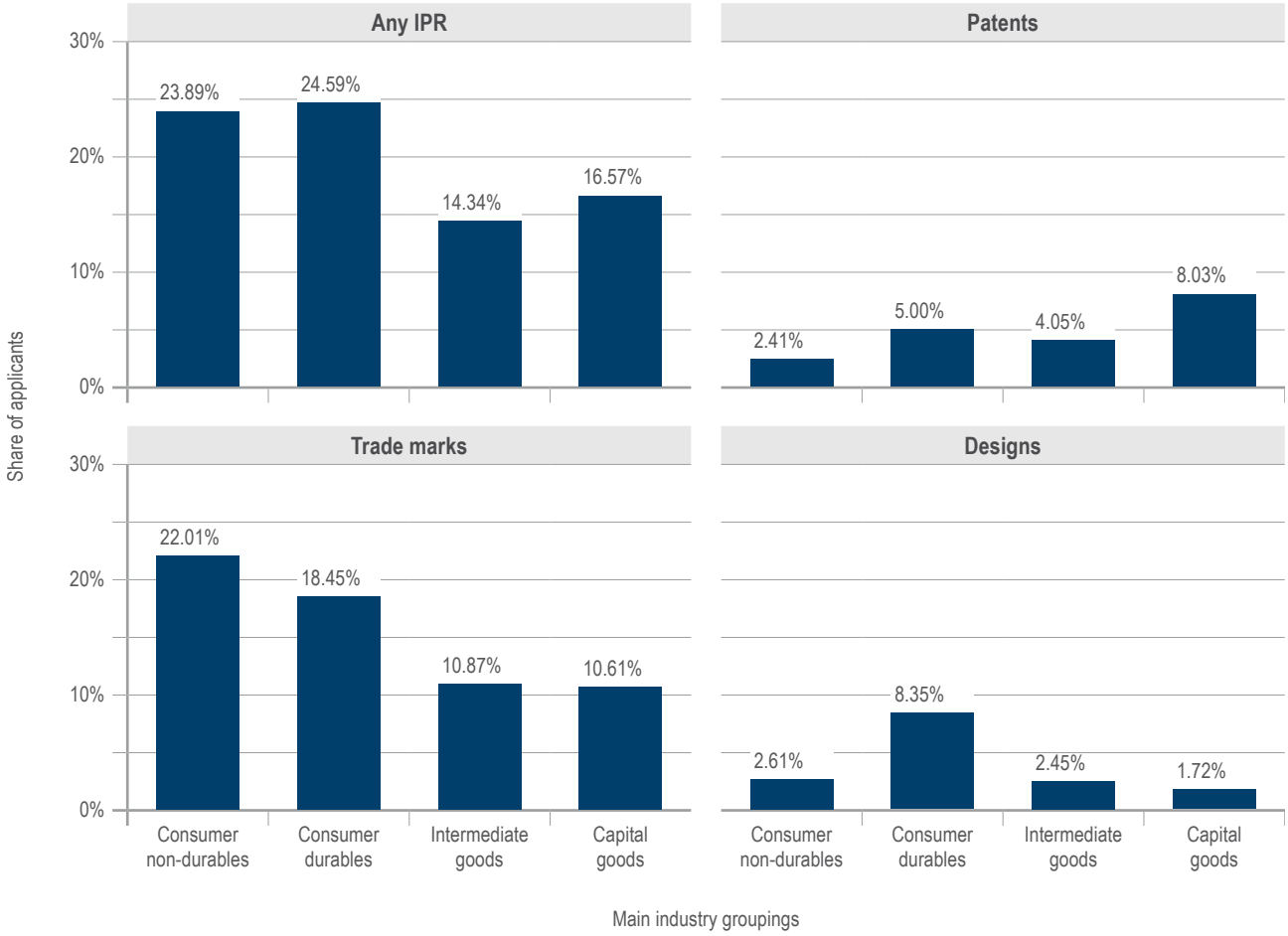
Figure 4.4:
IPR applicants by industry groupings (technology intensity)



Note: The share of HGFs within technology intensity based industry groupings is calculated as a mean over the period 2005-2010. IPR application categories are defined in accordance with definitions explained in Table 3.1. N = 208 084 observations for 64 998 individual firms. All the differences between industry groupings, except for design applications, are statistically significant at a 95% confidence level, In the case of designs, only the differences between low technology and other groupings are statistically significant, with all the other pairwise differences not significant at a 95% confidence level. For the overall statistical significance of the results, one-way ANOVA has been used. The Tukey Honest Significant Differences method was used for pairwise comparisons between industry groupings.

Figure 4.5 in turn indicates the distribution of IPR-using SMEs between the main industry groups (MIG). It shows that this distribution is skewed towards consumer-oriented industries, although these industries do not represent the majority of SMEs in the sample used for the study (see Figure 3.2 for a comparison). Consumer goods industries are especially prone to apply for trade mark protection. Over one fifth of firms in consumer non-durable industries applied for national or European trade marks within a three-year time window (t-5 to t-3). In comparison, this ratio is just above 10% for firms in intermediate or capital goods industries. By contrast, capital goods industries have the highest propensity to use patents. Over 8% of firms representing this group applied for patent protection.

Figure 4.5:
IPR applicants by main industry groupings

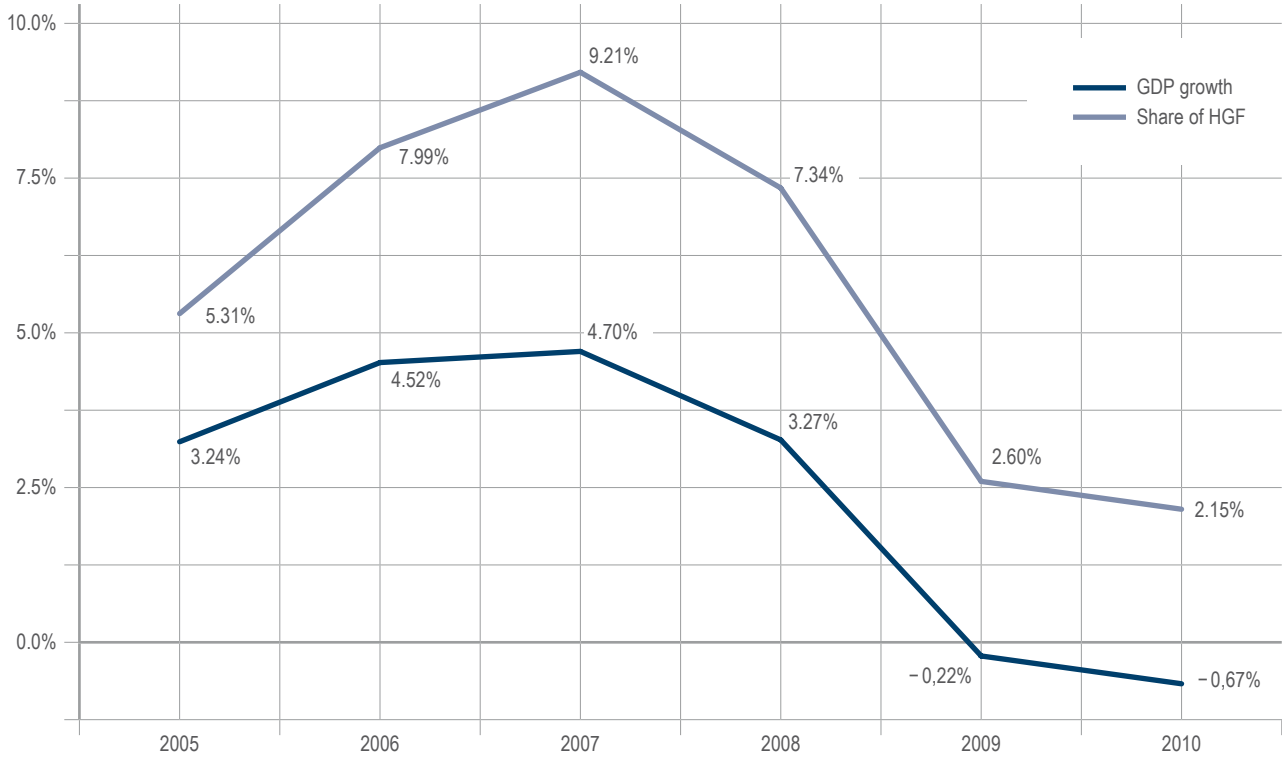


Note: The share of IPR applicants within MIG is calculated as a mean over the period 2005-2010. IPR application categories are defined in accordance with definitions explained in Table 3.1. N = 207 684 observations for 64 887 individual firms. The following differences are found to be non-significant at a 95% confidence level: within any IPR category – difference in IPR use by consumer durables and consumer non-durables sectors. Within the trade mark category – difference in trade mark use by intermediate goods and capital goods sectors. Within the design category –difference between intermediate goods and consumer non-durables sectors.
All other pairwise differences in use of IPRs are statistically significant. One-way ANOVA was used for the overall statistical significance of the results. The Tukey Honest Significant Differences method was used for pairwise comparisons between industry groupings.

4.2 General profile of high-growth firms

The proportion of HGFs in the dataset amounts to 6.5%, and is therefore smaller than the proportion of IPR-using firms. However, there are important differences in high growth rates depending on the year and the sector of activity. As can be seen in Figure 4.6 there are large fluctuations between annual rates of HGFs. Those rates are highly correlated with overall economic growth. In times of economic upsurge, such as 2007, the rate of HGFs among manufacturing firms rose to over 9%. However, when the economic crisis struck the economies of the EU in 2008, the share of HGFs among manufacturing firms dropped to just over 2%.

Figure 4.6:
Share of HGFs as a percentage of manufacturing firms

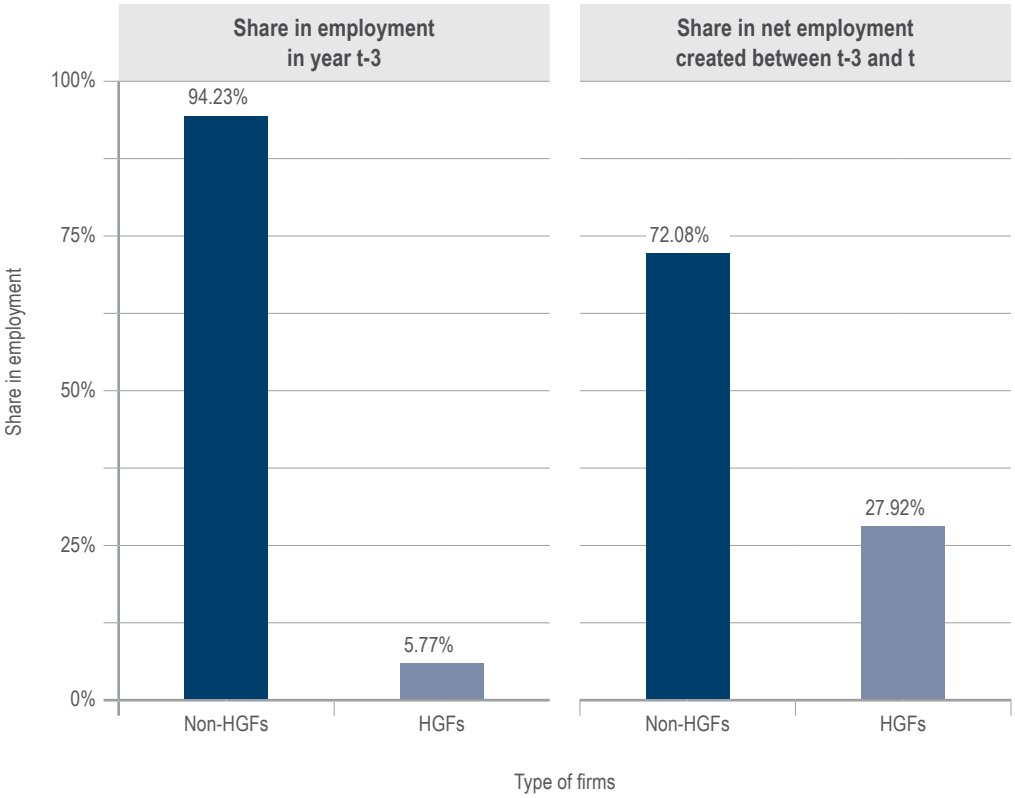


Note: N = 208 084 observations for 64 998 individual firms. The variable GDP growth is calculated as a mean annual growth of gross domestic product at market prices (in EUR) between the years t-3 and t for the 12 member states represented in the dataset.[12]

The impact of HGFs on the economy is much bigger than their sheer number suggests. Although the share of HGFs in total employment is relatively low and amounts to less than 6%, their share in net employment creation during the phase of rapid growth is much bigger and on average surpasses 25% of all jobs created during the three years of growth analysis (see Figure 4.7).

