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Trademarks and their association with *Kirznerian* entrepreneurs

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Abstract

Although trademarks are the most widely used form of Intellectual Property Rights (IPRs) by firms across all economic sectors worldwide, this indicator is a much less exploited information resource in empirical analysis compared with patents. Our work addresses this gap by investigating the relationship between trademark registration and entrepreneurial activity using data for 33 European countries. Our empirical results show a positive and significant relationship between the share of the self-employed workforce in a given country that can be considered 'entrepreneurial' –which we associate with the share of *Kirznerian* entrepreneurs– and trademark registration at the country level. These results have important implications for scholars, practitioners and policy makers, which are discussed in this work.

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1. Introduction

There is a large body of theoretical and empirical literature suggesting that Intellectual Property Rights (IPRs) make countries more innovative and consequently cause higher economic growth (Varsakelis 2001; Branstetter, Fishman, and Foley 2006; Kanwar 2006; Allred and Park 2007, Acs and Sanders, 2012). The rationale is that, presumably, the protection provided to innovators by IPRs guarantees their economic rents, which stimulate investment in knowledge and innovation and, subsequently, economic growth.

Both patents and trademarks are IPR indicators which are positively correlated with innovation performance and provide an insight into ongoing processes of industrial change (Mendonça, Pereira, and Godinho 2004; Mendonça 2012). While patents are typically related to original, non-trivial and productive inventions (i.e., technological aspects of a firm's business model), trademarks such as brand names and logos are registered to distinguish and protect the reputation of goods, services and corporate identities (i.e., marketing aspects) (Mendonça, Pereira, and Godinho 2004; Srinivasan, Lilien, and Rangaswamy 2008; Mendonça 2012; De Vries et al. 2017). Hence, these indicators provide complementary information on the industrial composition in a given region: patent counts are a pointer of technological expertise and trademark statistics are an indicator of commercial capability (Mendonça 2012).

Specifically, trademarks are of great interest for social science research, as they are not only an important aspect of contemporary culture worldwide (Mendonça, Pereira, and Godinho 2004) but also the most widely used form of IPRs by firms across all economic sectors worldwide (WIPO 2017). Figure 1 below shows the evolution of both indicators for selected economies in the period 2000-16.[1]

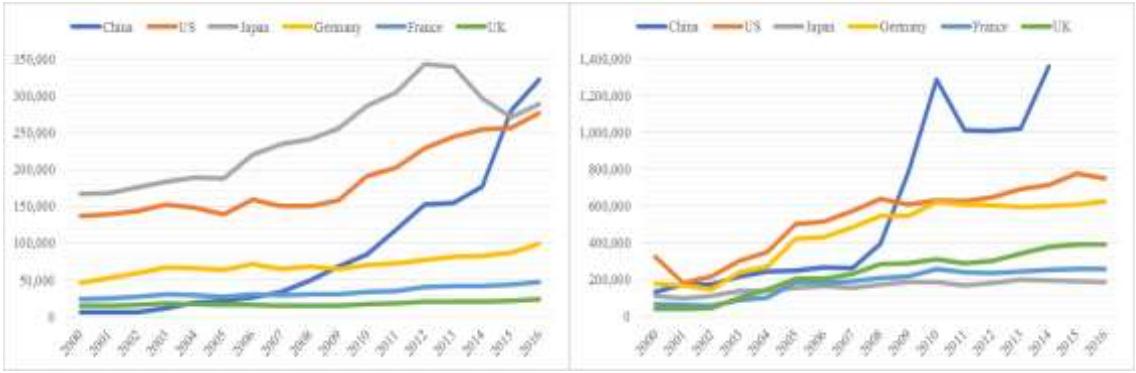

Fig. 1. Total patent (*left panel*) and trademark (*right panel*) registrations for selected countries. *Source*: WIPO IP Statistics Database.

In this line, the increasing importance of trademarks has recently spawned research investigating (i) the patterns of firms' usage of trademarks in relation to their innovation activities and new products, (ii) trademarks' relations to firms' economic performance and productivity, and (iii) the interplay between social costs and value of trademarks (see Malmberg 2005, and Schautschick and Greenhalgh 2016 for reviews). Furthermore, trademark-based indicators show promise for advancing research agendas concerned with (i) the rates and directions of product innovations in different industrial sectors, (ii) international patterns of specialisation, (iii) links between technological and marketing activities; and (iv) the evolution of economic organisations and structures (Mendonça, Pereira, and Godinho 2004).

However, although both patents and trademarks allow for complementary readings, patents have been used for decades in empirical analysis, whereas trademark data is a much less exploited information resource (Mendonça 2012). Thus, patents are commonplace in standard economic

[1] The observed differences in favour of trademark registration figures can be explained (at least) by (i) their comparatively lower cost and (ii) the absence of novelty requirement for trademark registration.

benchmarking publications (e.g. OECD or World Bank reports), whereas trademarks use as a country-level indicator has been very limited.[2] In particular, fundamental aspects of the function of trademark data as an additional indicator of innovative and entrepreneurial activity remain unexplored. Addressing this research gap is precisely the main aim of this work.

This work contributes to this scant literature by assessing the appropriateness of trademark data as a source of qualitative information about the self-employed workforce within a particular country or region. In this sense, there are some arguments for assuming certain properties of trademark data reveal hidden information about the self-employment population in a given economy. Thus, the majority of enterprises (between 70% and 95%) in all OECD countries are micro-businesses (i.e., enterprises with fewer than 10 employees) and the share of SMEs over the population of enterprises rises above 99% (OECD 2019a). Therefore, the proportion of individuals within the self-employment population running SMEs is very large. However, the propensity to patent is rather low in SMEs (Blind et al. 2006; Leiponen and Byma 2007; Thomä and Bizer 2013; Flikkema, De Man, and Castaldi 2014) and, hence, patents cannot adequately measure innovation in SMEs (Kleinknecht 2000). In contrast to patents, trademarks can be used to capture the "softer" non-technological types of innovation, i.e., service, marketing and organizational innovation, which are more probable within the SME framework (Flikkema, De Man, and Castaldi 2014). Under a microeconomic theoretical framework, the *Schumpeterian* entrepreneur (1912, 1942) would be more likely linked with R&D efforts and patent registration activity in large firms, while the *Kirznerian* entrepreneur (1973) would be more likely associated with trademark registration practices within the SME and self-employment framework.[3] Therefore, irrespective of the (rather low) share of technologically innovative or Schumpeterian entrepreneurs in a given economy,[4] an association is expected between trademark data and the relative weight of Kirznerian entrepreneurial activities over total self-employment in a given economy.

More specifically, this paper explores whether registered trademarks at the country level can be linked to the existing heterogeneity within entrepreneurship in 33 European countries. To this aim, an *ad hoc* country-level dataset covering the periods 2010 and 2015 is generated and linear regression models are used. As dependent variables, we use information on registered patents and trademarks provided by the *World Intellectual Property Organization* (WIPO). To account for this entrepreneurial heterogeneity, and based on microdata drawn from the *European Working Conditions Survey*, we use as covariates different groups of self-employed workers, from more to less entrepreneurial in a Kirznerian sense. Our proxies for Kirznerian entrepreneurs are self-employed with employees and opportunity entrepreneurs. Conversely, our proxies for less entrepreneurial forms of self-employment are dependent self-employed workers (i.e., self-employed without employees who generally has only one client) and necessity entrepreneurs. For all countries in our sample, this micro-level information is turned into macro-level data by estimating the share of self-employed workers belonging to the different groups of self-employed workers. Our regressions also include information about expenditure on R&D activities provided by Eurostat. As regards the evidence obtained, we observe how both our proxies for Kirznerian entrepreneurs are positively and statistically associated with trademark registration at the country level. Conversely, none of our groups of self-employed workers, from more to less entrepreneurial in a Kirznerian sense, seems to be statistically associated with patent registration activities at the country level. Our results have important implications for academics, practitioners and policymakers.

[2] Some notable exceptions are presented in subsection 2.1 below.

[3] There is also a growing body of empirical literature exploring the different impacts of entrepreneurship on regional economic growth depending on whether regional entrepreneurship is based on technological innovations (Schumpeterian type) or opportunity discoveries (Kirznerian type) (see e.g. Sundqvist et al. 2012, Aparicio, Urbano, and Audretsch 2016, and Ferreira et al. 2017 as recent examples).

[4] Most entrepreneurs don't employ personnel, are home-based, and earn low incomes (Shane 2009).

The remainder of the paper is structured as follows: Section 2 provides background information from which our general hypothesis is derived. Section 3 describes our data and variables. Section 4 presents the descriptive analysis and multivariate results, and Section 5 concludes with a discussion of implications, limitations of this study and suggestions regarding possible directions for future research.

