

How do country R&D change the allocation of self-employment across different types?

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Abstract

We investigate the impact of country R&D on the allocation of self-employment across different types, where types are identified based on occupational status and start-up motive. We first conduct a literature review based on which we consider the self-employed with employees to be of higher 'quality' (in terms of their overall contribution to the economy) compared to independent own-account workers, who in turn may be considered of higher 'quality' than dependent self-employed workers. Similarly, we also consider opportunity self-employed to be of higher 'quality' than necessity self-employed. Our empirical analysis then shows that the level of a country's R&D expenditures increases the share of self-employed with employees and that of opportunity self-employed (i.e. the self-employment types associated with higher 'quality') at the cost of the shares of dependent self-employed and necessity self-employed. Higher R&D expenditures at the country level thus increase the quality of self-employment in the country.

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1. Introduction

Emanating from the pioneering theoretical work on self-employment by Kihlstrom and Laffont (1979) and the subsequent empirical analyses of Evans and Jovanovic (1989) and Evans and Leighton (1989), a significant trajectory of research on the determinants of the supply of entrepreneurs has emerged over the last three decades (for an overview, see Parker 2018). However, although by now it is widely acknowledged that entrepreneurs differ greatly in their contribution to economy and society (Kuhn 2000; Blanchflower 2004; Cowling et al. 2004; Carree et al. 2007; Shane 2009; A. Millán et al. 2015; Wennekers and Van Stel 2017), this heterogeneity is not as acknowledged in empirical studies as it could and should be. This is unfortunate since encouraging entrepreneurship is often seen by policy makers as a route to combat unemployment and stimulating economic development (Meager 1992; Earle and Sakova 2000; Santarelli and Vivarelli 2007; Román et al. 2013; Dvouletý and Lukeš 2016). However, if the wrong ‘types’ of entrepreneurs are being stimulated, this may lead to adverse effects on the economy (Santarelli and Vivarelli 2007; Mueller et al. 2008; Román et al. 2011, 2013). Hence, new studies are needed that do not so much look into the determinants of the absolute *number* of entrepreneurs in a given country, but rather investigate the determinants of the *allocation* of entrepreneurship across different types. Moreover, we also need knowledge on which types generate bigger contributions to the economy. Only then we can evaluate whether a shift of the entrepreneurship distribution in a certain direction (e.g. more innovative and less imitative entrepreneurs, or vice versa) can be considered an improvement of the ‘quality’ of a population of entrepreneurs.

Entrepreneurship research should thus deepen the identification of the existing heterogeneity within the population of entrepreneurs. Indeed, several approaches attempted to capture different groups within entrepreneurship or self-employment.¹ The present study focuses on the heterogeneity of the self-employed along two dimensions: occupational status (self-employed with employees versus independent own-account worker versus dependent self-employed) and start-up motive (opportunity versus necessity). Based on literature review, we will consider for each dimension which types generally show higher firm performance and may thus be considered of higher ‘quality’ in terms of their expected overall contribution to the economy. Next, we investigate if and how country-level R&D influences the allocation of self-employment in terms of these two dimensions. R&D is an important determinant of entrepreneurship because it creates many entrepreneurial opportunities (Acs and Audretsch 2003; Venkataraman 1997), and a lot of potential for knowledge spillovers that benefit the economy (Audretsch 2007). However, to our knowledge the impact of R&D on the allocation of self-employment across different types has not been studied yet.

So the aim of this paper is to examine whether the innovative nature of an economy as expressed by its level of R&D undertaken as a percentage of GDP, affects the composition of the self-employed workforce and, in particular, the relative weights of (i) self-employed workers with employees; (ii) independent own-account self-employed workers; and (iii) dependent self-employed workers, over total self-employment in a given country. Moreover, we investigate whether country R&D affects the allocation between opportunity and necessity self-employed. To this end, we use (a) homogeneous proxies for dependent self-employed workers and opportunity self-employed; (b) a geographical coverage as wide as the EU-28 countries; and (c) the most recent international microdata available (5th and 6th waves of the *European Working Conditions Survey* for 2010 and 2015).