12 Source of GDP data: Eurostat table *nama_10_gdp*.

Figure 4.7:
Share of HGFs in total employment and net employment created

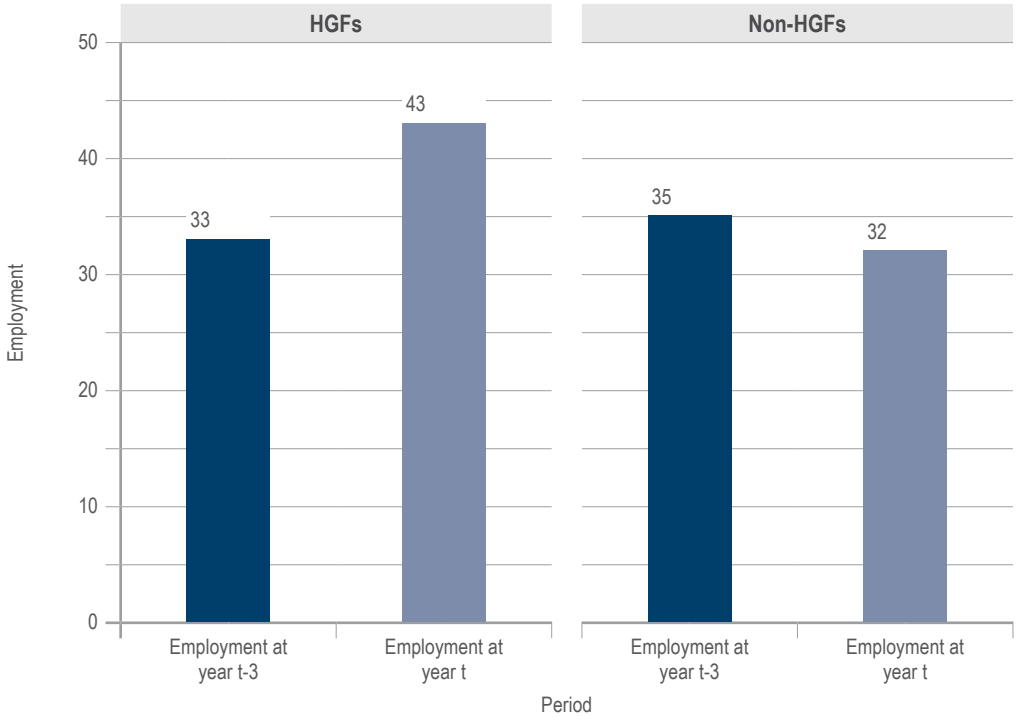


Note: The share in employment in year t-3 is calculated as a simple mean of ratios of employment in firms that subsequently achieved the status of HGF to employment in other firms not achieving this status in year t. The mean has been calculated for all the firms with employment data (N = 181 803) and years (t) 2005 to 2010. The highest share of HGFs in total employment reached 9.4% in 2007 and the lowest value of 2.3% was registered in 2010.

For the calculation shown in the right-hand panel only firms that increased employment over the period t-3 to t have been taken into account (N = 70 388). For each year the net employment created by firms from both groups was compared with total net employment. The highest ratio of HGF share in net employment created by HGFs was registered in 2006 (35%), the lowest in 2009 (18%). The figure shows the simple mean of annual values.

As shown in Figure 4.8, whereas in the group of HGFs the median employment between year t-3 and t increased by 10, from 33 to 43 employees, within the group of firms that did not achieve the status of HGF, median employment fell by 3 from 35 to 32 employees in the same period.

Figure 4.8:
Comparison of median employment growth for HGFs and non-HGFs in manufacturing

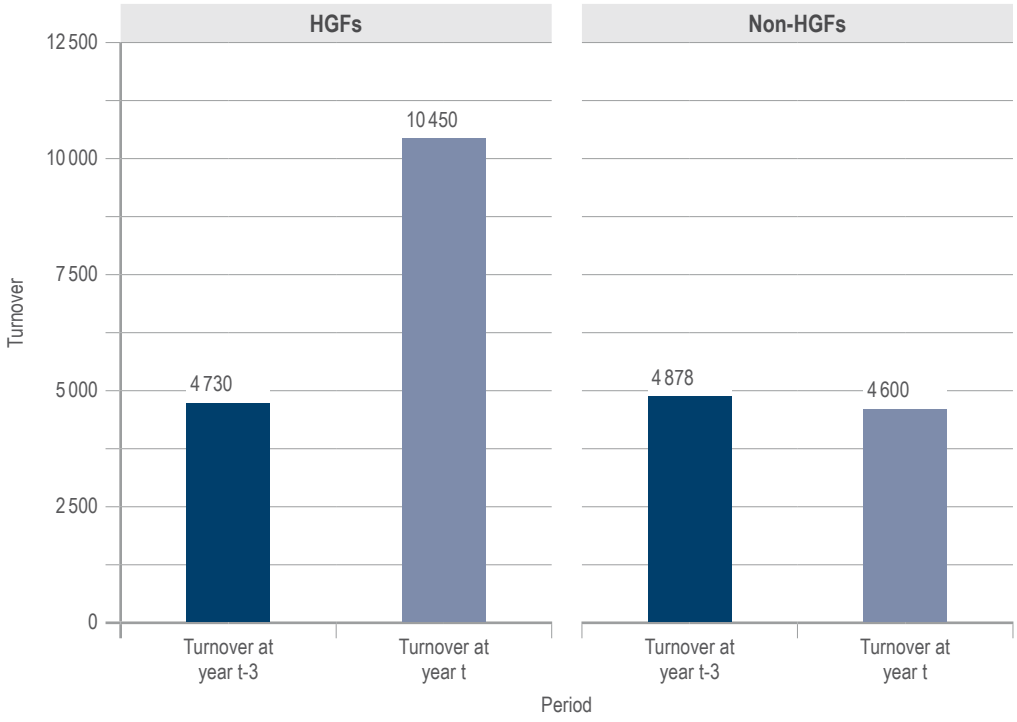


Note: The figure shows the median employment at year t-3 and t calculated as a mean of values for years (t) 2005 to 2010. Median employment has been calculated separately for HGFs and firms that did not achieve this status at year t. N = 181 803 observations for 56 912 individual firms. Differences in medians (both between the groups and between different time periods within the same group) are statistically significant at a 95% confidence level based on Kruskal-Wallis pairwise tests.

The difference in sales evolution between HGFs and other firms is even more pronounced. As illustrated in Figure 4.9, whereas the median turnover of HGFs more than doubled during the growth analysis period, it slightly decreased for firms that did not achieve that status.

In general, the analysis of the dataset confirms the observations from previous research literature, namely that although HGFs represent a small percentage of manufacturing firms, they play an important role in the economies of EU member states. They are responsible for a sizable share of new employment and are significant actors in the industrial landscape.

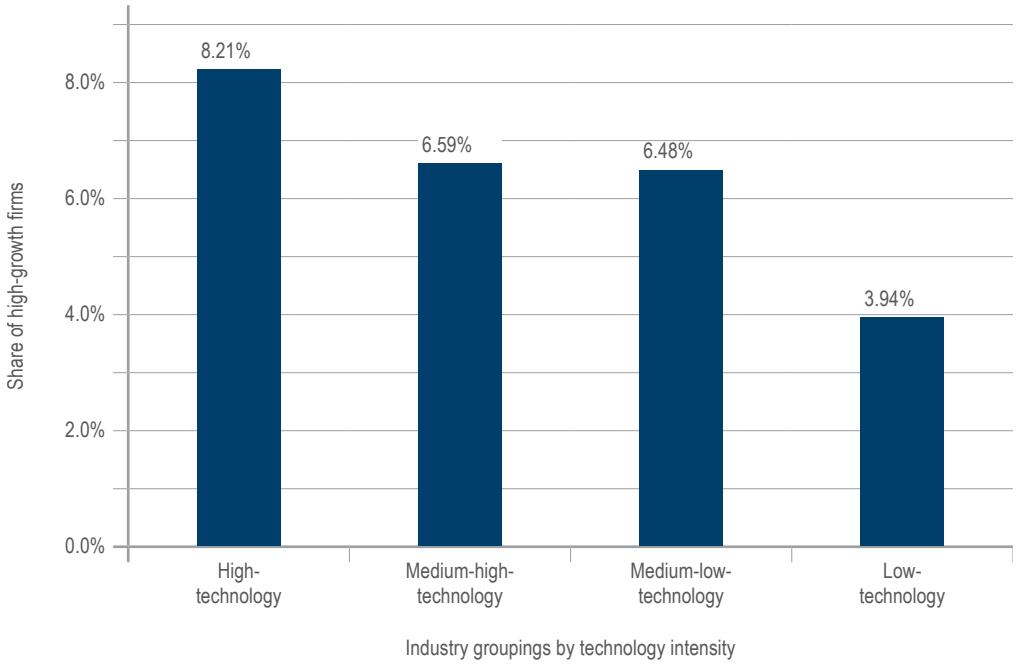
Figure 4.9:
Comparison of median turnover growth for HGFs and non-HGFs in manufacturing



Note: The figure shows the median turnover at year t-3 and t calculated as a mean of values for years (t) 2005 to 2010. Median employment has been calculated separately for HGFs and firms that did not achieve this status at year t. N = 208 084 observations for 64 998 individual firms. Turnover is given in EUR '000. Differences in medians (both between the groups and between different time periods within the same group) are statistically significant at a 95% confidence level based on Kruskal-Wallis pairwise tests.

Figures 4.10 and 4.11 in turn present statistics on the share of HGFs for different categories of manufacturing industries. Figure 4.10 clearly shows that the share of HGFs is positively correlated with the technology intensity of industries, which corresponds to the pattern also observed for IPR-using firms. The rate of high-growth firms in high-technology industries (such as pharmaceuticals, electronics and air and spacecraft and related machinery) is more than twice as high as the rate of high-growth firms in low-technology industries (such as the manufacturing of textiles, food products or paper). The rates of HGFs in the mid-technology industries are between the rates of high- and low-technology sectors.

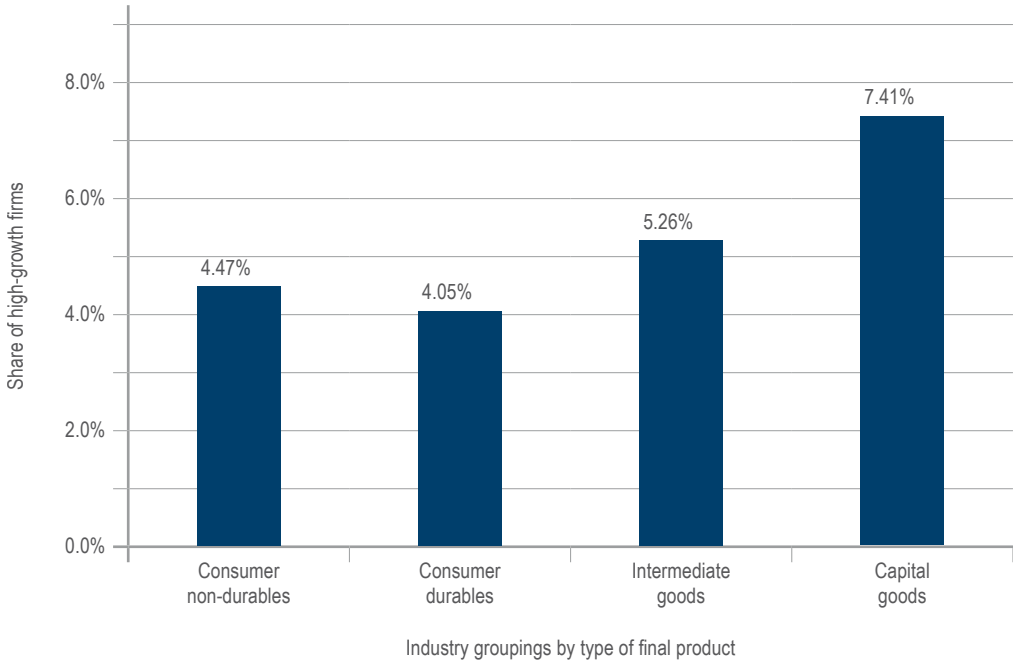
Figure 4.10:
Share of HGFs by industry groupings (technology intensity)



Note: The share of HGFs within technology intensity based industry groupings was calculated as a mean over the period 2005-2010.
N = 208 084 observations for 64 998 individual firms.
Differences between industry groupings are statistically significant at a 95% confidence level, except for the difference between medium-low and medium-high technology sectors. One-way ANOVA was used for the overall statistical significance of the results. The Tukey Honest Significant Differences method was used for pairwise comparisons between industry groupings.

MIG categories provide a different perspective on the distribution of industries, based on the distinction between the types of goods produced in each industry. As shown in Figure 4.11, capital goods industries (such as the manufacture of machines or motor vehicles) have the highest share of HGFs with over 7%. Intermediate goods industries (e.g. the manufacture of electrical goods and textiles) follow with an HGF share of 5.3%. Consumer non-durables (e.g. recorded media, cosmetics and pharmaceuticals) and consumer durables (e.g. consumer electronics, furniture and jewellery) have lower HGF shares of 4.5% and 4% respectively. This pattern differs from the observed distribution of IPR-using firms, whereby those firms were mainly present in consumer-oriented industries.