2. Background

Four elements are part of the background of this study. First, a small review of studies using trademarks as a country-level indicator is presented. Second, a brief review of Schumpeterian and Kirznerian views of entrepreneurship is provided. Next, we present the existing relationship between these two types of entrepreneurs and some particular IPR indicators such as patents and trademarks and derive our proposed relationship between Kirznerian entrepreneurship and trademarks (i.e., the general hypothesis to be tested in this work). Finally, possible operationalisations of Kirznerian entrepreneurship are discussed.

2.1 Trademarks as a country-level indicator

In contrast to patents, the use of trademark data as a country-level indicator in the economic literature has been scarce and sporadic. The more notable exceptions, to our knowledge, are presented below.

Thus, Fink, Javorcik, and Spatareanu (2005) use data on international trademark registrations as an indicator of both product quality and the extent of brand differentiation in order to examine an extension of Linder's (1961) hypothesis.[5] Similarly, Mangani (2007) proposes the use of registered trademarks to estimate the variety and quality of goods and services in an economy and, thus, describes the patterns of production and exports of about 120 countries. Baroncelli, Fink, and Javorcik (2005) use trademark registration data as an information source on how reputational assets are distributed and how they are exploited in international commerce. Baroncelli, Krivonos, and Olarreaga (2007) explore the extent to which discrimination against foreign applicants in the trademark registration is used as a *behind-the-border* barrier to imports, i.e., a protectionism indicator. Mendonça (2012) employs trademarks as an indicator for assessing dynamic competition and international competitiveness in the telecommunications equipment and services sector. De Rassenfosse (2016) observes the validity of an intangible investment, such as *brand equity*, as a powerful predictor of trademark applications.[6] Finally, Herz and Mejer (2016) suggest that the increase in trademark applications experienced over the last 20 years in Europe is not a sign of increased innovative performance but rather the result of (i) national trademark filings simply being price-sensitive, and (ii) a decrease and convergence of trademark filing fees across countries in Europe.

2.2 Schumpeterian and Kirznerian entrepreneurs in brief

The Schumpeterian (1912, 1942) view of innovation is an industry phenomenon where new products or practices spread among competing firms or drive out those firms that are unable to adapt. The result is change of industry practices. Hence, the *creativity* of Schumpeterian entrepreneurs *disrupts* what would otherwise have been a serene market. The creative genius of Schumpeterian entrepreneurs is thus scarce in nature.

In contrast, Kirzner's (1973) entrepreneurs are often viewed as merely speculative agents or arbitrageurs, i.e., individuals who are *alert* to price differentials which others had not yet noticed (Von Mises 1952). The discrepancies which the entrepreneur notices appear in the form of profit

[5] Linder's (1961) hypothesis suggests the quality of products as being the main determining factor of the closeness of exporter supply structures and importer preferences, which in turn explains why richer countries trade more among themselves than with poorer countries.

[6] Brand equity investment series data were obtained from studies that have followed the Corrado-Hulten-Sichel (CHS) methodology (Corrado, Hulten and Sichel 2005).

opportunities and, specifically, the prompt exploitation of such perceived opportunities by these entrepreneurs is what *drives the market towards the* (relevant new) *equilibrium* configurations.

Therefore, there is room for both views of the entrepreneurial process, and they are not at all mutually exclusive. Conversely, market dynamics can be seen as the outcome of two distinct kinds of entrepreneur-driven changes (Kirzner 2009). Furthermore, there are (at least) two arguments that support the existence of some overlapping (to a certain extent) between Schumpeterian and Kirznerian entrepreneurs. *First*, although the role of creator and innovator is commonly associated with Schumpeterian entrepreneurs, Kirzner's view is also linked to innovation in the sense that "his entrepreneur" discovers that there is indeed an opportunity to make a profit by introducing an innovation to a market (Dahlqvist and Wiklund 2012). Thus, while Kirzner's (1973) earlier work might paint an image of the entrepreneur as an arbitrageur who *sees* the existing, but hitherto overlooked, opportunity, his more recent work (e.g., Kirzner 2009) suggests that the discovery of opportunity by what he refers to as *real-world entrepreneurs* takes creativity, imagination and even talent.[7] And *second*, as Kirzner (2009) argues, the bold, creative, innovative (Schumpeterian) entrepreneur is, at a higher level of abstraction, also engaged in arbitrage. In this regard, Prof. Kirzner claimed the following:

> *What [a Schumpeterian entrepreneur] 'sees' is that, by assembling available resources in an innovative, hitherto undreamt of fashion, and thus perhaps converting them into new, hitherto undreamt of products, he may be able (in the future) to sell output at prices which exceed the cost of that output to himself. In 'all' its manifestations, entrepreneurship identifies arbitrage opportunities (Kirzner 2009, p. 150).*

All in all, Schumpeterian entrepreneurs can be viewed as decisive drivers of economic development and, simultaneously, a (small) *subset* of Kirznerian entrepreneurs.

2.3 The relationship between entrepreneurship and IPR indicators

The existing controversy between Schumpeterian and Kirznerian entrepreneurs and their respective innovation types runs parallel to other innovation indicators, i.e., the tandem patents and trademarks. Both types of IPRs allow the holder to protect his or her market power and, hence, guarantee economic rents. However, while patents are typically related to original, non-trivial and productive inventions (i.e., technological aspects of a firm's business model), trademarks can conversely be used to capture the "softer" non-technological types of innovation (i.e., service, marketing and organisational innovation).

In industrial organisation terms, those (presumably large) firms which are active in R&D-intensive and technology-oriented industries would be more likely to register patents, whereas firms that are active in advertising-intensive, consumer-related and service-related industries would be more likely to register trademarks (Amara, Landry, and Traoré 2008; Block et al. 2015a). These "softer" non-technological types of innovation, i.e., service, marketing and organisational innovation which can be better captured by trademarks, are, however, more probable within the SME framework (Flikkema, De Man, and Castaldi 2014). Hence, trademarks are also a useful resource to protect and appropriate the value of innovations in sectors or activities where patents are not a viable option (De Vries et al. 2017). As a result, start-ups are more likely to file trademarks than patents when entering the market (De Vries et al. 2017). In contrast, the likelihood of patent is rather low in SMEs (Blind et al. 2006; Leiponen and Byma 2007; Thomä and Bizer 2013; Flikkema, De Man, and Castaldi 2014) and, hence, trademarks are revealed as a more appropriate measure of innovation than patents in SMEs (Kleinknecht 2000). Therefore, since the share of individuals within the self-employment population running SMEs is broad (as argued in the introductory section), an important relationship between trademark filing behaviour and some innovative self-employed individuals is to be expected.

[7] See Dahlqvist and Wiklund (2012) for an interesting discussion of this issue.

Stated under a microeconomic theoretical framework, two claims emerge from our previous discussion. *First*, the bold, disruptive, *Schumpeterian* entrepreneur would be more active in R&D exertion and patent registration activity in large firms, whereas the opportunity-alert *Kirznerian* entrepreneur would be more involved in trademark registration practices within the SME and self-employment framework. *Second*, patents and trademarks are related but distinct means of appropriating the benefits of innovation with a low degree of substitution. Indeed, both IPRs are only observed to successfully work as complementary assets in some highly innovative sectors (Srinivasan, Lilien and Rangaswamy 2008; Llenera and Millot 2013).[8]

However, the causality of these relationships among entrepreneurship and different innovation types and their associated IPRs may go in both directions (Wennekers et al. 2010). Thus, since entrepreneurs are responsible for registering both patents and trademarks, *Schumpeterian* and *Kirznerian* entrepreneurial activities can thus naturally explain the occurrence of intellectual protection. However, the inverse relationship can also occur, i.e., IPR measures can also help explain levels of entrepreneurial activity.

As regards patents, since registration makes others pay for using some particular technological knowledge, this form of IPR becomes an important incentive for entrepreneurial R&D commitment. In addition, the patents a firm owns can also affect the prospects for follow-up funding (Audretsch, Bönte and Mahagaonkar 2012; Hsu and Ziedonis 2013; Haeussler, Harhoff and Mueller 2014), which can be used in later R&D investments. Furthermore, patents reveal that the firm was able to create an innovation and might do so again in the future (Farre-Mensa, Hegde and Ljungqvist 2017); i.e., patents can be a proxy for future R&D efforts. Finally, by publishing these rights, i.e., in the form of patents, technological knowledge becomes accessible in the form of "spillovers of R&D" which, in turn, raises business opportunities and new R&D efforts for the firms' neighbourhood (Jaffe 1986; Audretsch and Feldman 1996; Thumm 2004; Cassiman and Veugelers 2006).