¹ The more relevant traditional and recent approaches are: (i) *innovative* against *imitative* entrepreneurs (Schumpeter 1912); (ii) *productive*, *unproductive* and *destructive* entrepreneurs (Baumol 1990); (iii) self-employed *with* or *without* employees (Carrasco 1999); (iv) *dependent* against *independent* self-employment (Burchell et al. 1999); (v) *opportunity* against *necessity* entrepreneurs (Reynolds et al. 2002); (vi) *providing* versus *enabling* entrepreneurship (Burke 2012) and (vii) the distinction between several engagement levels in the entrepreneurial process (Van der Zwan et al. 2010).

The present paper contributes to the general literature on the determinants of entrepreneurship. Although this literature is extensive, research to date typically focuses on explaining the propensity of being an entrepreneur (Simoes et al. 2016), or at the macro-level, on explaining the rate or *number* of entrepreneurs in a region or country (Parker 2018). However, studies focusing on the *allocation* of entrepreneurs among certain types (i.e. studies focusing on the quality rather than the quantity of entrepreneurship) are scarce.

We also contribute more specifically to the literature on R&D and entrepreneurship. The knowledge spillover theory of entrepreneurship (Acs et al. 2013) argues that firms tend to locate closely to sources of knowledge spillovers (e.g. universities or corporate research laboratories) as this facilitates exploitation of such spillovers, and hence a positive link has been found between R&D and entrepreneurship at the regional level (Audretsch and Lehmann 2005). Moreover, country-level R&D expenditures have been found to increase firm performance of individual entrepreneurs (Van Stel et al. 2014). However, the impact of R&D on the qualitative composition of a country's population of entrepreneurs (i.e. the allocation of entrepreneurs over different types) has not been studied yet.

Finally, our paper also contributes to the emerging field within entrepreneurship literature that distinguishes between different types of entrepreneurs. In this regard, several studies focus on the subgroup of high-growth or high-potential entrepreneurs (Henrekson and Johansson 2010). However, more general approaches to identify types of entrepreneurs along different dimensions are scarce and typically conceptual in nature (e.g. Baumol 1990; Terjesen et al. 2016; Wennekers and Van Stel 2017). In this regard, our aim to identify 'high-quality' self-employment is closely related to the concept of 'productive' entrepreneurship in the Baumol (1990) sense. Belitski and Korosteleva (2010) explain that certain segments of self-employment may be considered productive whereas other segments of self-employment are more likely to be unproductive. In this sense, our quest for identifying (the determinants of) 'high-quality' self-employed can be seen as an attempt to identify those segments of self-employment that can be considered productive in the Baumol sense (Belitski and Korosteleva 2010). Apart from the literature on high-growth firms, the literature on types of entrepreneurship is mainly conceptual in nature, and empirical studies are scarce (Henrekson and Sanandaji 2018 is an exception). We contribute by empirically operationalising types of entrepreneurship along two dimensions and focusing on the determinants of the relative shares of these different types in total self-employment.

In Section 2 we conduct a brief literature review to establish which types of entrepreneurs may be considered to be of higher 'quality' (in terms of their overall contribution to the economy). We also derive hypotheses regarding the impact of R&D on the allocation of self-employment across the different types. We then test these hypotheses making use of the 2010 and 2015 waves of the *European Working Conditions Survey*. This data base, the variables that we employ from it and our methods of analysis are discussed in Section 3. Section 4 describes the empirical results and, finally, Section 5 concludes.

2. Literature review & hypotheses

We first discuss some matters related to operationalizing the types of self-employment we use in this paper into statistical indicators. Next, we conduct a short literature review to establish the relative 'quality' (in terms of direct performance and expected contribution to the economy) of the various self-employment types that we focus on. Finally, we derive hypotheses regarding the impact of country-level R&D on the allocation of self-employment across different types.

2.1 Operationalizing types of self-employment

Economists tend to classify entrepreneurs and their motives from actual observed behavior. This is the so-called 'revealed preference' principle. In particular, labour economists are often content to utilise self-employment as a working definition (Parker 2018). A practical advantage of using self-employment as a measure of entrepreneurship is that it is widely implemented – both at the

individual level within human population surveys and at the national level, via the *OECD Labour Force Statistics* database, allowing international comparisons to be performed. In this sense, around 15.8 per cent of the workforce in the EU-28 are self-employed (OECD 2018).

The self-employed are usually classified formally as individuals who earn no regular wage or salary but who derive their income by exercising their profession or business on their own account and at their own risk. In this sense, OECD's own self-employment definition stresses how 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 2018). Stated otherwise, the OECD acknowledges the existing heterogeneity behind this indicator.