Figure 4.11:
Share of HGFs by main industry groupings

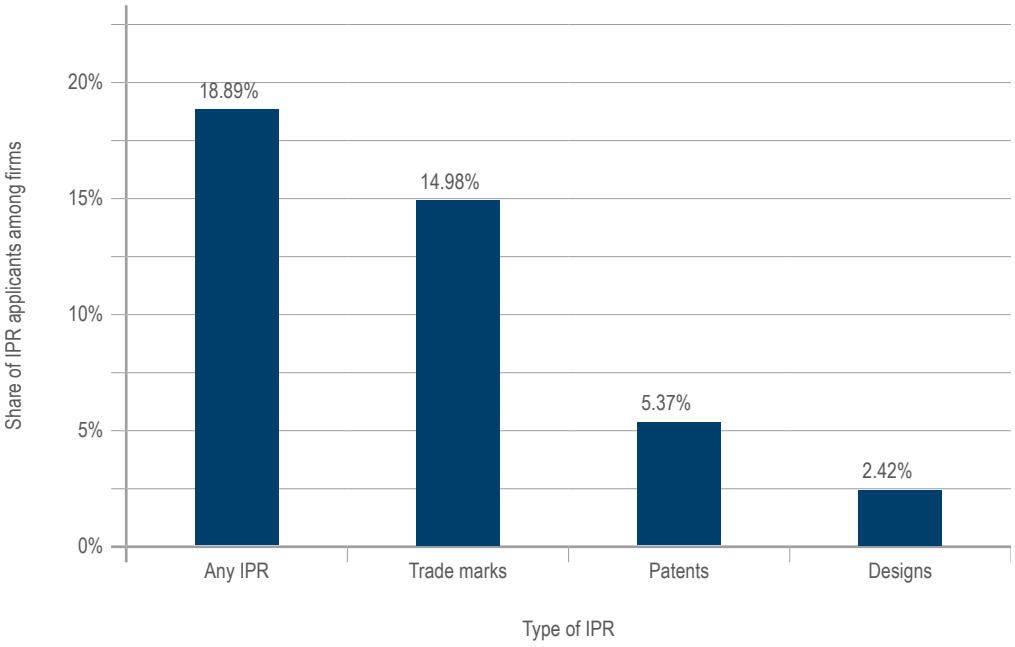


Note: The share of HGFs within MIG was calculated as a mean over the period 2005-2010.
N = 207 684 observations for 64 887 individual firms.
Differences between industry groupings are statistically significant at a 95% confidence level, except for the difference between the consumer durables and consumer non-durables sectors. One-way ANOVA was used for the overall statistical significance of the results. The Tukey Honest Significant Differences method was used for pairwise comparisons between industry groupings.

Figure 4.12 indicates the frequency of IPR use by HGFs. Overall, about 18.9% of HGFs in the database have been using IPRs, which is slightly above the share of IPR-using firms observed in the entire population of SMEs (17.9%, see Figure 4.1). The percentage of HGFs that have been using patents and trade marks is also slightly above the shares of SMEs using these IPRs in the entire population. By contrast, design rights are used by a slightly lower proportion of firms in the population of HGFs than in the entire population of SMEs considered in the study.

These differences are, however, difficult to interpret, as they may be related to the different distribution of SMEs and HGFs between industries. Against this backdrop, the purpose of the next section is therefore to use econometric analysis to identify potential correlations between the use of IPRs and high growth experienced by some SMEs, after controlling for confounding factors such as the country and industry where the SMEs operate.

Figure 4.12:
Frequency of IPR use by HGFs



Note: N = 11 475 observations for 7 831 individual firms.

05 / Econometric analysis

5.1 Introduction

In order to further analyse the use of IP rights by HGFs, this chapter assesses whether the filing of IP rights can provide a reliable indicator of future (high) growth of European SMEs. Considering SMEs from the external perspective of investors, business partners and policy analysts, it addresses the following questions:

- *Is the filing of IP rights a reliable signal of the growth potential of European SMEs?* The use of IP rights indicates that an SME has been engaged in innovative and/or creative activities, and that it has secured legal protection of the resulting intellectual assets. As such, it is expected to provide a good benchmark indicator for promising SMEs.

- *Does the filing of European IP rights signal a higher likelihood of SME growth?* The development of European SMEs frequently implies an international expansion beyond their domestic market. Since European patents, trade marks and designs span several national markets and are often used to protect more valuable intellectual assets (OECD, 2009), they are likely to signal a higher growth potential for innovative SMEs.

- *What are the types and combinations of IP rights that work best as indicators of high growth potential?* Patents, trade marks and designs protect specific types of intellectual assets, thereby providing potentially different information on the profile and growth potential of SMEs. The respective importance of these IP rights also varies between industries, and their value as a signal of future growth may therefore differ accordingly.

An econometric approach has been followed to address these questions. It consists of assessing the relation between the IP filing activities of SMEs during the *previous* three-year period and the likelihood that they will grow in the *subsequent* three-year period.

Besides prior IPR ownership, the estimated model takes into account other factors – such as the initial size and age of the SMEs, or the industry in which they operate – that may influence future growth (a more detailed description of the methodology is provided in section 5.2). The model therefore makes it possible to assess the predictive power of prior IP ownership as a signal of the future growth of SMEs. Importantly, this predictive power should not be interpreted as a causal effect: the mere filing of an IP right cannot trigger growth, but it may signal a firm's ability to sustain growth through the creation, protection and exploitation of intellectual assets.

The following sections review different indicators based on prior IPR ownership, taking into account the diversity of IP rights as well as their geographical scope. All of them are found to provide effective signals as to the future growth of SMEs.

5.2 Probabilities, odds and interpretation of logistic regression model results

The dependent variable of interest in the present report is the high growth (positive growth) event which is dichotomous and takes a value of 1 if a firm achieved a turnover growth of 20% or more (more than 0% in the case of positive growth) in three consecutive years and 0 if it did not. The main interest lies in predicting the probability of a positive outcome, i.e. observing a high-growth period (positive growth period). In the case of a binary dependent variable, the standard OLS model is not adequate. Fitted probabilities estimated by linear probability models may take values below zero and greater than one. Those limitations may be dealt with by using the binary response models. In the present report, the logistic regression model is employed for estimating the relationship between prior IPR application and high (positive) growth periods.

Logistic regression uses the logistic function to model a mean of the dependent variable. For a binary dependent variable, the probability that it takes a value of 1 is defined as π. Logistic regression focuses on modelling $\mathrm{logit}(\pi)$, which equals the natural logarithm of $\pi/(1-\pi)$. Logistic regression describes the logarithm of odds that the dependent variable takes a value of 1 (high/positive growth) as a function of the values of the predictors as illustrated in equation (2) (Jaccard, 2001):

$$logit\,(\pi) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k \qquad (2)$$

The essence of odds is the comparison of probability of the positive event with the probability of the alternative outcome as in equation (3):

$$Odds = \pi/(1-\pi) \qquad (3)$$

where π is a probability of an event.

Table 5.1 illustrates the relationship between probability and odds.

Table 5.1:
Relationship between probability and odds

Probability	Odds
0.1	0.11
0.25	0.33
0.5	1
0.67	2

If the probability of the event equals 0.5, associated odds of positive outcome are exactly the same as a probability of a negative outcome, hence the odds for positive outcome equal 1.

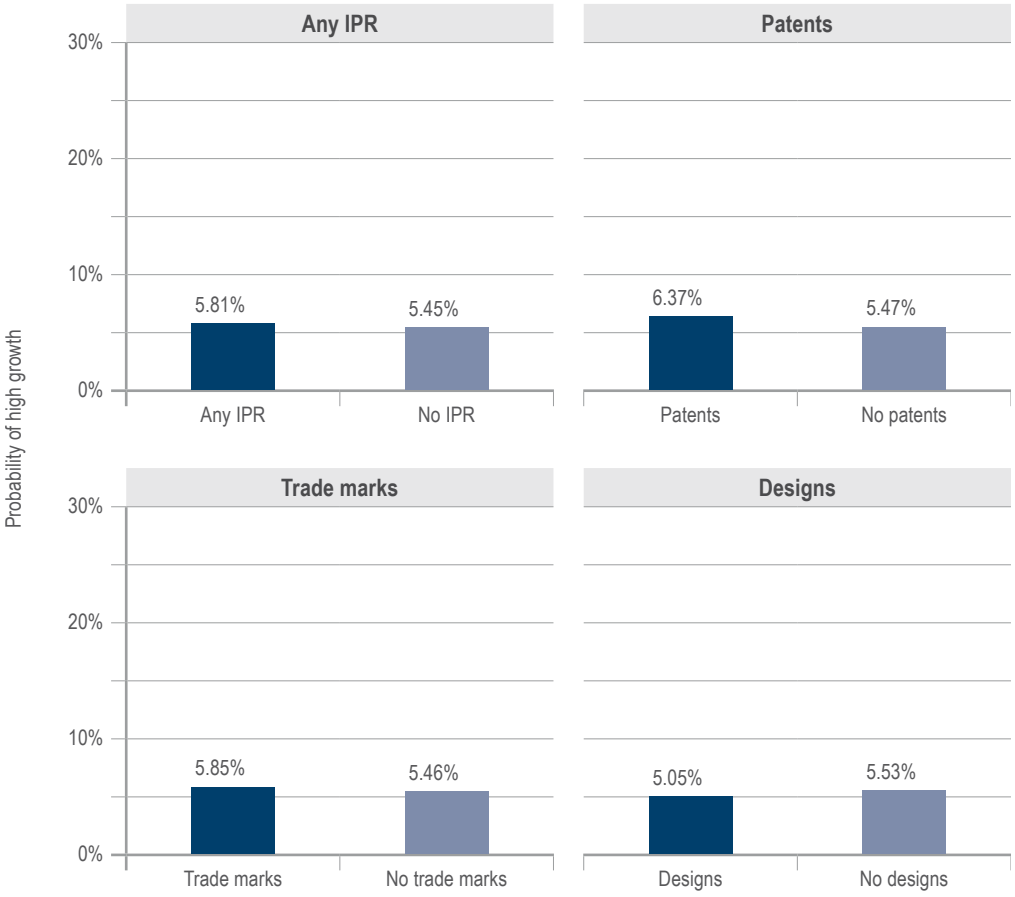
In the subsequent section the results of logistic regression estimation are presented focusing on the focal IPR variables, which, as explained in Table 3.1, also have a dichotomous character and take a value of 1 if a firm applied for the focal IPR in a period t-5 to t-3 and 0 if a firm did not apply for IPR protection. Exponent of the coefficient of the dichotomous IPR variable is equivalent to the estimated ratio of odds for a firm with prior IPR application to odds for a firm without such application, as shown in equation (4):

$$OR = \frac{(odds\ of\ achieving\ high\ growth\ for\ IPR\ applicants)}{(odds\ of\ achieving\ high\ growth\ for\ firms\ not\ applying\ for\ IPR)} \quad (4)$$

where OR is the odds ratio estimated by the logistic regression.

Figure 5.1 shows the rate of high growth among various types of IPR applicants as compared with other firms.

Figure 5.1: Comparison of ratios of high growth conditional on prior IPR applications



Given the ratios shown in Figure 5.1 the odds of a high growth period for IPR applicants, as compared with other firms, calculated from equation (3), are as follows: 1.07 for applicants for any IPR, 1.18 for patent applicants, 1.08 for trade mark applicants and 0.91 for design applicants. Odds ratios are equal to the exponent of the focal IPR coefficient of the logistic regression, where the focal IPR variable is the only independent variable in the model. Ratios above 1 indicate a higher probability of observing a high growth period.

The logistic regressions reported in Annex III allow for the estimation of odds ratios of achieving high (positive) growth of IPR applicants compared with other firms, controlling for other important aspects that may play a role in the propensity to achieve high (positive) growth such as industry of activity, country of seat or year. Additionally, it allows an estimate to be made of the statistical significance of the results. Simple correlation tables are also reported in Annex II.

5.3 Impact of prior IP use

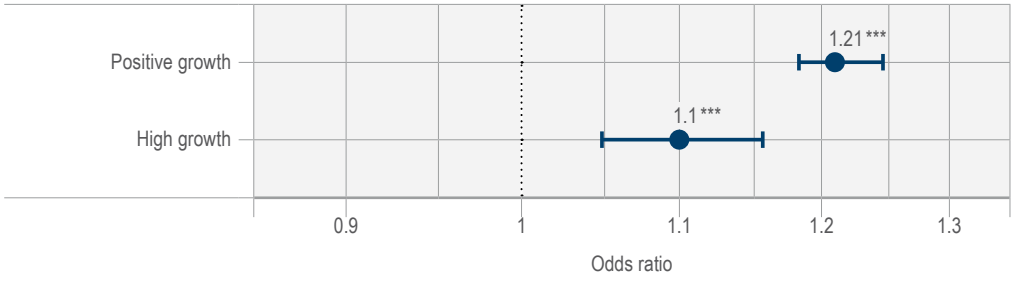
As a first step, this section focuses on the use of IP rights as a possible predictor of SME growth, without establishing any distinction between categories of IP rights. For this purpose, the analysis compares (all other factors being equal) the likelihood that a European SME will experience a (high) growth period if it has – or has not – been filing *any* type of IP rights in the period t-5 to t-3.