When turning our attention to trademarks, analogous arguments can also be applied. Thus, filing trademarks demonstrates a start-up's degree of market and growth orientation and its willingness to protect its current and future marketing efforts from the impairment of others (Krasnikov, Mishra and Orozco 2009; Sandner and Block, 2011; Brahem, El Harbi and Grolleau 2013). Like patents, trademarks have been found to be positively related to firm survival (Srinivasan, Lilien, and Rangaswamy 2008; Helmers and Rogers 2010), firm valuations (Sandner and Block 2011; Greenhalgh and Rogers 2012) and access to external funds (Block et al. 2014). Moreover, particularly for nascent entrepreneurs (whose businesses are, by definition, small), the impact of trademark registration on both firm valuation and external investors is even higher than that by filed patents (Block et al. 2014). Finally, important knowledge spillovers can also occur as a result of registering trademarks. *First*, brand loyalty might spill over across products of the same firm (Parchomovsky and Siegelman 2002). *Second*, advertising of the trademarked product may spill over to its generic competitors, so that some of the benefit to the trademark 'leaks' away to its rivals (Llenera and Millot 2013). *Last*, product improvements (in the form of registered trademarks) can also generate knowledge spillovers which, in turn, may act as an important source of new business opportunities not only for imitative entrepreneurship but also innovative entrepreneurship that wishes to build further on the earlier innovations made in other firms (Acs et al. 2009; Burke and Fraser 2012).

Once the bidirectional relationship between entrepreneurship and IPRs has been argued, previous claims can be presented in a more straightforward manner: (i) *Schumpeterian* entrepreneurship is more likely linked with R&D efforts and patenting in large firms, and (ii) *Kirznerian* entrepreneurship is more likely associated with trademarking activity by SMEs and self-employed

[8] Srinivasan, Lilien and Rangaswamy (2008) find patents and trademarks to be complementary assets in the high-tech industry. Llenera and Millot (2013) find evidence of this complementarity in sectors such as pharmaceutical or chemical products.

workers. Therefore, irrespective of the (rather low) share of technologically innovative or Schumpeterian entrepreneurs in a given economy, an association is expected between trademark data and the relative weight of Kirznerian entrepreneurial activities over total self-employment in a given economy.

Previous discussion leads us to state our general hypothesis for this work as follows:

> **GENERAL HYPOTHESIS**. Trademarks present a stronger association with Kirznerian entrepreneurs' activity in a given economy than patents.

This work specifically aims to assess the appropriateness of using this trademark and patent information as a source of qualitative information on the self-employed workforce within a country. Given the exploratory nature of the current study, such relationships are expressed in terms of associations and, hence, a formal analysis of the presumably bidirectional causality between these variables is a topic for further research.

2.4 Operationalisation of *Kirznerian* entrepreneurship

Due to data availability constraints, the production of statistical evidence in order to test our general hypothesis is, however, not straightforward. Hence, a proper selection of indicators for entrepreneurship from the pool of available empirical operationalisations is required. In particular, detailed information not only about the number of entrepreneurs in a particular geographical area but also about the way these entrepreneurs carry out their task is crucial.

In this sense, and based on the so-called 'revealed preference' principle, *economists* tend to classify entrepreneurs into different types from actual observed attributes and behaviours. Thus, self-employment is the more common labour economists' working definition for entrepreneurs (Parker 2018). Its wide implementation –both at the individual level within human population surveys and at the national level, via the *OECD Labour Force Statistics* database– is, undoubtedly, a practical advantage. In this sense, approximately 15.8 per cent of the workforces in the EU-28 are self-employed (OECD, 2019b).

The self-employed are formally considered as individuals working for themselves (instead of working for an employer that pays a salary or a wage) who derive their income by exercising their profession or business on their own account and at their own risk. However, there is plenty of heterogeneity behind this indicator, as acknowledged by the OECD's own self-employment definition: "*self-employment may be seen either as a survival strategy for those who cannot find any other means of earning an income or as evidence of entrepreneurial spirit and a desire to be one's own boss*" (OECD 2019b).

Both the *number of employees* and the *number of clients* are immediate sources of self-employment heterogeneity based on their observed attributes. The *number of employees* leads to the distinction between *self-employed with employees* and *own-account workers*. The former type contributes to the job-generation process and, hence, works on a larger scale than own-account workers, which implies some degree of business success (Earle and Sakova 2000). Indeed, self-employed with employees are considered as more entrepreneurial forms of self-employment than own-account workers (Earle and Sakova 2000; Kuhn 2000; Román, Congregado, and J.M. Millán 2013; J.M. Millán, Congregado, and Román 2014a, 2014b). This larger scale, however, would probably still remain within the SME framework, as argued in the preceding sections. As a consequence, both self-employed with and without employees would rarely participate in (Schumpeterian) R&D intensive and technology-oriented activities and, hence, would seldom be involved in patent registration. Conversely, their SME scale is more appropriate to performing those aforementioned "softer" non-technological types of innovation which can be registered in the form of trademarks (Flikkema, De Man, and Castaldi 2014). Thus, although trademark registration seems more likely for the outperforming group, i.e., self-employed with employees, there are no a-priori reasons to assume that own-account workers will not register trademarks to a certain extent.

When turning our attention to the *number of clients*, an interesting distinction emerges within the group of own-account workers. Thus, as opposed to the *independent own-account self-employed* who work for different clients-firms, *dependent self-employed workers* work exclusively (or mainly) for a specific firm. Hence, they are economically dependent in the sense that they generate their whole (or a substantial part of their) income from this business relationship and, obviously, take an entrepreneurial risk (Muehlberger and Bertolini 2008). The OECD defines this particular group as "*own-account self-employed whose conditions of work are nonetheless similar to those of employees, in the sense that they work mainly or exclusively for a specific client-firm with limited autonomy and often closely integrated into its organizational structure*" (OECD 2014). Dependent self-employment can be regarded as a sub-phenomenon of a general trend towards increasing labour market flexibility (Eichhorst et al. 2013), to which the growth of the *gig economy*, typified by online platforms and isolated independent workers, is seriously contributing (Stewart and Standord 2017). Unfortunately, these workers are usually beyond the scope of labour law (Muehlberger and Bertolini 2008; Román, Congregado, and Millán 2011; A. Millán and J.M. Millán 2017; A. Millán, J.M. Millán, and Román 2018), collective bargaining and trade union representation (Supiot 2001; ILO 2003). We will agree at any rate that there is nothing entrepreneurial about merely being a disguised employee and, therefore, trademark registration is expected to be anecdotal among this group.

All in all, based on the *economists*' view, three groups of self-employed workers emerge, from more to less entrepreneurial in a Kirznerian sense: (1) *self-employed with employees*; (2) *independent own-account self-employed*; and (3) *dependent self-employed workers*.

Business scholars propose an alternative classification for entrepreneurs where the source of heterogeneity concerns their *start-up motivation*. We refer here to the distinction between *opportunity* and *necessity* entrepreneurs, for which the more widely used operationalisation is that based on the Global Entrepreneurship Monitor (GEM) definition proposed by Reynolds et al. (2002). In the GEM Adult Population Survey, respondents indicating that they run a business are asked whether they started their business because they saw a business opportunity they wanted to pursue, or whether they had no alternatives to obtain paid work.[9] This approach allows the contrast between those *opportunity-alert* (Kirznerian) entrepreneurs on the one hand, and those who can be considered self-employed as a *last resort* (Alba-Ramirez 1994; Hyytinen and Rouvinen 2008) on the other.

In this sense, these *opportunity entrepreneurs* can be interested in defending their market share, differentiating their products or services by means of trademarks as a way to guarantee their ability to compete monopolistically and, thus, ensure a compensation for their marketing investments (Malmberg 2005). Their involvement, however, in (Schumpeterian) R&D-intensive projects or patent registration is hardly expected, due to the same scale arguments we previously used when presenting the *economists*' approach; i.e., the proportion of self-employed individuals running large firms, in which registering patents might occur, is minimal. When turning to the *necessity entrepreneurs*, these are more likely to run standard low-margin and low-added-value businesses mainly based on imitative strategies. Therefore, the absence of any particular attribute or a firm's brand to protect against competitors makes registering trademarks an unlikely practice among this group.

To sum up, both approaches, either that of economists or business scholars, allow us, on the basis of existing data sources, to identify useful proxies of *Kirznerian* entrepreneurs (i.e., *self-employed*

[9] GEM data suffers from severe drawbacks, such as the limited numbers of covariates or the impossibility of comparing its figures with data from official international statistics such as Eurostat or the OECD. Fortunately, other cross-country datasets for the European area also allow to obtain accurate proxies for opportunity and necessity entrepreneurs. We refer here to the *European Community Household Panel* (ECHP), the *European Union Statistics on Income and Living Conditions* (EU-SILC) or the *European Working Conditions Survey* (EWCS), the last being the one we use in the present study.

with employees and *opportunity entrepreneurs*) and less (or none) entrepreneurial forms of self-employment (i.e., *dependent self-employed workers* and *necessity entrepreneurs*).

3. Data and variables

3.1. Dependent variables: trademarks and patents

The World Intellectual Property Organization (WIPO) offers global statistics on different intellectual property indicators: patents, trademarks, utility models and industrial designs. Our main dependent variables are based on registered trademarks and patents at the country level provided by the WIPO. To make fairer comparisons between countries, these figures are adjusted by GDP, as usual (see e.g., WIPO 2017). GDP data are derived from the World Bank national accounts data and OECD National Accounts data files.

In particular, our dependent variables are the registered trademarks and patents per constant 2010 US$ billion GDP for the periods 2010 and 2015. Both variables are generated for both periods at the country level for 33 European countries, which yields 66 observations. Table 1 below shows this information for the countries in our sample.[10]

--- Insert Table 1 about here ---

3.2. Focal variables: occupational status, start-up motivation and expenditure on R&D

As argued in our background section, trademark-filing activities are expected to relate to some particular groups within self-employment, whereas patent registration practices seem to be associated with R&D efforts. Therefore, our focal variables must be defined accordingly.

However, due to data limitations, identifying the existing heterogeneity within the self-employed workforce is not straightforward. Precisely to overcome this issue, we use data from the Fifth and Sixth waves of the *European Working Conditions Survey* –EWCS 2010 and 2015– (Eurofound 2012, 2016, 2018), which are the first waves in the EWCS series allowing the identification of certain categories. This survey is carried out every five years by the EU Agency *Eurofound* (*European Foundation for the Improvement of Living and Working Conditions*) and offers key work-related information on 44,000 workers (including both employees and self-employed individuals) covering 35 European countries.[11] To this end, these workers are interviewed about several working condition aspects, including physical environment, workplace design, working hours, work organisation and social relationships in the workplace. Depending on country size and national arrangements, the sample ranges from 1,000 to 4,000 workers per country.

Conditional on self-classification, the EWCS 2010 and 2015 allow us to create 2 separate classifications of self-employed workers from more to less entrepreneurial forms. The *first classification of self-employed workers* combines the information collected by 2 different questions. *First*, the individuals in the survey are asked about their main activity status: self-employed with employees, self-employed without employees, employed or other. *Second*, an additional question is asked to those respondents who previously indicated being self-employed without employees, i.e., whether his/her firm generally has more than one client. Based on this information, we classify self-employed workers within our dataset from more to less entrepreneurial in (1) self-employed with employees; (2) independent own-account self-employed (i.e., self-employed without employees answering positively to the question about whether his/her firm generally has more than one client); and (3) dependent self-employed worker (i.e., self-employed without employees answering negatively to the question about whether

[10] Detailed definitions of all our country-level and individual variables are presented, respectively, in Tables A1 and A2 in the Appendix.

[11] This set includes the EU-28 together, 5 candidate countries (Albania, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia and Turkey) and 2 EFTA countries (Norway and Switzerland).

his/her firm generally has more than one client). For the clarity of our exposition, we will refer hereafter to this classification as *occupational status within self-employment*. Our final sample includes men and women aged 18 to 65 who are classified as self-employed individuals. All individuals working part-time, i.e., working under 15 hours per week, are excluded. The final dataset, after removing cases with missing data for any of the relevant variables, yields 8,535 observations for 33 countries.[12]

The *second classification of self-employed workers* is created by means of a *third* question, which is asked to those respondents who previously indicated being self-employed either with or without employees, i.e., whether he or she became self-employed mainly through personal preference, because he or she had no other alternatives for work, because of a combination of both reasons, or because of neither of these reasons. As this question was only used within the EWCS series in 2015, a subdataset is, hence, generated by excluding data from the EWCS 2010. Our subdataset, when using data from the EWCS 2015, yields 4,345 observations for 33 countries. Based on this information, we classify the observed set of self-employed workers within our dataset into (1) opportunity entrepreneur, (2) hybrid opportunity-necessity entrepreneur, (3) necessity entrepreneur, and (4) entrepreneur for other reasons. Categories 1, 2 and 3 are ordered from more to less entrepreneurial form of self-employment. Category 4, however, is assumed to have, by definition, a heterogeneous composition. For clarification purposes, we will refer henceforth to this classification as *start-up motivation*.

For the 33 European countries in our sample, this micro-level information is turned into macro-level data by estimating the share of self-employed workers belonging to the different categories included within both classifications presented above. In this sense, to ensure that these figures accurately reflect the population of self-employed workers in each country, post-stratification weights provided by the EWCS are used. This process yields only 64 observations, which is precisely the size of our final dataset.[13] Table 2 below shows the new data generated.

--- Insert Table 2 about here ---

To capture the presence and commitment to technological effort and innovation activities in each of the considered economies, our regressions also include the 5-year average Gross Domestic Expenditure on R&D (GERD) for periods 2006-10 and 2011-15. This indicator includes expenditures by business enterprises, higher education institutions, as well as government and private non-profit organisations.[14] To make fairer comparisons between countries, Eurostat provides this information expressed as *Purchasing Power Standards* (PPS) per inhabitant at constant 2005 prices.[15] Table 1 above also shows figures regarding this indicator for the 33 European countries in our sample.

3.3. Control variables

With the aim of controlling for the possible effects of different sector compositions of the economies under study, the empirical models control for the share of self-employed individuals working in high-technology industry and knowledge-intensive services for the 33 European countries in our sample. To this end, we use Eurostat aggregations of the manufacturing industry and services sector according to technological intensity based on NACE at the 2-digit level.[16]

[12] Albania and Montenegro are excluded during this process.
[13] The EWCS did not collect information for Serbia and Switzerland in 2010.
[14] GERD has been widely used within entrepreneurship literature as a measure of technological commitment in a particular economy (see e.g. Van Stel, J.M. Millán, and Román 2014).
[15] PPS is the technical term used by Eurostat for the common (artificial) currency in which national accounts aggregates are expressed when adjusted for price-level differences using PPPs. Thus, PPPs can be interpreted as the exchange rate of the PPS against the €.
[16] Eurostat aggregations based on 'Statistics on high-tech industry and knowledge-intensive services' (sometimes referred to as simply 'high-tech statistics') can be found at https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

Again, post-stratification weights provided by the EWCS are used to ensure that these figures accurately reflect each country's sector composition.

Finally, in order to control for the business cycle and some structural differences among countries, the empirical models also include the 5-year average unemployment rates for the periods 2006-10 and 2011-15, which we collect from Eurostat, and a period 2015 (vs. 2010) dummy.

4. Results

4.1. Descriptive analysis

We aim to explore the relationship between different statistics on IPR indicators and some particular groups within the self-employment workforce. Our hypotheses formulation is based on the assumption that these groups are good proxies for entrepreneurs in the Kirznerian sense and other less entrepreneurial forms of self-employment, respectively. In this sense, one important advantage of our country-level entrepreneurship dataset presented in Table 2 above is that we have access to the microdata information that was used for the macrodata generation process. Thus, we can use all the individual-based information within the EWCS to characterise those self-employed individuals belonging to each occupational status and start-up motivation we use in the analysis. Table 3 below compares these groups.

--- Insert Table 3 about here ---

We first explore occupational status within self-employment. Approximately 32.6%, 57.2% and 10.2% of our sample are, respectively, self-employed with employees, independent own-account self-employed and dependent self-employed workers. In this sense, the self-employed with employees are, in our sample, most often male and most often with a partner and with children. Moreover, they have the highest educational attainment, earnings and ability to make ends meet. Finally, they also work the longest hours and feel the healthiest. These figures suggest the appropriateness of this self-employment category in order to capture Kirznerian entrepreneurs. When comparing independent own-account self-employed and dependent self-employed workers, the latter group is lower-educated, older and more likely to have worse health perception. Furthermore, they work longer hours and, conversely, have lower earnings and are less able to make ends meet. Finally, they are also less likely to work in high-tech industry and knowledge-intensive services. These figures suggest the appropriateness of using dependent self-employed workers as a proxy for the least entrepreneurial form of self-employment. As expected, independent own-account workers show up as an intermediate category where many (but not all) can be examples of Kirznerian entrepreneurs.

When concentrating on start-up motivation (only available for the EWCS 2015), a similar characterisation of our relevant groups is revealed. However, the proportions of belonging to these groups vary substantially with respect to those obtained for our occupational statuses. In particular, 61.5% of our sample report being opportunity entrepreneurs. We observe, inter alia, that this group is in our sample most often male, higher-educated, and most often with a better health perception. Moreover, they have the highest earnings and ability to make ends meet. Finally, they are also the most likely to work in high-tech industry and knowledge-intensive services. These attributes suggest the appropriateness of this category in order to capture Kirznerian entrepreneurs. Regarding their necessity entrepreneurs' counterparts, this group accounts for 20.9% of our sample. These self-employed workers present the lowest educational attainment levels and least often work in high-tech industry and knowledge-intensive services. Furthermore, they have the lowest earnings and are the least able to make ends meet. Hence, this category seems to be confirmed as a good proxy for the least entrepreneurial form of self-employment. Finally, the groups of hybrid entrepreneurs and entrepreneurs for other reasons account for 15% and 2.6% of our sample. Their intermediate positions in terms of education levels, earnings, ability to make ends meet and likelihood to work for high-tech industry and

knowledge-intensive services suggest these categories may also collect a certain proportion of Kirznerian entrepreneurs.