Prior IP use is found to be a sensible indicator of future growth, with a positive and significant correlation with both growth and high growth (Figure 5.2). A European SME is about 1.1 times more likely to experience a three-year high growth period when it has been applying for IP rights in the three-year window preceding growth. The likelihood of experiencing a positive turnover growth over three years is likewise 1.21 times higher when the SME has been a prior IPR applicant.

Reading the figures

The following figures show the estimated value of the odds ratio of (high) growth and the 95% confidence interval around this point estimate. A solid line indicates that the estimated odds ratio is statistically significant at 95% confidence level and a dashed line that it is not significant at 95% confidence level. Detailed results of the estimated econometric models are presented in Annex III.

Figure 5.2:
Prior IPR applications and turnover growth



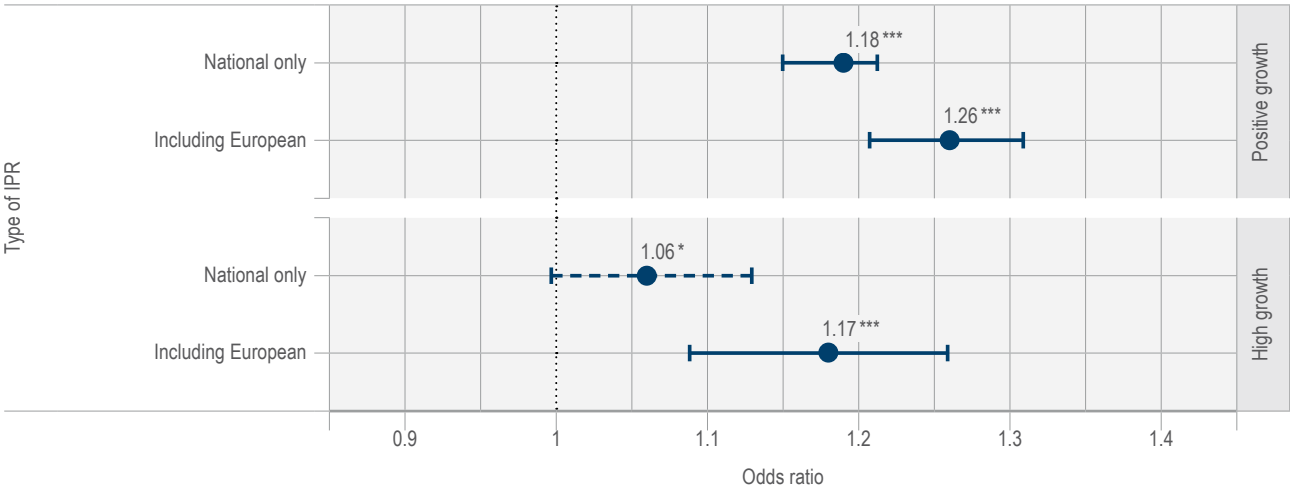
Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior IPR applications and the odds of (high) growth without prior IPR applications. For detailed results of the model estimation see Table 10.1.

National and European IP rights

The same approach can be applied to assess the specific impact of European IP rights. For this purpose, SMEs that have been filing European patent, trade mark and/or design applications are considered as a distinct group, which enables a comparison with SMEs that have only been filing national IP rights (Figure 5.3).

Both the filing of national IP rights and the filing of European IP rights remain statistically significant predictors of SME growth. However, the magnitude and statistical significance of the effects differ between the two categories of IP rights. The likelihood of high growth is 1.06 times higher when SMEs have used national IP rights only – which is below the 1.1 factor observed when all IP rights are pooled – and the statistical significance of this effect is weak.[13] By contrast, the prior use of European IP rights increases this likelihood by a factor of 1.17, thus providing a stronger and statistically significant predictor of high growth.

Figure 5.3:
Prior applications for European IPRs and turnover growth



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior IPR applications and the odds of (high) growth of firms without prior IPR applications. For detailed results of the model estimation see Table 10.2.

Likewise, the likelihood of experiencing a three-year period of turnover growth is 1.18 times higher for SMEs endowed with national IP rights only, as compared with a 1.26 factor for firms applying for European IP rights alone or in combination with national rights. These results therefore suggest that European IP rights are better able to signal innovative SMEs with high growth potential.

13 It only satisfies the 10% threshold.

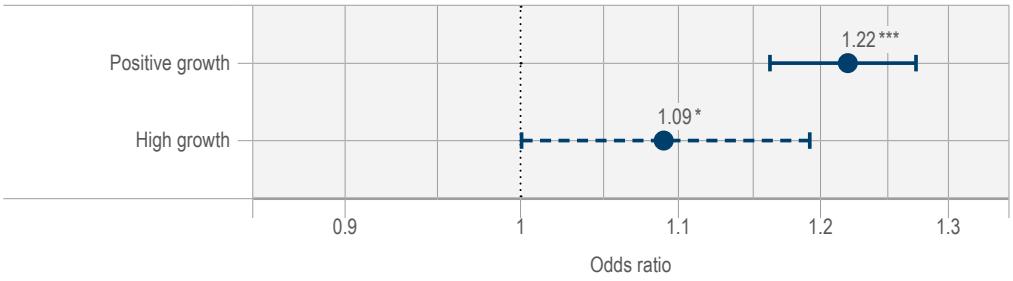
5.4 Patent indicators

This section examines IP indicators based on patents only. These indicators are expected to be more informative about the growth potential of SMEs that innovate in technology. The predictive power of the sole prior filing of patents is therefore tested both at the general level (for all SMEs in the sample) and for SMEs operating in specific industries grouped by technology intensity.

General impact of prior patent use

The prior filing of patents is found to be a significant indicator of future growth (Figure 5.4). A European SME is 1.09 times more likely to experience a high growth if it has been filing patents in the previous period. However, this result is statistically significant at the 90% confidence level only. The likelihood of experiencing a positive turnover growth is 1.22 times higher when the SME has been a patent user. In both cases, prior patent filing is as good a predictor of (high) growth as the pooled IP indicator assessed in the previous section (Figure 5.2).

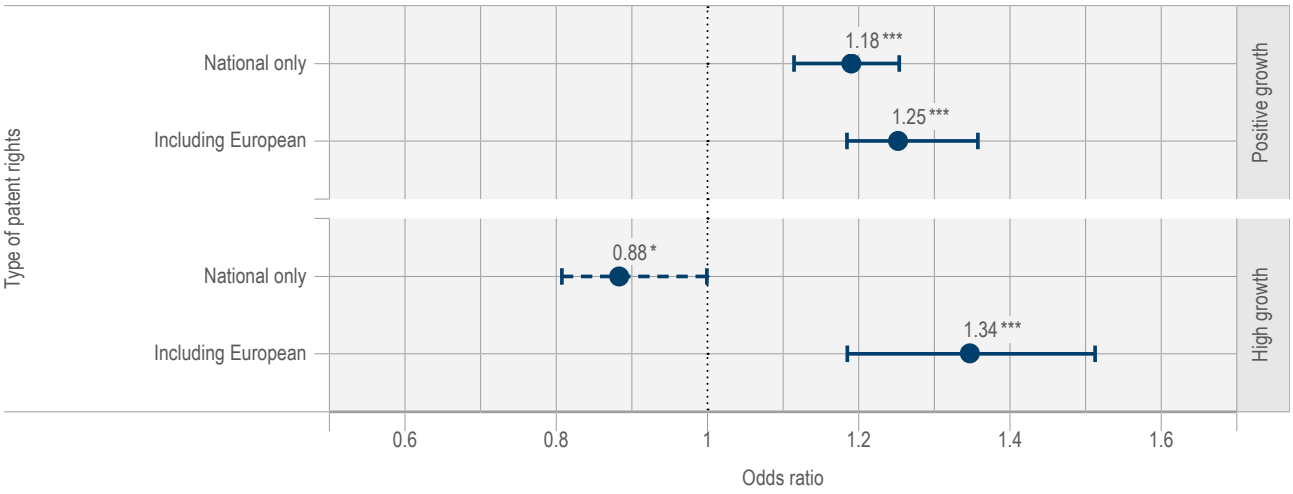
Figure 5.4:
Prior patent applications and turnover growth



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior patent applications and the odds of (high) growth without prior patent applications. For detailed results of the model estimation see Table 10.3.

Patent indicators also confirm that the use of European rights is more strongly associated with future growth (Figure 5.5). The likelihood of turnover growth is 1.18 times higher for SMEs that have only been filing national patents, and 1.25 times higher for those that have been filing European patents, as compared with firms that did not file for patent protection.

Figure 5.5:
Prior use of European patents and turnover growth



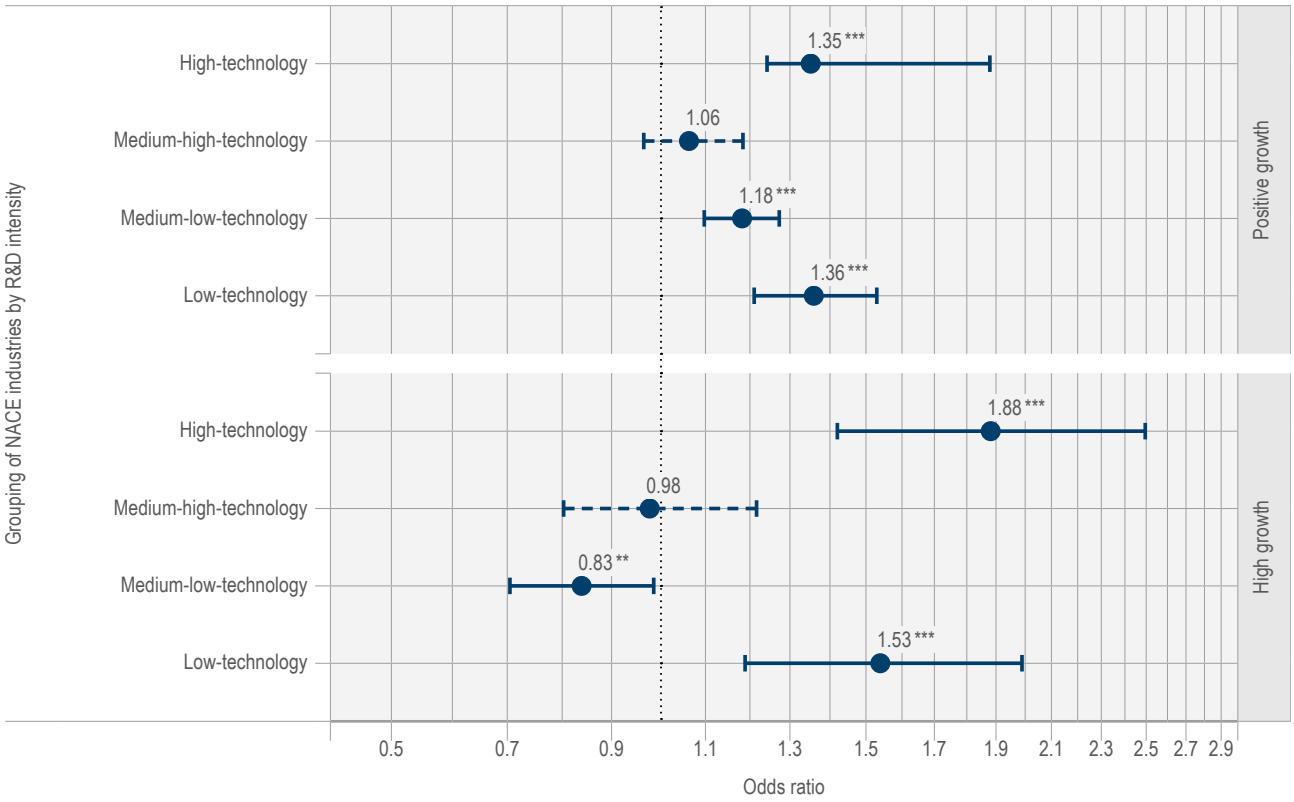
Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior patent applications and the odds of (high) growth without prior patent applications. For detailed results of the model estimation see Table 10.4.

European patents in particular emerge as a powerful signal of the high growth potential of innovative SMEs. The estimated odds ratio of prior filing of European patents is 1.34 in the case of high growth and higher than the corresponding odds ratio for positive growth (1.25). This is not the case for the prior filing of national patents, which does not appear to be significantly correlated with subsequent high growth.

Impact of prior patent use by industry

In Figure 5.6, the correlation between prior patenting and SME growth is further assessed for different industries, as defined by the Eurostat classification of high-tech groups. The results indicate a stronger predictive power of patent indicators in high-tech industries than in medium-high-tech and medium-low-tech industries. Interestingly, they also suggest that patent filing activities are a powerful signal of future growth in low-tech industries.

Figure 5.6:
Prior patent use and turnover growth by industry

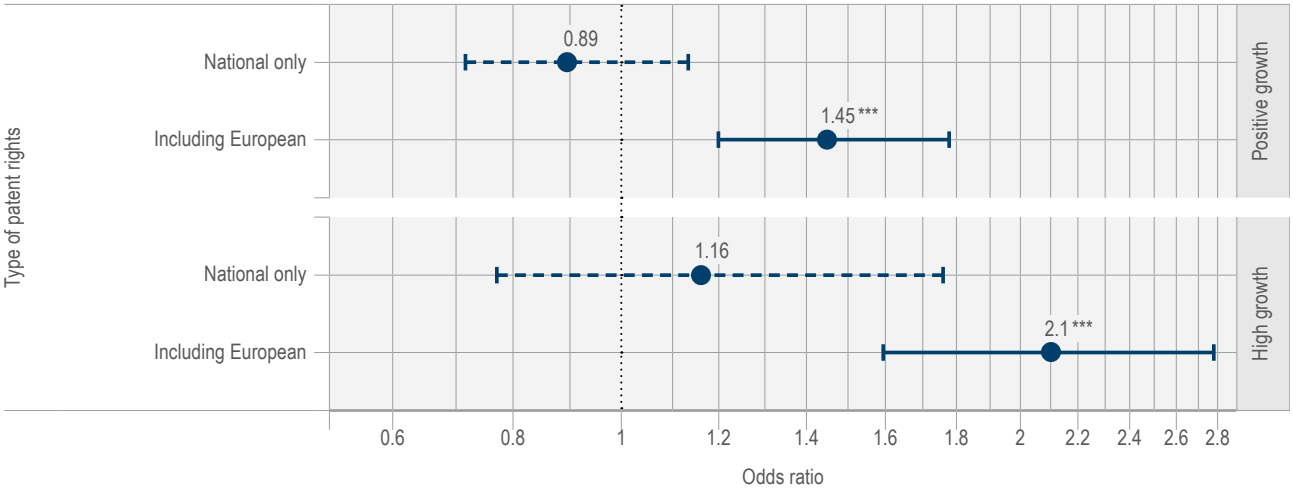


Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior patent applications and the odds of (high) growth without prior patent applications. For detailed results of the model estimation see Table 10.5.

High-tech industries include the manufacturing of pharmaceuticals, computers, electronics, optical products, and air and spacecraft and related machinery, all of which are patent-intensive. Patent indicators are a strong signal of the growth potential of European SMEs in those industries. SMEs with prior patent filings are 1.35 times more likely to experience a growth period, and 1.88 times more likely to experience a high growth period, during the next three years.

A further distinction between national and European patent filings shows that firms in high-tech industries are the key driver of these results (Figure 5.7), thereby underlying the importance of international growth for high-tech SMEs. When restricted to European patents only, the likelihood of growth and high growth is multiplied by even higher factors (1.45 and 2.1 respectively), whereas the prior filing of national patents only is not found to be statistically significant. It appears in particular that European SMEs operating in high-tech industries are twice as likely to experience high growth if they have filed European patents in the prior three-year period.

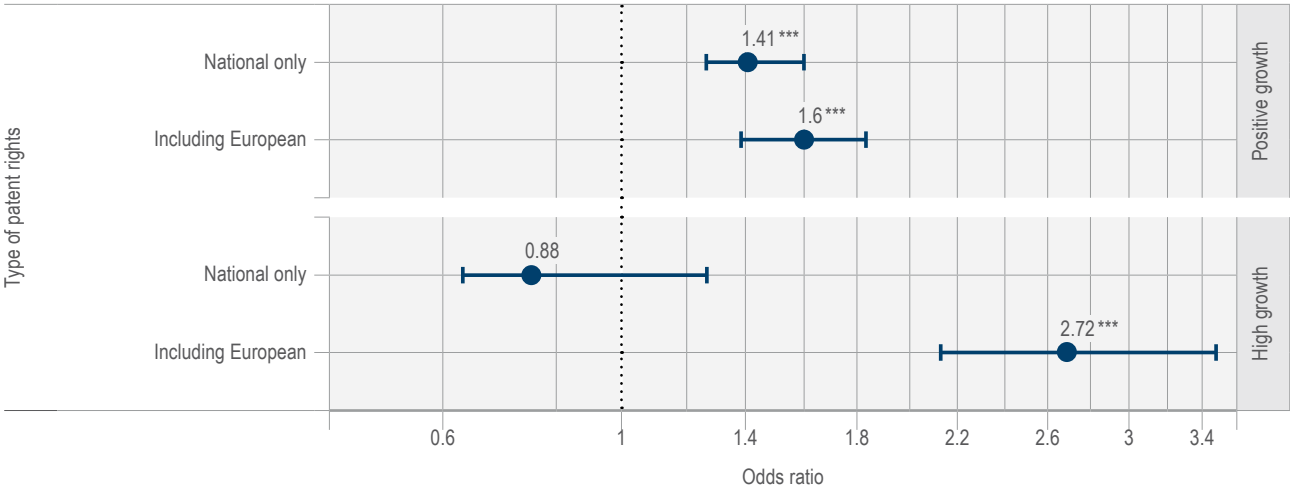
Figure 5.7:
Prior use of European patents and turnover growth in high-tech industries



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior patent applications and the odds of (high) growth without prior patent applications. For detailed results of the model estimation see Table 10.6.

While the predictive power of prior patent use is small and not statistically significant for medium-high-tech and medium-low-tech industries, it turns out to be high and significant in low-tech industries – with significant odds of 1.36 for growth and 1.53 for high growth (Figure 5.6). These industries include sectors such as the manufacturing of food products, textiles, paper and products of wood that are typically not patent-intensive. Prior patent filings in such sectors are therefore likely to reveal the fraction of SMEs that undertake and leverage innovative activities to sustain growth.

Figure 5.8:
Prior use of European patents and turnover growth in low-tech industries



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior patent applications and the odds of (high) growth without prior patent applications. For detailed results of the model estimation see Table 10.7.

Figure 5.8 establishes the distinction between prior applicants for national versus European patents. It shows that both indicators have a roughly similar impact on the odds of SME growth (respectively 1.41 and 1.6), which confirms that innovation is a first important factor of the growth potential of SMEs in low-tech industries. However, only the prior filing of European patents is correlated with high growth, and this correlation is very strong (with an odds ratio of 2.72). Prior European patent filings therefore provide a particularly strong signal in low-tech industries to identify innovative SMEs with a high growth potential at international level.

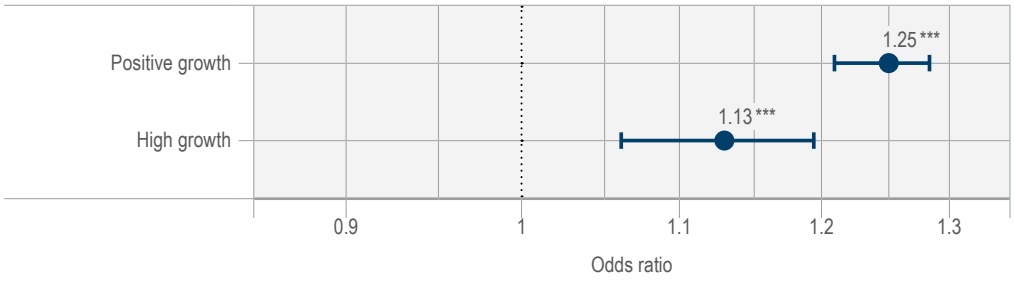
5.5 Trade mark indicators

This section examines IP indicators based on trade marks only. These indicators are expected to reveal the growth potential of SMEs that differentiate in quality by building and exploiting original brands on their products and services. In order to better identify the different contexts in which trade marks may be used, the predictive power of the sole prior filing of trade marks is tested both at the general level (for all SMEs in the sample) and for industries with different end-use product categories.

General impact of the prior use of trade marks

The prior filing of trade marks is a strong indicator of the (high) growth potential of European SMEs (Figure 5.9). An SME is 1.13 times more likely to experience high growth if it has been filing trade marks in the previous period, and its likelihood of experiencing a positive turnover growth is up to 1.25 times higher. In both cases, prior trade mark filing outperforms both the pooled IP indicators and the patent indicators that have been assessed in the previous section (Figure 5.2 and Figure 5.4).

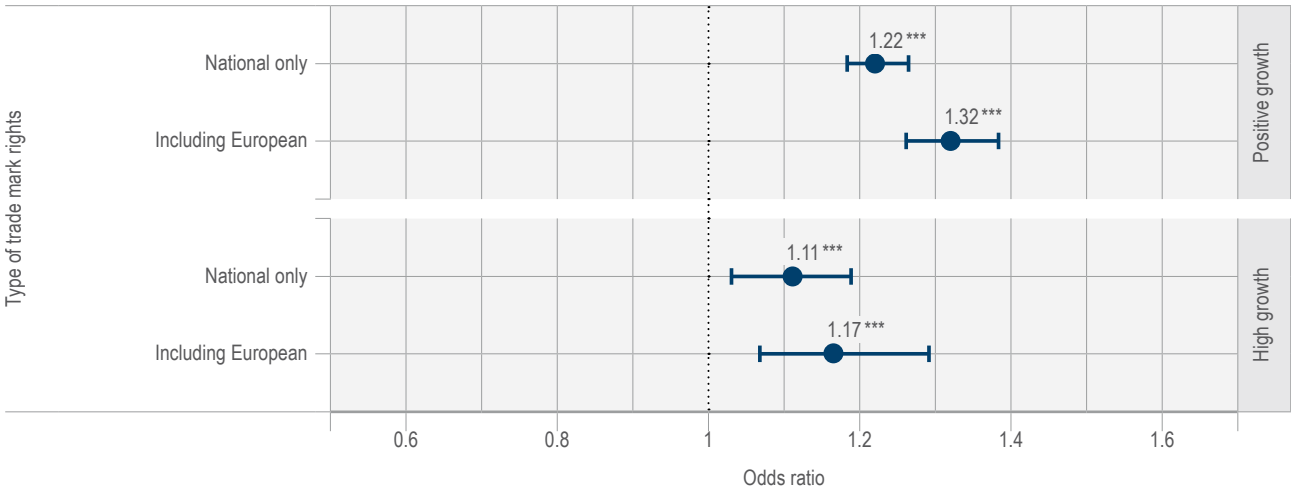
Figure 5.9:
Prior trade mark use and turnover growth



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior trade mark applications and the odds of (high) growth without prior trade mark applications. For detailed results of the model estimation see Table 10.8.

Trade mark indicators also show that European rights are more frequently associated with the future growth of SMEs (Figure 5.10), thereby illustrating the importance of international markets for their development. The likelihood of turnover growth is 1.32 times higher for SMEs that have been filing European trade marks, and 1.22 times higher for those that have only been filing national trade marks. Likewise, the likelihood of high growth increases by a factor of 1.17 if the SME has filed European trade marks, as compared with a factor of 1.11 if it has filed national trade marks only.

Figure 5.10:
Prior use of European trade marks and turnover growth

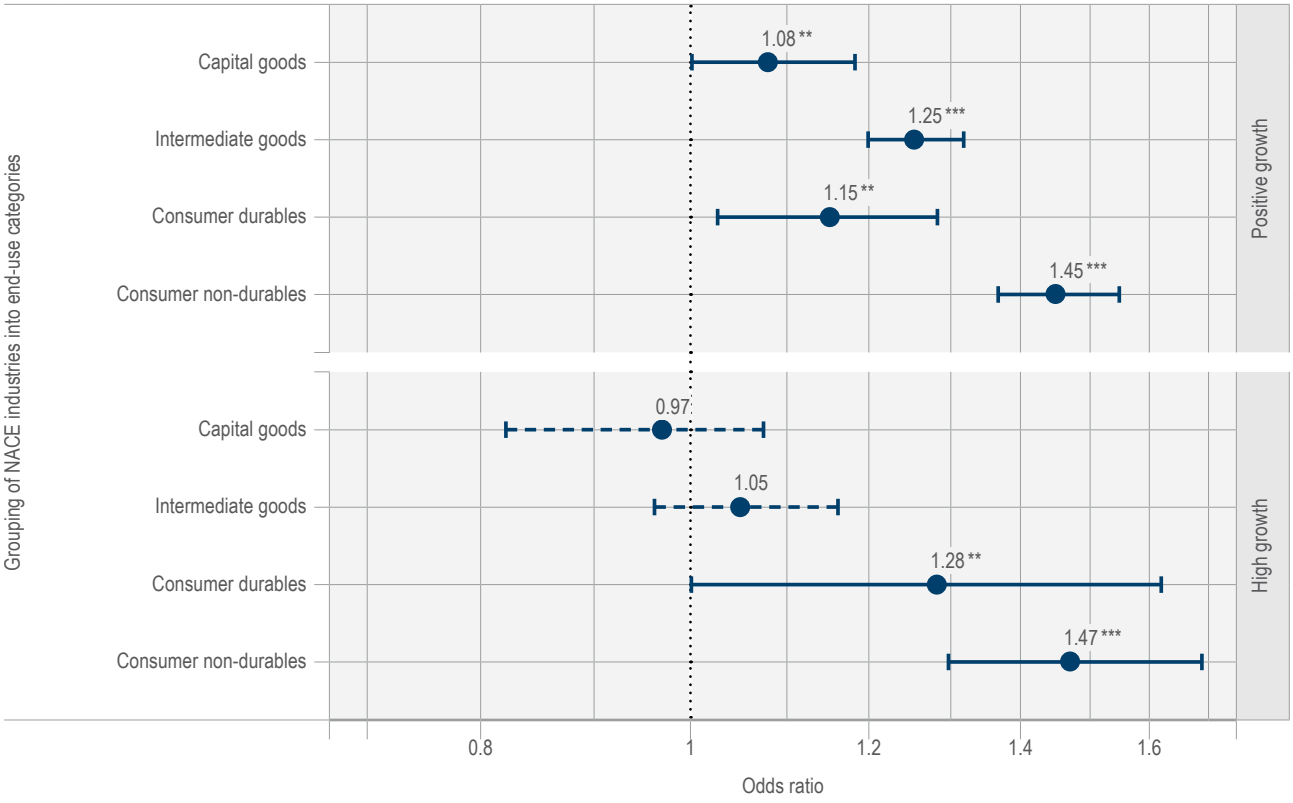


Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior trade mark applications and the odds of (high) growth without prior trade mark applications. For detailed results of the model estimation see Table 10.9.