4.2. Multivariate analysis

The estimation results are presented in Tables 4 and 5. Table 4 in subsection 4.2.1 shows the results from 4 specifications as regards patents and their covariates. Similarly, Table 5 in subsection 4.2.2 shows the results from 4 specifications aimed to present trademarks and their covariates. As regards estimation methods, we opted for estimating by means of OLS models and adjusted the standard errors for intra-countries correlation by clustering in those models where more than one EWCS wave was involved. The following structure is used to present our results. First, average predicted values of our dependent variables are indicated at the top of each specification. Below, each model is presented in a three-column format, where marginal effects and t-statistics are reported. Thus, within each specification, the first column shows the absolute marginal effects associated with all covariates. The second column also refers to marginal effects but is expressed in relative terms (with respect to average predicted values of our dependent variables). The third column presents t-statistics associated with marginal effects. Finally, the following information is reported at the bottom of each specification: (i) use of post-stratification weights, (ii) R-squared, (iii) sample size, and (iv) periods involved.

4.2.1. Results for patents

Table 4 below shows the estimation results from 4 specifications.

--- Insert Table 4 about here ---

Models 1A-1B explore the relationship between patents and occupational status within self-employment, whereas models 2A-2B investigate the association between patents and start-up motivation. All models incorporate our measure of R&D effort, our control for sector composition and our control for business cycle. Models 1B and 2B correct for the possible presence of representation issues using post-stratification weights in our measures for occupational status, start-up motivation and sector composition. Finally, models 1A-1B also include a period dummy given that 2 different periods, i.e., 2010 and 2015, are involved.

In line with what was predicted by our general hypothesis, our results show how none of our measures for occupational status and start-up motivation seem to be statistically associated with patent registration activities at the country level. We associate this absence of relationship with the existing rather low propensity to patent within the SME and self-employment framework (Blind et al. 2006; Leiponen and Byma 2007; Thomä and Bizer 2013; Flikkema, De Man, and Castaldi 2014), discussed above in our background section. As an illustration, only 7% of the total self-employed in our sample have 10 or more employees and only 2% have 50 or more employees. Hence, these self-employed are hardly engaged in patent-related activities and, as a result, patents do not seem to be revealed as a convenient measure of innovation for self-employed workers (as happens for SMEs; Kleinknecht 2000).

In contrast, our results consistently show a robust association at the country level between expenditures on R&D and patent registration, as predicted in the preceding sections. In particular, average predicted patents per constant 2010 US$ billion GDP are observed to increase by 0.21% (model 1B) with each PPS per inhabitant unit of increase in GERD. In light of this relationship, an important association is revealed between patents and (Schumpeterian) R&D-intensive and technology-oriented industrial activities.

Finally, as for our control variables, none of our controls for sector composition, business cycle and period show any statistically significant association with patent registration.

4.2.2. Results for trademarks

Table 5 below shows the estimation results from 4 specifications.

--- Insert Table 5 about here ---

The relationship between trademarks and occupational status within self-employment is investigated in Models 3A-3B, whereas models 4A-4B explore the association between trademarks and start-up motivation.

In line with what was stated by our general hypothesis, our results show how both categories of self-employed workers which better capture Kirznerian entrepreneurs, i.e., self-employed with employees and opportunity entrepreneurs, are positively and statistically associated with trademark registration at the country level. Similarly, independent own-account self-employed workers, which can also capture a certain amount of Kirznerian entrepreneurs, are also found to be positively and statistically associated with trademark registration. Specifically, average predicted trademarks per constant 2010 US$ billion GDP are observed to increase by 2.6% (model 3B), 2% (model 3B) and 2.9% (model 4B) with each unitary increase in the share of self-employed with employees, independent own-account self-employed workers, and opportunity entrepreneurs, respectively.[17]

We associate this result with the better ability of trademark indicators to capture the "softer" non-technological types of innovation, i.e., service, marketing and organisational innovation, which are more probable within the SME framework and self-employment framework (Flikkema, De Man, and Castaldi 2014), as discussed previously. Therefore, an important association is revealed between trademarks and the relative weight of Kirznerian entrepreneurs in a given economy.

Conversely, we find no relevant association at the country level between expenditures on R&D and trademark registration. This absence of a link between both indicators can be explained by the existing relationship between R&D efforts and technology-oriented firms, for which the propensity to register trademarks (patents) is low (high) (Amara, Landry, and Traoré 2008; Block et al. 2015a).

Regarding our control variables, we only find a negative relationship between unemployment rate and trademark registration, i.e., those economies with lower unemployment seem to register trademarks with higher likelihood (models 3A-3B). In contrast, neither our control for sector composition nor our period dummy shows any association with trademark registration.

4.2.3. Robustness checks

We perform several robustness checks. *First*, although we present only a few models in Tables 4–5, a complete stepwise regression approach (in which models incorporate covariates one by one) was followed, which serves as a robustness check for the results obtained in previous models. *Second*, as noted in subsection 4.2, we adjusted the standard errors for intra-countries correlation by clustering in those models where more than one EWCS wave was involved (models 1A-1B and 3A-3B). These approaches indicate no major changes relative to simple pooled regressions. *Third*, the robustness of our t-statistics was verified by re-estimating them from variance–covariance matrices of the coefficients obtained by bootstrapping. *Fourth*, the results are not sensitive to the use of dependent variables adjusted by population (instead, GDP). *Fifth*, the results are also robust to the use of two alternative proxies for Kirznerian entrepreneurs, i.e., self-employed with employees and opportunity entrepreneurs. *Sixth*, our results remain stable when using measures for occupational status and start-up motivation which are corrected for representation issues using post-stratification weights (models B). *Seventh*, the results are also not sensitive to the use of GERD adjusted for GDP (instead, population and PPP) and a more

[17] The reference categories for occupational status and start-up motivation are, respectively, dependent self-employed workers and necessity entrepreneurs. Therefore, each unitary increase in the share of self-employed with employees and opportunity entrepreneurs lead, respectively, to a unitary decrease in the share of dependent self-employed workers and necessity entrepreneurs.

restrictive definition of high-tech manufacturing industries[18]. *Finally*, the results are also robust to the restriction of our geographical framework to the EU-28 area. All results regarding these robustness checks are available upon request.

5. Conclusions

This work assesses the appropriateness of trademark data as a source of qualitative information on the self-employed workforce within a particular country or region. More specifically, this paper investigates the possible existence of an association between trademark data and relative weight of Kirznerian entrepreneurial activities over total self-employment in a given economy. To this end, we use country-level information for 33 European countries during the periods of 2010 and 2015. Our empirical results suggest that trademarks present a stronger association with Kirznerian entrepreneurs' activity in a given economy than patents.

This evidence has important implications for scholars, practitioners and policymakers. From an academic perspective, this paper lies at the intersection of entrepreneurship, innovation and industrial organisation. For entrepreneurship literature, our results *first* confirm the need to consider self-employment as a heterogeneous or multifaceted group (Carrasco 1999; Burchell, Deakin, and Honey 1999; Reynolds et al. 2002; Grilo and Thurik 2008; Van der Zwan, Thurik, and Grilo 2010) and, *second*, suggest a strong association between trademark data and the presence of Kirznerian entrepreneurs in a given economy. Finally, from an innovation and industrial organisation perspective, there is an emerging body of literature supporting the links between trademarks and innovation (Mendonça, Pereira, and Godinho 2004, Flikkema, De Man, and Castaldi 2014; Block et al. 2015b), to which the present paper contributes. In this regard, trademarks are revealed as a unique (and still under-exploited) source of information for the analysis of innovation behaviour and industrial dynamics. For practitioners, this study stresses the importance of trademarks for opportunity-driven business development. Finally, from a public policy perspective, our results underline the risk of using a unique recipe when defining instruments for self-employment promotion. By ignoring the existing heterogeneity, prescriptions might be beneficial for certain forms of self-employment and harmless—or even harmful—for other types.

Our paper has some limitations, the more serious one being, perhaps, data availability and, in particular, our rather low number of observations. In addition, this work is exploratory in scope and, hence, its results can only be presented in an associative manner. Therefore, it remains unclear what the exact mechanisms behind our findings are. Undoubtedly, for finer-grained evidence and a better-tailored policy approach, better data availability is simply essential. In this sense, there are reasons to be optimistic, as the production and availability of reliable and internationally comparable statistics able to capture the existing heterogeneity within self-employment are expected to grow in the short term. Thus, the European Union Labour Force Survey *ad hoc* module 2017 (EU-LFS AHM 2017) on self-employment, which is expected to be ready for scientific purposes in 2019, incorporates particular sub-modules specifically designed to identify dependent self-employed workers (sub-module 1) and opportunity vs. necessity entrepreneurs (sub-module 2). Moreover, the former sub-module is planned to be permanently incorporated into the survey from 2019 onwards, which means a forthcoming availability of information extracted from some 1.8 million interviews throughout participating countries[19] each quarter. Future research will benefit from these new data.

[18] This more restrictive definition excludes those industries classified by 'Eurostat high-tech statistics' as only medium-high (and not strictly high) technology manufacturing industries. We refer here to the following NACE rev. 2 codes: 20 = Manufacture of chemicals and chemical products; 27 = Manufacture of electrical equipment; 28 = Manufacture of machinery and equipment not elsewhere classified; 29 = Manufacture of motor vehicles, trailers and semi-trailers; and 30 = Manufacture of other transport equipment.

[19] The EU-28, 2 candidate countries (the Former Yugoslav Republic of Macedonia and Turkey) and 3 EFTA countries (Iceland, Norway and Switzerland).

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Tables (*to be inserted in the text*)

Table 1: Patents, trademarks and Gross Domestic Expenditure on R&D (GERD) for 33 European countries

	Patents *per constant 2010 US$ billion GDP*				**Trademarks** *per constant 2010 US$ billion GDP*				**GERD** *PPS per inhabitant at constant 2005 prices*			
Country	**Rank#**	**2010**	**Rank#**	**2015**	**Rank#**	**2010**	**Rank#**	**2015**	**Rank#**	**2006-10**	**Rank#**	**2011-15**
Austria	9	11.7	7	17.2	8	217.4	10	203.4	6	793.4	3	942.7
Belgium	12	10.4	10	12.5	15	152.0	16	155.3	10	563.6	9	682.9
Bulgaria	21	4.2	29	1.9	4	275.4	5	360.9	31	48.9	30	79.9
Croatia	29	1.7	33	0.9	31	50.1	30	86.1	23	111.5	27	104.2
Cyprus	17	5.7	16	7.8	3	389.1	3	661.8	25	101.9	28	102.8
Czech Republic	26	2.8	21	4.9	24	126.0	23	142.7	17	263.7	15	385.3
Denmark	8	12.2	8	16.3	20	134.4	17	153.2	5	803.7	6	863.6
Estonia	20	4.3	20	5.2	6	245.7	4	411.2	19	193.1	17	291.0
Finland	2	26.0	2	28.2	22	132.0	18	152.6	3	1,006.7	4	906.0
France	7	12.6	9	15.8	27	97.7	29	92.1	11	558.9	11	596.1
Germany	4	20.7	5	23.4	13	182.1	14	163.2	7	744.3	5	890.6
Greece	28	2.1	28	2.0	32	47.6	31	76.6	21	137.3	25	142.7
Hungary	19	4.4	22	4.4	25	110.1	21	145.1	20	154.3	20	200.3
Ireland	15	7.5	17	7.6	19	139.6	27	100.7	12	478.1	12	530.8
Italy	10	11.7	13	9.1	14	168.9	20	149.7	16	295.9	16	306.5
Latvia	13	10.2	15	7.9	11	193.2	8	210.8	29	76.1	29	94.4
Lithuania	27	2.2	24	3.1	18	139.7	12	198.9	22	113.9	23	160.7
Luxembourg	5	17.4	3	25.9	1	586.8	2	695.3	4	989.8	7	802.0
Macedonia	32	1.3	32	1.1	16	147.8	32	52.5	33	40.0	33	40.0
Malta	14	8.8	12	9.5	2	431.0	1	1082.6	24	111.3	21	168.0
Netherlands	6	17.1	6	19.7	9	204.0	13	183.8	9	568.0	10	654.2
Norway	18	5.6	18	6.6	33	32.8	33	34.8	8	657.2	8	700.0
Poland	23	3.3	19	5.7	21	133.6	19	151.6	26	86.3	24	146.0
Portugal	31	1.3	30	1.6	10	197.8	7	212.3	18	262.6	19	254.1
Romania	25	2.8	26	2.1	29	96.3	25	108.4	32	48.6	32	48.0
Serbia	24	2.9	27	2.0	26	99.7	26	102.1	30	71.8	31	70.9
Slovakia	30	1.6	31	1.6	28	96.9	24	124.6	27	84.2	22	165.7
Slovenia	11	11.6	11	12.3	7	223.5	9	204.2	14	375.3	13	519.9
Spain	22	3.3	23	4.0	12	187.4	11	200.1	15	309.2	18	285.3
Sweden	3	21.7	4	23.6	17	145.1	15	160.6	1	1,018.8	2	1,007.4
Switzerland	1	28.3	1	35.0	5	266.2	6	270.4	2	1,013.8	1	1,089.7
Turkey	33	1.2	25	2.2	30	64.0	28	95.7	28	77.0	26	112.0
United Kingdom	16	6.8	14	7.9	23	127.3	22	145.1	13	455.9	14	463.5
33 European countries		***9.2***		***10.4***		***139.4***		***146.3***		***392.8***		***436.5***

Notes: Countries' population sizes are used as supranational weights to ensure that larger (smaller) countries weigh heavier (weaker) when calculating aggregated figures at the European level (i.e., for our 33 European countries). *Data sources*: WIPO IP Statistics Database, Eurostat, World Bank national accounts data, and OECD National Accounts data files.

Table 2: Occupational status within self-employment and start-up motivation for 33 European countries

	Occupational status 2010			Occupational status 2015			Start-up motivation [a] 2015			
	1	**2**	**3**	**1**	**2**	**3**	**1**	**3**	**3**	**4**
Country	*SEwE*	*IOA*	*DSEW*	*SEwE*	*IOA*	*DSEW*	*Opp*	*Hyb*	*Nec*	*Oth*
Austria	42.9	51.1	6.0	37.4	51.5	11.1	40.7	15.2	30.1	14.1
Belgium	40.1	59.0	0.9	43.6	50.2	6.1	79.0	5.9	7.8	7.3
Bulgaria	38.8	48.6	12.6	37.7	58.1	4.2	67.4	10.9	21.7	0
Croatia	46.8	41.1	12.1	39.7	44.5	15.8	34.2	24.8	38.6	2.4
Cyprus	36.2	48.0	15.8	35.9	53.2	10.9	74.4	13.2	11.9	0.5
Czech Republic	32.8	57.2	10.1	32.6	62.3	5.0	51.3	30.3	17.2	1.3
Denmark	58.9	38.6	2.5	36.7	60.3	3.0	83.3	12.3	4.5	0
Estonia	36.5	57.8	5.7	62.4	30.1	7.5	56.7	15.7	20.6	7.0
Finland	25.3	66.1	8.6	36.8	50.5	12.7	80.0	12.4	6.1	1.5
France	28.1	68.7	3.2	43.9	51.9	4.3	68.8	17.4	10.2	3.6
Germany	43.1	52.5	4.4	58.8	37.8	3.5	61.9	21.5	12.9	3.8
Greece	23.8	65.2	11.0	37.1	51.9	11.0	50.4	24.7	23.1	1.8
Hungary	39.7	54.4	6.0	34.0	49.0	17.0	44.2	23.9	20.5	11.4
Ireland	30.7	60.0	9.3	37.8	50.5	11.7	67.5	10.5	21.0	1.0
Italy	31.3	62.4	6.3	32.1	61.1	6.8	63.4	18.5	16.3	1.8
Latvia	43.0	44.3	12.7	48.0	40.6	11.5	42.7	21.3	32.5	3.5
Lithuania	31.3	50.2	18.5	39.9	46.5	13.6	63.8	14.2	21.3	0.7
Luxembourg	45.7	49.8	4.5	31.7	58.3	10.1	72.8	14.0	9.3	3.9
Macedonia	31.2	53.9	15.0	33.6	49.6	16.8	28.1	19.1	50.3	2.5
Malta	39.7	54.3	6.0	27.8	61.9	10.3	67.1	15.9	14.2	2.8
Netherlands	25.9	66.2	8.0	27.8	67.9	4.3	76.4	12.1	8.0	3.5
Norway	29.4	66.0	4.6	34.5	55.6	9.9	69.8	14.6	14.0	1.7
Poland	15.1	71.4	13.5	36.6	50.2	13.1	47.7	23.0	20.3	9.1
Portugal	23.6	68.9	7.5	31.8	48.2	20.0	44.3	18.3	35.3	2.1
Romania	13.1	62.9	24.0	29.1	46.1	24.8	50.4	12.8	36.9	0
Serbia	*n.a.*	*n.a.*	*n.a.*	24.1	57.0	18.9	32.6	12.3	54.2	0.9
Slovakia	20.6	63.7	15.8	22.8	60.0	17.2	69.7	12.4	16.2	1.7
Slovenia	49.9	48.1	2.1	31.6	51.7	16.7	60.2	17.5	17.4	5.0
Spain	37.0	59.6	3.3	33.4	60.5	6.1	52.6	17.9	27.3	2.3
Sweden	26.8	72.7	0.5	30.5	62.6	6.9	87.6	7.3	5.1	0
Switzerland	*n.a.*	*n.a.*	*n.a.*	45.6	47.3	7.0	61.5	22.1	11.2	5.2
Turkey	25.9	62.4	11.7	23.0	42.0	34.9	53.6	6.9	38.5	1.0
United Kingdom	27.7	62.9	9.3	20.0	66.7	13.4	74.5	8.9	14.7	1.9
33 European countries	***30.8***	***61.4***	***7.9***	***35.5***	***52.3***	***12.1***	***60.8***	***20.4***	***15.7***	***3.1***

Notes: *SEwE* = self-employed with employees, *IOA* = independent own-account self-employed worker, *DSEW* = dependent self-employed worker, *Opp* = opportunity entrepreneur, *Hyb* = hybrid opportunity-necessity entrepreneur, *Nec* = necessity entrepreneur, *Oth* = entrepreneur for other reasons; To ensure that these figures accurately reflect the population of self-employed workers in each country, post-stratification weights provided by the EWCS are used. The design weights are calibrated by comparing the EWCS with Eurostat's Labour Force Survey with regard to respondents' gender, age, region, occupation and sector of economic activity. Countries' population sizes are used as supranational weights to ensure that larger (smaller) countries weigh heavier (weaker) when calculating aggregated figures at the European level (i.e., for our 33 European countries); [a] The information about entrepreneurship reasons is only available within the EWCS 2015.
Data source: EWCS 2010, 2015 and Eurostat.