Impact of prior trade mark use by industry

As a next step, the correlation between the prior filing of trade marks and SME growth is assessed for different types of industries, as defined by Eurostat's main grouping for end-use categories. The results reported in Figure 5.11 show that the predictive power of the trade marks differs between industries. It is high for consumer-oriented industries, including consumer durables (e.g. consumer electronics, photographic equipment, furniture and jewellery) and non-durables (e.g. pharmaceuticals, cosmetics, sports goods, food products and recorded media). By contrast, there is no strong correlation between the prior use of trade marks and the future (high) growth of SMEs in capital goods and intermediate goods industries.

Figure 5.11: Prior use of European trade marks and turnover growth by industry



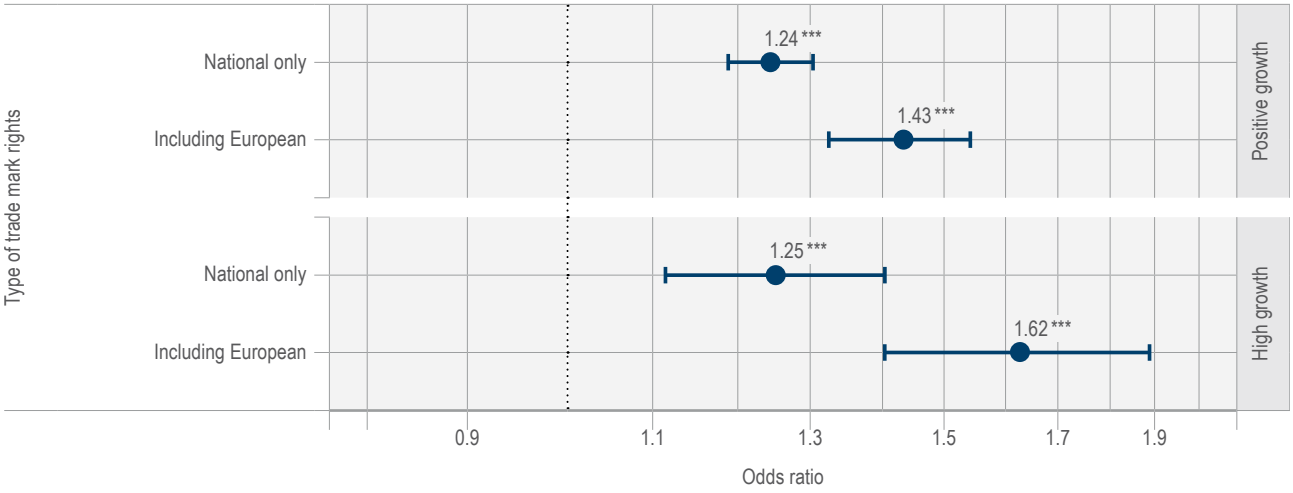
Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior trade mark applications and the odds of (high) growth without prior trade mark applications. For detailed results of the model estimation see Table 10.10.

Since they are in direct contact with final consumers, companies in consumer-oriented industries make frequent use of trade marks. As indicated in Figure 5.11, prior trade mark filings also appear to be a good signal of the growth potential of SMEs in these sectors. In consumer durables, the probability of experiencing (high) growth is 1.15 (or 1.28 for high growth) higher for SMEs that have been filing trade marks. The value of trade marks as a signal is even higher in consumer non-durables, with an odds ratio of 1.45 for growth and 1.47 for high growth.

Interestingly, the respective value of national and European trade marks as a signal of future SME growth is not the same in consumer non-durables (e.g. pharmaceuticals, cosmetics, sports goods, food products and recorded media) and durables (e.g. consumer electronics, photographic equipment, furniture and jewellery).

In non-durables (Figure 5.12), prior applications for European trade marks provide a stronger signal of future growth (with an odds ratio of 1.43), and an even stronger signal of high growth (odds ratio of 1.62). This confirms the importance of foreign markets for the development of SMEs in those industries.

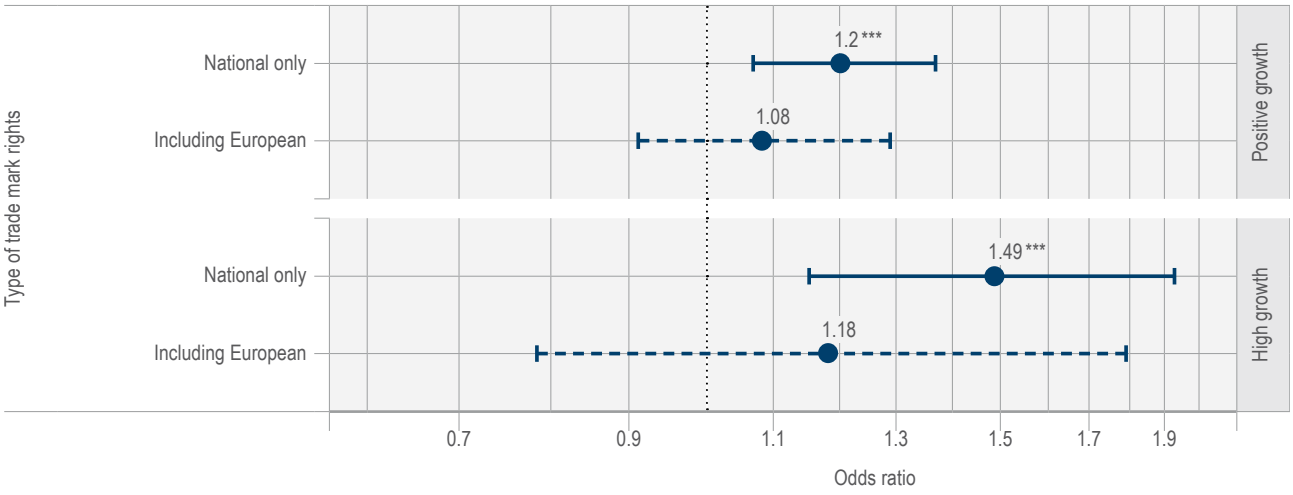
Figure 5.12:
Prior use of European trade marks and turnover growth in consumer non-durables industries



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior trade mark applications and the odds of (high) growth without prior trade mark applications. For detailed results of the model estimation see Table 10.11.

By contrast, national trade marks perform better than European ones in predicting the growth of SMEs in consumer durables (Figure 5.13). It therefore seems that the potential for SMEs' (high) growth in these sectors primarily resides in their ability to deploy a brand in their domestic market.

Figure 5.13:
Prior use of European trade marks and turnover growth in consumer durables industries



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior trade mark applications and the odds of (high) growth without prior trade mark applications. For detailed results of the model estimation see Table 10.12.

5.6 IPR bundle indicators

The results presented in the previous sections show that refined indicators based on the use of either patents or trade marks only perform particularly well for different categories of SMEs operating in specific sectors. This provides a first confirmation that the diversity of IP rights can also be exploited to assess the economic profile and potential of European SMEs.

Against this background, this section aims to explore whether combinations of different IP rights can provide additional indicators to predict the (high) growth potential of SMEs. For this purpose, three categories of IP rights – patents, trade marks, and registered design rights – have been considered. Registered design rights are particularly relevant in the context of IP bundles, as they are typically used as an additional form of IP protection, in combination with either patents and/or trade marks.

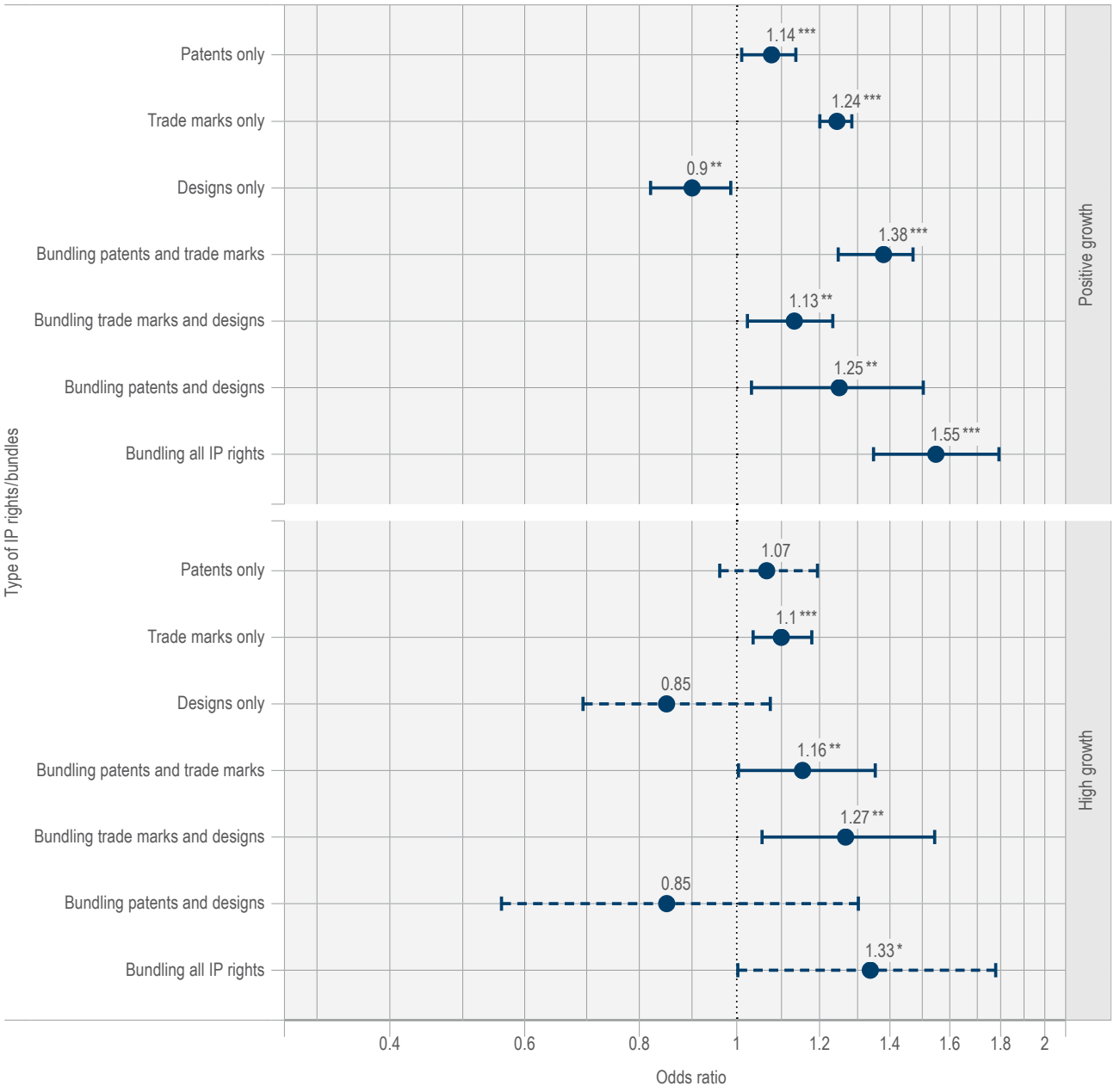
Based on the three categories of IP rights, a total of seven possible IP bundles (involving one, two or three different IP rights) have been tested together in the same model. The advantage of this approach is that it makes possible to distribute the odds of future growth between the different bundles. The results, presented in Figure 5.14, show that IP bundles generally perform better than stand-alone IP rights in predicting SME growth, and that IP bundles involving trade marks are particularly performant in this respect.

The comparison of the prior use of isolated types of IP rights with the prior use of bundles of two of these rights clearly shows that the latter perform better in signalling future (high) growth. For example, the likelihood of subsequent high growth increases by a factor of 1.1 only for SMEs that have only been filing trade marks, whereas that likelihood is 1.16 times higher if the trade mark has been combined with a patent, and 1.34 times higher if it has been combined with a design right.