Table 3. Descriptive statistics for occupational status within self-employment and start-up motivation in the EWCS

	Occupational status						**Start-up motivation** [b]							
	1 *Self-employed with employees 2010, 2015*		**2** *Independent own-account self-employed worker 2010, 2015*		**3** *Dependent self-employed worker 2010, 2015*		**1** *Opportunity entrepreneur 2015*		**2** *Hybrid opportunity-necessity entrepreneur 2015*		**3** *Necessity entrepreneur 2015*		**4** *Entrepreneur for other reasons 2015*	
# observations	N = 2,780		N = 4,881		N = 874		N = 2,670		N = 652		N = 909		N = 114	
% observations	32.6%		57.2%		10.2%		61.5%		15%		20.9%		2.6%	
Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Educational attainment														
Basic education [a]	0.059		0.114		0.222		0.058		0.060		0.188		0.052	
Secondary education [a]	0.598		0.613		0.638		0.598		0.635		0.632		0.681	
Tertiary education [a]	0.343		0.272		0.140		0.344		0.305		0.180		0.267	
Job characteristics														
Years of tenure in present job (*1 – 53*)	13.53	9.85	12.54	10.37	14.70	12.48	14.09	10.56	12.18	10.49	12.70	11.36	15.13	11.97
Working hours (*15 – 98*)	49.5	13.3	46.0	15.3	44.2	16.3	46.2	13.4	45.0	13.7	44.5	15.5	42.6	16.0
Net monthly earnings - PPP $ of 2015 (*1 – 55,210*)	2,884	2,454	1,950	1,733	1,471	1,509	2,545	2,578	1,984	1,422	1,440	1,115	2,021	1,380
Sector composition														
High-tech industry and knowledge-intensive services [a]	0.035		0.038		0.035		0.048		0.041		0.017		0.026	
Demographic characteristics														
Female [a]	0.293		0.372		0.368		0.332		0.351		0.399		0.422	
Immigrant [a]	0.107		0.101		0.097		0.111		0.113		0.115		0.121	
Age (*18-65*)	44.46	10.50	44.24	11.10	46.24	11.54	45.67	10.77	44.83	10.97	46.02	11.18	46.35	10.85
Cohabiting [a]	0.773		0.709		0.722		0.725		0.710		0.698		0.733	
Children under 14 [a]	0.341		0.308		0.251		0.299		0.299		0.275		0.241	
Health (1-5)	4.05	0.73	3.98	0.78	3.80	0.79	4.08	0.73	3.96	0.75	3.77	0.79	3.97	0.80
Ends meet (1-6)	4.24	1.16	3.70	1.31	3.35	1.34	4.16	1.17	3.71	1.22	3.18	1.34	4.05	1.32

Notes: N = 8,535; [a] Dummy variable; [b] The information about entrepreneurship reasons is only available within the EWCS 2015.
Data source: EWCS 2010, 2015.

Table 4. Results for patents –*linear regression models (OLS)*–

# Model	1A			1B			2B			2C		
Average predicted patents per constant 2010 US$ billion GDP (*y*)	9.14			9.11			10.04			10.03		
Independent variables (*x*)	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic
Focal variables												
Occupational status within self-employment												
1 Share of self-employed with employees (*13.1 – 62.4*)	0.076	0.83	1.64	0.047	0.52	1.05						
2 Share of independent own-account self-employed workers (*30.1 – 62.7*)	0.015	0.17	0.39	0.020	0.21	0.45						
3 Share of dependent self-employed workers (*ref.*) (*0.5 – 34.9*)												
Start-up motivation												
1 Share of opportunity entrepreneurs (*28.1 – 87.6*)							0.052	0.52	1.16	0.053	0.53	1.17
2 Share of hybrid opportunity-necessity entrepreneurs (*5.9 – 30.3*)							0.141	1.41	1.06	0.148	1.47	1.04
3 Share of necessity entrepreneurs (*ref.*) (*4.5 – 54.2*)												
4 Share of entrepreneurs for other reasons (*0 – 14.1*)							-0.069	-0.69	-0.26	0.044	0.44	0.18
R&D effort												
GERD PPS per inhabitant at constant 2005 prices (*40.0 – 1,089.7*)	0.021	0.22	7.16***	0.021	0.23	7.60***	0.024	0.24	6.64***	0.023	0.23	7.02***
Control variables												
Sector composition												
Share of high-tech industry and knowledge-intensive services (*2.3 – 11.7*)	-0.293	-3.21	-1.08	-0.195	-2.14	-0.83	-0.621	-6.18	-1.31	-0.601	-6.00	-1.61
Business cycle												
Unemployment rate (*3.0 – 33.8*)	-0.115	-1.26	-1.15	-0.100	-1.10	-0.92	-0.137	-1.36	-1.11	-0.144	-1.44	-1.14
Period												
2015 [a]	0.968	10.59	1.23	0.958	10.51	1.20						
Post-stratification weights for entrepreneurship variables used	No			Yes			No			Yes		
R-squared	0.90			0.89			0.92			0.92		
# observations	64						33					
Periods	2010, 2015						2015					

Notes: [a] Dummy variable. For continuous variables, *dy/dx* captures absolute marginal effects whereas [(*dy/dx*)/*y*]% refers to marginal effects, but expressed in relative terms with respect to predicted probabilities. In the context of dummy variables, these reflect the impact for a discrete change of the dummy variable from 0 to 1; * $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$; For models 1A-1B, the maximum correlation is -0.495 (between GERD and Unemployment rate), and the VIFs values (from model 1B) range from 1.07 to 1.49. For models 2A-2B, the maximum correlation is -0.564 (between Share of opportunity entrepreneurs and Unemployment rate), and the VIFs values (from model 2B) range from 1.32 to 1.78. Thus, multicollinearity does not pose a concern.
Data source: WIPO IP Statistics Database, Eurostat, World Bank national accounts data, OECD National Accounts data files, and EWCS 2010, 2015.

Table 5. Results for trademarks –*linear regression models (OLS)*–

# Model	3A			3B			4A			4B		
Average predicted trademarks per constant 2010 US$ billion GDP (*y*)	201.4			200.4			221.8			221.8		
Independent variables (*x*)	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}$%	t-statistic
Focal variables												
Occupational status within self-employment												
1 Share of self-employed with employees (*13.1 – 62.4*)	5.79	2.87	3.08***	5.23	2.61	3.84***						
2 Share of independent own-account self-employed workers (*30.1 – 62.7*)	3.01	1.50	2.25**	3.93	1.96	2.23**						
3 Share of dependent self-employed workers (*ref.*) (*0.5 – 34.9*)												
Start-up motivation												
1 Share of opportunity entrepreneurs (*28.1 – 87.6*)							6.07	2.74	2.58***	6.40	2.89	2.63***
2 Share of hybrid opportunity-necessity entrepreneurs (*5.9 – 30.3*)							0.49	0.22	0.12	3.16	1.42	0.84
3 Share of necessity entrepreneurs (*ref.*) (*4.5 – 54.2*)												
4 Share of entrepreneurs for other reasons (*0 – 14.1*)							11.82	5.33	1.39	11.59	5.23	1.36
R&D effort												
GERD PPS per inhabitant at constant 2005 prices (*40.0 – 1,089.7*)	-0.11	-0.06	-0.76	-0.10	-0.05	-0.72	-0.32	-0.14	-1.36	-0.29	-0.13	-1.41
Control variables												
Sector composition												
Share of high-tech industry and knowledge-intensive services (*2.3 – 11.7*)	-9.43	-4.68	-0.62	-13.80	-6.89	-1.01	5.99	2.70	0.22	-4.62	-2.08	-0.25
Business cycle												
Unemployment rate (3.0 – 33.8)	-10.01	-4.97	-1.85*	-10.59	-5.29	-1.82*	-8.34	-3.76	-1.45	-8.87	-4.00	-1.35
Period												
2015 [a]	73.94	36.71	1.62	73.16	36.50	1.55						
Post-stratification weights for entrepreneurship variables used	No			Yes			No			Yes		
R-squared	0.64			0.63			0.63			0.62		
# observations	64						33					
Periods	2010, 2015						2015					

Notes: [a] Dummy variable. For continuous variables, *dy/dx* captures absolute marginal effects whereas [(*dy/dx*)/*y*]% refers to marginal effects, but expressed in relative terms with respect to predicted probabilities. In the context of dummy variables, these reflect the impact for a discrete change of the dummy variable from 0 to 1; * $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$; For models 3A-3B, the maximum correlation is -0.495 (between GERD and Unemployment rate), and the VIFs values (from model 3B) range from 1.07 to 1.49. For models 4A-4B, the maximum correlation is -0.564 (between Share of opportunity entrepreneurs and Unemployment rate), and the VIFs values (from model 4B) range from 1.32 to 1.78. Thus, multicollinearity does not pose a concern.
Data source: WIPO IP Statistics Database, Eurostat, World Bank national accounts data, OECD National Accounts data files, and EWCS 2010, 2015.