Similar results can be observed for patents and designs. There is no statistically significant correlation between the prior use of design rights alone and high growth, although the results shown in Figure 5.14 suggest that the relationship between design application only and growth may even be negative. However, bundles combining a design right with a patent and/or trade mark have a significant predictive power, thereby illustrating the complementarity between those rights. The prior filing of patents only is found to be a statistically significant signal of future growth but is likewise outperformed by the combination of patents with trade marks and/or design rights. A possible explanation is that the use of a patent in combination with a trade mark may signal that the invention or technology is much closer to the implementation and commercialisation stage, while a patent alone may signal that the invention or technology is still being researched or developed.

A closer look at the bundles of two or more categories of IP rights shows that the broadest possible combination is also the best performing one in predicting both SME growth (with an odds ratio of 1.55) and high growth (1.33), but in the latter case only at 90% confidence level. Bundles involving trade marks also appear to systematically outperform bundles of patents with design rights, thus suggesting that trade marks are the basic building block of effective IP bundles.

Figure 5.14:
Prior use of IP bundles and turnover growth



Note: *p<0.1; **p<0.05; ***p<0.01
The odds ratio is defined as the estimated ratio of the odds of (high) growth with prior applications for various bundles of IPR and the odds of (high) growth without any IPR application. For detailed results of the model estimation see Table 10.13.

06 / Limitations

As discussed above, there are data limitations that make it difficult to establish a causal relationship between applications for IPRs and subsequent growth. The main confounding factors that correlate with both propensity to use IPR and growth are the underlying business model and the intrinsic innovation performance of the firm. IPRs are the legal mechanisms that allow for some exclusivity in exploitation of a firm's unique contribution and appropriation of the results of its innovation. However, innovations protected by the same types of IPR differ on many important aspects such as quality, degree of novelty, the extent to which customers' needs are addressed, etc. Without proper controls for those aspects of the business model, establishing a strict causal link between IPR protection and subsequent growth is impossible.

In the econometric specifications, some control variables are included in order to help isolate the relationship between IPR protection and growth: industry sector, country, GDP growth and age of firm. However, other aspects of a firm's activity that contribute to its growth, such as the quality and experience of the management team, are by their nature unobservable. Due to data limitations it is not possible to control for such variables. To the extent that such firm-specific attributes correlate with both the quality of the products and services and the propensity to file for IPR protection, an important part of the correlation between IPR applications and growth may be due to those unobserved variables.

The research focus of this study is to investigate whether previous IPR activity can be used by investors, business partners and policy-makers as an informative signal for detecting SMEs with high growth potential. The econometric methods employed in the present report – logit models estimated on the pooled dataset – have been considered sufficient for that purpose. Further research, on causal explanation of observing HGF events through previous IPR activity, may employ panel data methods in order to control for firm-specific and time-invariant unobserved heterogeneity. This approach will require overcoming sample attrition issues, whereby some firms drop out from the panel due to bankruptcy, mergers or simple non-compliance with the reporting obligations.

Sales and employment data is not available for the whole population of manufacturing firms. Some firms in the initial dataset do not report turnover data at all. Missing data could also be the result of more lenient reporting obligations for some firms depending on their size, sector of activity and country. It may also be a result of simple non-compliance with existing reporting obligations, or associated with firms that exit the market due to bankruptcy or takeover. However, previous studies have shown that firms that apply for IP rights are more likely to survive than firms that do not own IP rights (see for example Helmers and Rogers, 2010) Therefore, the results in this study, which are based on data from surviving firms, are more likely to underestimate the impact of IP rights on observing positive growth or high growth periods.

The HGF definition in the present report, although based on objective and widely established thresholds, may be more difficult to meet by some firms depending on their size, area of activity or country. This problem was mitigated by including relevant control variables in the econometric specification.

07 / Conclusion

High-growth firms are a key driver of innovation and economic growth in Europe, and are therefore increasingly considered as a priority target by policy-makers at EU and national levels. They are also of particular interest for investors and potential business partners who want to benefit from their development. The results of the study illustrate this specificity: HGFs represent just 6% of the sample of European SMEs considered in the study, but contributed 28% of the net job creations by these SMEs.

Because the development of HGFs typically involves innovation and expansion in international markets, these types of SME are particularly likely to rely on formal IPRs such as patents, trade marks and registered designs. IPRs help these SMEs appropriate their intellectual assets in their home and foreign markets. They are instrumental for them in securing better margins, organising technology transfers and collaborations and attracting investors.

The findings of the study confirm the importance of IPRs for these fast-growing SMEs. Although the share of HGFs in all European SMEs is smaller than the 18% share of IPR-using SMEs, the study finds evidence that future HGFs rely more often on IPRs than other SMEs. It further establishes that refined indicators, taking into account the type of IPR filed by SMEs and the industry in which they operate, provide strong predictors of the likelihood that an SME will become an HGF in subsequent years.

7.1 Main results

SMEs that have filed at least one IPR are found to be 21% more likely to grow in the following three years, and 10% more likely to become an HGF. Similar results are also obtained when the analysis focuses on the prior use of patents or trade marks only. The likelihood that a firm will become an HGF is for instance 9% higher for SMEs that have filed at least one patent in the prior three years, and 13% higher for those that have filed at least one trade mark.

Further analyses show that HGFs are more reliant on international IPR protection than other SMEs. The likelihood of becoming an HGF is 17% higher for SMEs that have filed at least one European IPR, compared with 6% for those that have only filed national IPRs. This difference is especially marked in the case of patents: SMEs that have filed at least one European patent are 34% more likely to become an HGF, whereas the prior filing of national patents only is not found to be significantly correlated with a higher likelihood of high growth..

Indicators based on prior patent filings turn out to be particularly good predictors of high growth potential in high-tech industries such as pharmaceuticals, electronics and spacecraft and related machinery. In those industries, the likelihood of high growth is 110% higher for SMEs that have filed a European patent. Interestingly, the predictive power of patents is also very high in low-tech industries (such as food products and textiles), where the prior filing of a European patent is associated with

a 172% increase in the likelihood of the SME subsequently experiencing a high growth period. This latter finding is a good illustration of the ability of patents to reflect the competitive advantage that a firm in a low-tech sector can gain by innovating.

Prior trade mark filings are found to be better predictors of high growth potential in consumer-oriented industries. In consumer non-durable industries (e.g. recorded media, cosmetics and pharmaceuticals), the prior filing of a European trade mark is associated with a 62% increase in the likelihood of experiencing high growth. By contrast, the filing of a national trade mark is a better predictor (+49%) of the likelihood of high growth in consumer durable industries such as consumer electronics, furniture and jewellery.

A final set of results highlights the existing complementarity between different categories of IPR, and the relevance for SMEs of combining patents, trade marks and design rights to more effectively support their business. SMEs that use a bundle of trade marks, patents and designs are more likely to experience a high growth period than those that rely on a single category of IPR. IP bundles involving trade marks systematically outperform other bundles, thus indicating that trade marks are a fundamental building block for creating IP bundles, since they signal not just innovation, but innovation that leads to market entry and thus increased turnover.

7.2 Discussion

These results are of particular interest for policy-makers, potential investors and business partners wishing to detect future HGFs at an early stage in their development. Beyond highlighting a stronger reliance of HGFs on IPRs, they demonstrate that registered IPRs provide a rich and relevant source of information to identify potential HGFs. Simple indicators of IPR activity are a clear signal of an SME's ability to create intellectual assets and appropriate the returns from those assets. The study demonstrates that more detailed analysis of an SME's IPR portfolios, taking into account the SME's business environment, is even more indicative of its ability to effectively exploit those assets to effectively sustain a fast growth in future markets.

It is, however, important to note that the study establishes a correlation between the use of IPR and the high growth potential of SMEs, not a causal effect of the use of IPRs on the probability of high growth. The mere filing of an IP right is obviously not sufficient to trigger growth. However, it clearly signals that the filing firm has created one or more intellectual assets that are eligible for formal IPR protection, and that the firm intends to legally protect and exploit those intellectual assets in the marketplace. Therefore, the use of IPR protection itself may not be the main reason for growth, but likely provides benefits to the firm that facilitate periods of exceptional growth.

The refined indicators in this study further suggest that the ability of an SME to effectively leverage its IPRs to sustain high growth largely depends on the quality of its IP management and IP strategy. In other words, success also critically depends on the SME's ability to build a relevant combination of IPRs on the appropriate geographical scale, and to proactively exploit this IPR portfolio to capture and develop value in the market.

08 / Annex I: Industry groupings

Table 8.1:
Classification of NACE divisions in accordance with technology intensity

NACE	NACE division description	Technology group
10	Manufacture of food products	Low-technology
11	Manufacture of beverages	Low-technology
12	Manufacture of tobacco products	Low-technology
13	Manufacture of textiles	Low-technology
14	Manufacture of wearing apparel	Low-technology
15	Manufacture of leather and related products	Low-technology
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Low-technology
17	Manufacture of paper and paper products	Low-technology
18	Printing and reproduction of recorded media	Low-technology
31	Manufacture of furniture	Medium-low-technology
32	Other manufacturing	Medium-low-technology
19	Manufacture of coke and refined petroleum products	Medium-low-technology
22	Manufacture of rubber and plastic products	Medium-low-technology
23	Manufacture of other non-metallic mineral products	Medium-low-technology
24	Manufacture of basic metals	Medium-low-technology
25	Manufacture of fabricated metal products, except machinery and equipment	Medium-low-technology
33	Repair and installation of machinery and equipment	Medium-high-technology
20	Manufacture of chemicals and chemical products	Medium-high-technology
27	Manufacture of electrical equipment	Medium-high-technology
28	Manufacture of machinery and equipment n.e.c.	Medium-high-technology
29	Manufacture of motor vehicles, trailers and semi-trailers	Medium-high-technology
30	Manufacture of other transport equipment	Medium-high-technology
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	High-technology
26	Manufacture of computer, electronic and optical products	High-technology

Table 8.2: Main industry groupings

NACE	NACE Rev. 2 description	Aggregate classification
07	Mining of metal ores	Intermediate goods
08	Other mining and quarrying	Intermediate goods
09	Mining support service activities	Intermediate goods
10.6	Manufacture of grain mill products, starches and starch products	Intermediate goods
10.9	Manufacture of prepared animal feeds	Intermediate goods
13.1	Preparation and spinning of textile fibres	Intermediate goods
13.2	Weaving of textiles	Intermediate goods
13.3	Finishing of textiles	Intermediate goods
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	Intermediate goods
17	Manufacture of paper and paper products	Intermediate goods
20.1	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	Intermediate goods
20.2	Manufacture of pesticides and other agrochemical products	Intermediate goods
20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	Intermediate goods
20.5	Manufacture of other chemical products	Intermediate goods
20.6	Manufacture of man-made fibres	Intermediate goods
22	Manufacture of rubber and plastics products	Intermediate goods
23	Manufacture of other non-metallic mineral products	Intermediate goods
24	Manufacture of basic metals	Intermediate goods
25.5	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	Intermediate goods
25.6	Treatment and coating of metals; machining	Intermediate goods
25.7	Manufacture of cutlery, tools and general hardware	Intermediate goods
25.9	Manufacture of other fabricated metal products	Intermediate goods
26.1	Manufacture of electronic components and boards	Intermediate goods
26.8	Manufacture of magnetic and optical media	Intermediate goods
27.1	Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	Intermediate goods
27.2	Manufacture of batteries and accumulators	Intermediate goods
27.3	Manufacture of wiring and wiring devices	Intermediate goods
27.4	Manufacture of electric lighting equipment	Intermediate goods
27.9	Manufacture of other electrical equipment	Intermediate goods
05	Mining of coal and lignite	Energy
06	Extraction of crude petroleum and natural gas	Energy
19	Manufacture of coke and refined petroleum products	Energy
35	Electricity, gas, steam and air conditioning supply	Energy
36	Water collection, treatment and supply	Energy
25.1	Manufacture of structural metal products	Capital goods
25.2	Manufacture of tanks, reservoirs and containers of metal	Capital goods
25.3	Manufacture of steam generators, except central heating hot water boilers	Capital goods
25.4	Manufacture of weapons and ammunition	Capital goods
26.2	Manufacture of computers and peripheral equipment	Capital goods
26.3	Manufacture of communication equipment	Capital goods

NACE	NACE Rev. 2 description	Aggregate classification
26.5	Manufacture of instruments and appliances for measuring, testing, and navigation; watches and clocks	Capital goods
26.6	Manufacture of irradiation, electro medical and electrotherapeutic equipment	Capital goods
28	Manufacture of machinery and equipment n.e.c.	Capital goods
29	Manufacture of motor vehicles, trailers and semi-trailers	Capital goods
30.1	Building of ships and boats	Capital goods
30.2	Manufacture of railway locomotives and rolling stock	Capital goods
30.3	Manufacture of air and spacecraft and related machinery	Capital goods
30.4	Manufacture of military fighting vehicles	Capital goods
32.5	Manufacture of medical and dental instruments and supplies	Capital goods
33	Repair and installation of machinery and equipment	Capital goods
26.4	Manufacture of consumer electronics	Consumer durables
26.7	Manufacture of optical instruments and photographic equipment	Consumer durables
27.5	Manufacture of domestic appliances	Consumer durables
30.9	Manufacture of transport equipment n.e.c.	Consumer durables
31	Manufacture of furniture	Consumer durables
32.1	Manufacture of jewellery, bijouterie and related articles	Consumer durables
32.2	Manufacture of musical instruments	Consumer durables
10.1	Processing and preserving of meat and meat products	Consumer non-durables
10.2	Processing and preserving of fish, crustaceans and molluscs	Consumer non-durables
10.3	Processing and preserving of fruit and vegetables	Consumer non-durables
10.4	Manufacture of vegetable and animal oils and fats	Consumer non-durables
10.5	Manufacture of dairy products	Consumer non-durables
10.7	Manufacture of bakery and farinaceous products	Consumer non-durables
10.8	Manufacture of other food products	Consumer non-durables
11	Manufacture of beverages	Consumer non-durables
12	Manufacture of tobacco products	Consumer non-durables
13.9	Manufacture of other textiles	Consumer non-durables
14	Manufacture of wearing apparel	Consumer non-durables
15	Manufacture of leather and related products	Consumer non-durables
18	Printing and reproduction of recorded media	Consumer non-durables
20.4	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	Consumer non-durables
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Consumer non-durables
32.3	Manufacture of sports goods	Consumer non-durables
32.4	Manufacture of games and toys	Consumer non-durables
32.9	Manufacturing n.e.c.	Consumer non-durables

09 / Annex II: Descriptive statistics of the main dataset

Table 9.1:
Distribution of HGFs by NACE divisions

Division	N	N (HGF)	HGF share
Manufacture of tobacco products (12)	92	15	0.163
Manufacture of other transport equipment (30)	1 824	199	0.109
Manufacture of basic metals (24)	4 864	509	0.105
Manufacture of basic pharmaceutical products and pharmaceutical preparations (21)	1 140	115	0.101
Manufacture of coke and refined petroleum products (19)	400	36	0.090
Manufacture of computer, electronic and optical products (26)	6 001	471	0.078
Repair and installation of machinery and equipment (33)	5 313	410	0.077
Manufacture of electrical equipment (27)	7 374	536	0.073
Manufacture of fabricated metal products, except machinery and equipment (25)	38 265	2 558	0.067
Manufacture of machinery and equipment n.e.c. (28)	20 767	1 366	0.066
Manufacture of motor vehicles, trailers and semi-trailers (29)	4 298	264	0.061
Manufacture of other non-metallic mineral products (23)	14 571	782	0.054
Manufacture of food products (10)	21 245	1 112	0.052
Manufacture of chemicals and chemical products (20)	7 475	387	0.052
Other manufacturing (32)	6 011	303	0.050
Manufacture of beverages (11)	3 384	160	0.047
Manufacture of rubber and plastic products (22)	10 098	465	0.046
Manufacture of leather and related products (15)	7 062	319	0.045
Manufacture of wearing apparel (14)	6 612	270	0.041
Manufacture of furniture (31)	8 162	296	0.036
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16)	9 341	290	0.031
Manufacture of paper and paper products (17)	5 049	146	0.029
Printing and reproduction of recorded media (18)	8 394	228	0.027
Manufacture of textiles (13)	10 342	238	0.023

Table 9.2:
Distribution of HGFs by country

Country code	N	N (HGF)	HGF share
LT	1 325	274	0.207
NL	258	31	0.120
DK	128	12	0.094
GB	6 157	430	0.070
BE	5 146	345	0.067
HU	2 162	144	0.067
ES	62 941	3 624	0.058
IT	85 130	4 545	0.053
DE	9 154	452	0.049
FR	29 749	1 366	0.046
PT	5 430	237	0.044
AT	504	15	0.030

Table 9.3:
Table of correlation between IPR and growth

	Positive growth	pat_prior	tm_prior	des_prior	Age	Size (t-3)
pat_prior	0.02*					
tm_prior	0.03*	0.17*				
des_prior	-0.01*	0.16*	0.17*			
Age	-0.04*	0.02*	0.03*	0.02*		
Size t-3	0.01*	0.14*	0.13*	0.07*	0.15*	
GDP growth (t-3 to t)	0.27*	-0.04*	0.04*	0.00	-0.09*	-0.10*

Table 9.4:
Table of correlation between IPR and high growth

	HGF	pat_prior	tm_prior	des_prior	Age	Size (t-3)
pat_prior	0.01*					
tm_prior	0.01*	0.17*				
des_prior	0.00	0.16*	0.17*			
Age	-0.08*	0.02*	0.03*	0.02*		
Size (t-3)	-0.01	0.14*	0.13*	0.07*	0.15*	
GDP growth (t-3 to t)	0.10*	-0.04*	0.04*	0.00	-0.09*	-0.10*

10 / Annex III: Results of econometric models

Table 10.1:
Predictive power of prior IPR applications (odds ratios)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior IP applicant	1.097***	1.208***
	(0.029)	(0.016)
Log of size (turnover t-3)	0.993	1.028***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.860***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.168***
	(0.011)	(0.006)
Constant	0.188***	1.398***
	(0.057)	(0.165)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0794	0.1051

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.2:
Predictive power of prior IPR applications – comparison of national and European rights (odds ratios)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
European IP applicant (only or with national IPR)	1.166***	1.259***
	(0.046)	(0.025)
National IP applicant only	1.060*	1.181***
	(0.033)	(0.018)
Log of size (turnover t-3)	0.990	1.026***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.860***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.168***
	(0.011)	(0.006)
Constant	0.192***	1.417***
	(0.058)	(0.167)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0794	0.1051

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.3:
Predictive power of prior patent applications

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior patent application	1.091*	1.217***
	(0.049)	(0.028)
Log of size (turnover t-3)	0.997	1.037***
	(0.014)	(0.007)
Log of age at t-3	0.516***	0.862***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.168***
	(0.011)	(0.006)
Constant	0.183***	1.307**
	(0.055)	(0.154)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0793	0.1046

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.4: Predictive power of prior patent applications (national vs European)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Including prior European patent	1.342***	1.255***
	(0.080)	(0.041)
Prior national patent only	0.881*	1.183***
	(0.058)	(0.037)
Log of size (turnover t-3)	0.995	1.037***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.862***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.075***	1.168***
	(0.011)	(0.006)
Constant	0.186***	1.310**
	(0.056)	(0.154)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0795	0.1046

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.5: Predictive power of prior patent applications (grouping of NACE industries by R&D intensity)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior pat user	0.832**	1.176***
	(0.071)	(0.047)
Log of size (turnover t-3)	1.014	1.071***
	(0.014)	(0.007)
Log of age at t-3	0.514***	0.872***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.165***
	(0.011)	(0.006)
Low-tech	0.569***	0.833***
	(0.014)	(0.009)
Medium-high-tech	1.023	1.076***
	(0.027)	(0.015)
High-tech	1.087	1.011
	(0.056)	(0.029)
Prior pat user/low-tech	1.841***	1.159**
	(0.245)	(0.073)
Prior pat user/medium-high-tech	1.177	0.902*
	(0.130)	(0.049)
Prior pat user/high-tech	2.259***	1.147
	(0.328)	(0.102)
Constant	0.200***	0.577***
	(0.060)	(0.066)
Country dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0724	0.0871

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.6: Predictive power of prior patent applications (high-tech industries)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior European patent application	2.103***	1.446***
	(0.301)	(0.147)
Prior national patent application only	1.163	0.895
	(0.247)	(0.108)
Log of size (turnover t-3)	0.843***	0.956
	(0.050)	(0.032)
Log of age at t-3	0.471***	0.877***
	(0.034)	(0.036)
Mean annual GDP growth (years t-3 to t)	0.988	1.090***
	(0.028)	(0.020)
Constant	2.593	5.380***
	(3.130)	(3.377)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	7 141	7 141
McFadden pseudo R^2	0.0666	0.0533

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.7: Predictive power of prior patent applications (low-tech industries)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior European patent application	2.719***	1.602***
	(0.362)	(0.121)
Prior national patent application only	0.880	1.405***
	(0.148)	(0.088)
Log of size (turnover t-3)	0.957*	1.074***
	(0.025)	(0.011)
Log of age at t-3	0.462***	0.828***
	(0.013)	(0.010)
Mean annual GDP growth (years t-3 to t)	1.069***	1.157***
	(0.016)	(0.008)
Constant	0.584	0.859
	(0.271)	(0.146)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	85 694	85 694
McFadden pseudo R^2	0.0665	0.0766

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.8:
Predictive power of prior trade mark applications

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior trade mark application	1.126***	1.247***
	(0.032)	(0.018)
Log of size (turnover t-3)	0.993	1.030***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.860***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.167***
	(0.011)	(0.006)
Constant	0.187***	1.373***
	(0.057)	(0.162)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0794	0.1052

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.9: Predictive power of prior trade mark applications (national vs European)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
National only	1.109***	1.219***
	(0.037)	(0.020)
Including European	1.169***	1.319***
	(0.057)	(0.032)
Log of size (turnover t-3)	0.992	1.028***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.860***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.167***
	(0.011)	(0.006)
Constant	0.189***	1.388***
	(0.057)	(0.164)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0794	0.1052

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.10:
Predictive power of prior trade mark applications (grouping of NACE industries by end product use)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior tm application	1.050	1.252***
	(0.050)	(0.029)
Log of size (turnover t-3)	1.010	1.055***
	(0.014)	(0.007)
Log of age at t-3	0.512***	0.863***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.073***	1.164***
	(0.011)	(0.006)
Capital goods	1.414***	1.129***
	(0.034)	(0.014)
Consumer durables	0.672***	0.675***
	(0.037)	(0.016)
Consumer non-durables	0.751***	0.976*
	(0.022)	(0.013)
Prior tm user/capital goods	0.920	0.862***
	(0.068)	(0.033)
Prior tm user/consumer durables	1.216	0.919
	(0.151)	(0.051)
Prior tm user/consumer non-durables	1.400***	1.158***
	(0.094)	(0.037)
Constant	0.172***	0.644***
	(0.052)	(0.074)
Country dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	207 684	207 684
McFadden pseudo R^2	0.0697	0.0883

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.11: Predictive power of prior trade mark applications (consumer non-durables)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior European tm application	1.622***	1.430***
	(0.124)	(0.055)
Prior national tm application only	1.254***	1.241***
	(0.072)	(0.033)
Log of size (turnover t-3)	0.928**	1.034**
	(0.028)	(0.013)
Log of age at t-3	0.447***	0.847***
	(0.015)	(0.013)
Mean annual GDP growth (years t-3 to t)	1.065***	1.151***
	(0.019)	(0.010)
Constant	0.930	1.181
	(0.514)	(0.273)
Country dummies	Yes	Yes
NACE division dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	53 504	53 504
McFadden pseudo R^2	0.0651	0.0682

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.12:
Predictive power of prior trade mark applications (consumer durables)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Prior European tm application	1.183	1.084
	(0.250)	(0.096)
Prior national tm application only	1.488***	1.204***
	(0.200)	(0.074)
Log of size (turnover t-3)	0.848**	1.091***
	(0.064)	(0.033)
Log of age at t-3	0.416***	0.751***
	(0.033)	(0.026)
Mean annual GDP growth (years t-3 to t)	1.092**	1.316***
	(0.048)	(0.030)
Constant	3.959	0.426**
	(4.106)	(0.177)
Country dummies	Yes	Yes
Year dummies	Yes	Yes
NACE division dummies	Yes	Yes
Observations	11 881	11 881
McFadden pseudo R^2	0.0914	0.1029

Note: *p<0.1; **p<0.05; ***p<0.01

Table 10.13:
Predictive power of bundles of IP rights (odds ratio)

	Dependent variable	
	HGF (1)	**Positive growth** (2)
Patent applicant only	1.068	1.137***
	(0.063)	(0.035)
Trade mark applicant only	1.103***	1.235***
	(0.035)	(0.019)
Bundling patent with trade mark	1.161**	1.383***
	(0.088)	(0.056)
Design applicant only	0.855	0.900**
	(0.095)	(0.042)
Bundling patent with design	0.852	1.252**
	(0.185)	(0.117)
Bundling trade mark with design	1.275**	1.134**
	(0.127)	(0.057)
Bundling all IP rights	1.331*	1.548***
	(0.196)	(0.116)
Log of size (turnover t-3)	0.991	1.025***
	(0.014)	(0.007)
Log of age at t-3	0.515***	0.860***
	(0.008)	(0.007)
Mean annual GDP growth (years t-3 to t)	1.074***	1.167***
	(0.011)	(0.006)
Constant	0.190***	1.417***
	(0.058)	(0.167)
Year dummies	Yes	Yes
NACE dummies	Yes	Yes
Country dummies	Yes	Yes
Observations	208 084	208 084
McFadden pseudo R^2	0.0795	0.1053

Note: *p<0.1; **p<0.05; ***p<0.01

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