Appendix. Variable definitions

Table A1. Country-level variables

Variable	Description
Dependent variables	
Trademarks per constant 2010 US$ billion GDP	Registered trademarks per constant 2010 US$ billion GDP. Data correspond to total trademark registrations, direct and via the *Madrid system*, expressed in equivalent class counts. This variable is generated for the periods 2010 and 2015 (*Data sources*: WIPO IP Statistics Database & World Bank national accounts data, and OECD National Accounts data files).
Patents per constant 2010 US$ billion GDP	Patent grants per constant 2010 US$ billion GDP. Data correspond to total patent grants registrations, direct and *Patent Cooperation Treaty* national phase entries, expressed in equivalent class counts. This variable is generated for the periods 2010 and 2015 (*Data sources*: WIPO IP Statistics Database & World Bank national accounts data, and OECD National Accounts data files).
Focal variables	
Occupational status within self-employment [a]	
1 Share of self-employed with employees	% of self-employed workforce who declare being self-employed with employees. This variable is generated for the years 2010 and 2015 (*Data source*: EWCS).
2 Share of independent own-account self-employed workers	% of self-employed workforce who declare being self-employed without employees and answer positively to the question on whether he/she generally has more than one client or customer. This variable is generated for the years 2010 and 2015 (*Data source*: EWCS).
3 Share of dependent self-employed workers	% of self-employed workforce who declare being self-employed without employees and answer negatively to the question on whether he/she generally has more than one client or customer. This variable is generated for the years 2010 and 2015 (*Data source*: EWCS).
Start-up motivation [a]	
1 Share of opportunity entrepreneurs	% of self-employed workforce who declare having become self-employed mainly through own personal preferences. This variable is generated for the year 2015 (*Data source*: EWCS).
2 Share of hybrid opportunity-necessity entrepreneurs	% of self-employed workforce who declare having become self-employed due to a combination of both reasons: own personal preferences and no other alternatives for work. This variable is generated for the year 2015 (*Data source*: EWCS).
3 Share of necessity entrepreneurs	% of self-employed workforce who declare having become self-employed because had no other alternatives for work. This variable is generated for the year 2015 (*Data source*: EWCS).
4 Share of entrepreneurs for other reasons	% of self-employed workforce who declare having become self-employed due to neither of these previous reasons. This variable is generated for the year 2015 (*Data source*: EWCS).
R&D effort	
GERD PPS per inhabitant at constant 2005 prices	5 years average Gross Domestic Expenditure on R&D expressed as Purchasing Power Standards –PPS– per inhabitant at constant 2005 prices. This variable includes expenditure on research and development by business enterprises, higher education institutions, as well as government and private non-profit organisations. This variable is generated for the periods 2006-10 and 2011-15 (*Data source*: Eurostat).
Control variables	
Sector composition [a]	
Share of high-tech industry and knowledge-intensive services [a]	% of self-employed workforce who declare working in high-technology industry and knowledge-intensive services, as defined by Eurostat aggregations based on 'Statistics on high-tech industry and knowledge-intensive services'. It includes all workers whose codes of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) at 2-digit level, are 20 = Manufacture of chemicals and chemical products; 21 = Manufacture of basic pharmaceutical products and pharmaceutical preparations; 26 = Manufacture of computer, electronic and optical products; 27 = Manufacture of electrical equipment; 28 = Manufacture of machinery and equipment not elsewhere classified; 29 = Manufacture of motor vehicles, trailers and semi-trailers; 30 = Manufacture of other transport equipment; 59 = Motion picture, video and television programme production, sound recording and music publishing activities; 60 = Programming and broadcasting activities; 61 = Telecommunications; 62 = Computer programming, consultancy and related activities; 63 = Information service activities; and 72 = Scientific research and development (*Data source*: EWCS).
Business cycle	
Unemployment rate	5 years average unemployment rates. This variable is generated for the periods 2006-10 and 2011-15 (*Data sources*: Eurostat, ILO).
Period	
2015	Dummy equals 1 for observations corresponding to the period 2015 and 0 for observations corresponding to the period 2010 (*Data source*: EWCS).

Notes: [a] Two variants of these variables are used in our regressions: (i) uncorrected for the possible presence of over or under-representation of certain groups, and (ii) corrected for the possible presence of representation issues using post-stratification weights.

Table A2. Individual-level variables

Variable	Description
Occupational status within self-employment	
1 Self-employed with employees	Dummy equals 1 for workers who declare being self-employed with employees.
2 Independent own-account self-employed worker	Dummy equals 1 for individuals who declare being self-employed without employees and answer positively to the question on whether he/she generally has more than one client or customer.
3 Dependent self-employed worker	Dummy equals 1 for individuals who declare being self-employed without employees and answer negatively to the question on whether he/she generally has more than one client or customer.
Start-up motivation	
1 Opportunity entrepreneur	Dummy equals 1 for workers who declare having become self-employed mainly through own personal preferences. This variable is only available for wave 2015.
2 Hybrid opportunity-necessity entrepreneur	Dummy equals 1 for workers who declare having become self-employed due to a combination of both reasons: own personal preferences and no other alternatives for work. This variable is only available for wave 2015.
3 Necessity entrepreneur	Dummy equals 1 for workers who declare having become self-employed because had no other alternatives for work. This variable is only available for wave 2015.
4 Entrepreneur for other reasons	Dummy equals 1 for workers who declare having become self-employed due to neither of these reasons. This variable is only available for wave 2015.
Educational attainment	
Basic education	Dummy equals 1 for workers with less than lower secondary education (ISCED-1997, 0-1).
Secondary education	Dummy equals 1 for workers with, at least, lower secondary education but non-tertiary education (ISCED-1997, 2-4).
Tertiary education	Dummy equals 1 for workers with tertiary education (ISCED-1997, 5-6).
Job characteristics	
Years of tenure in present job	Number of years of experience in the company or organization.
Working hours	Working hours per week.
Net monthly earnings - PPP $ of 2015	Average net earnings in recent months. The variable is defined in PPP $ of 2015.
Sector composition	
High-tech industry and knowledge-intensive services	Dummy equals 1 for individuals who declare working in high-technology industry and knowledge-intensive services, as defined by Eurostat aggregations based on 'Statistics on high-tech industry and knowledge-intensive services'. It includes all workers whose codes of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) at 2-digit level, are 20 = Manufacture of chemicals and chemical products; 21 = Manufacture of basic pharmaceutical products and pharmaceutical preparations; 26 = Manufacture of computer, electronic and optical products; 27 = Manufacture of electrical equipment; 28 = Manufacture of machinery and equipment not elsewhere classified; 29 = Manufacture of motor vehicles, trailers and semi-trailers; 30 = Manufacture of other transport equipment; 59 = Motion picture, video and television programme production, sound recording and music publishing activities; 60 = Programming and broadcasting activities; 61 = Telecommunications; 62 = Computer programming, consultancy and related activities; 63 = Information service activities; and 72 = Scientific research and development.
Demographic characteristics	
Female	Dummy equals 1 for females.
Immigrant	Dummy equals 1 for citizens of a different country of that of residence.
Age	Age reported by the worker.
Cohabiting	Dummy equals 1 for individuals cohabiting with spouse/partner.
Children under 14	Dummy equals 1 for individuals cohabiting with any son or daughter aged under 14.
Health	Variable ranging from 1 to 5. The scale refers to the level of health declared by the worker. It equals 1 for individuals whose health is very bad and 5 for individuals whose health is very good.
Ends meet	Variable ranging from 1 to 6. The scale refers to the household ability to make ends meet. It equals 1 for households which make ends meet very easily and 6 for households which make ends meet with great difficulty.

Data source: EWCS.