A first source of heterogeneity is related with the number of employees. Thus, some individuals operate as *self-employed with employees* –or employers– (and, hence, contribute directly to the job-generation process) and many more as *own-account workers* –or sole proprietorships–, i.e., the simplest form of business organisation. Both groups are often considered as proxies for *true* entrepreneurs and less entrepreneurial forms of self-employment, respectively (Earle and Sakova 2000; Kuhn 2000; Román et al. 2013; J.M. Millán et al. 2014a, 2014b). Furthermore, as will be explained in the next subsection, to account for the existing heterogeneity within the group of self-employed workers without employees, identification of *dependent self-employed workers* is also of relevance.

Business scholars propose alternative approaches to entrepreneurship. Thus, equating entrepreneurship with opportunity recognition is now standard practice in the business studies approach to entrepreneurship (Shane and Venkataraman 2000). Opportunity and necessity entrepreneurship is typically measured on the basis of the Global Entrepreneurship Monitor (GEM) definition proposed by Reynolds et al. (2002). Respondents of the GEM Adult Population Survey 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.

2.2 The 'quality' of different types of self-employed workers

The self-employed can be considered a heterogeneous group in terms of their own direct performance, wherein only a minority of entrepreneurs generate jobs (i.e. the self-employed with employees), innovation and wealth leading to a conclusion in the literature that 'less is more' or more self-employment is not necessarily better (Burke et al. 2000; Blanchflower 2004; Shane 2009; Van Praag and Van Stel 2013). In particular, policies to stimulate self-employment, e.g. in the form of start-up subsidies, may lead to more but not necessarily 'better' entrepreneurship. Indeed, these incentives can generate an adverse selection problem by encouraging mostly unskilled individuals to enter (solo) self-employment and, therefore, deteriorating entrepreneurship quality (Román et al. 2011, 2013; Dvouletý and Lukeš 2016). In terms of the distinction self-employed with or without employees, Belitski and Korosteleva (2010) explain that self-employed with employees are often seen as 'productive' in the Baumol sense whereas own-account workers are often considered unproductive.

It is also clear that among the solo self-employed a great diversity exists with some occupational groups of solo self-employed (freelancers) earning more than equivalent employees (e.g. IPSE Freelancer Confidence index reports 2014-2018; CRSE 2017; Burke and Vigne 2018) and playing an 'entrepreneurial enabling role' for business customers comprising SMEs and large corporations engaged in innovation and growth (Burke, 2011, 2012; Burke and Cowling 2015). So, although in *direct* terms, solo self-employed are less productive than those with employees, there are segments of solo self-employed who *indirectly* enable entrepreneurship in other firms by providing a flexible and diverse pool of freelance expertise that enables firms to grow faster and undertake more innovation than would be possible if they were only to rely on their own

employees (Burke 2011, 2012). In this manner, the solo self-employed can *indirectly* generate significant value added in other firms.

So one useful means of accounting for the existing heterogeneity within the solo self-employed workers without employees is undertaken by OECD (2014), who define ‘*dependent self-employed workers*’ 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”. By contrast, *independent own-account self-employed workers* have multiple clients and relate more to the project-based freelance workers described by Burke and Cowling (2015) who enable entrepreneurship in other firms and are able to share in the gains in the value added that they generate in these companies thereby earning more than equivalent employees – and indeed more than dependent solo self-employed. The situation faced by dependent solo self-employed is that they often find themselves in an economically weak situation and this is being widely discussed in international (OECD 2000, 2014; ILO 2003) and European political and legal forums (Supiot 2001; EIRO 2002; Perulli 2003; Sciarra 2005; European Commission 2006; Eichhorst et al. 2013). Nevertheless, the number of empirical studies that explore the frequency and working conditions of dependent self-employed workers has been rather low to date, despite this topic being a potentially pressing political issue.² The heterogeneous nature of the situations involved, the lack of a definition or statistical tool and, ultimately, the lack of reliable data are seen as more than probable causes of this research gap (Eichhorst et al. 2013; ILO 2006).

A second source of heterogeneity among the self-employed concerns their start-up motive. Van Stel et al. (2018) show that entrepreneurs who started a business because they spotted a business opportunity (opportunity entrepreneurs) perform better than those who had no other options for work (necessity entrepreneurs). This may be the case because opportunity entrepreneurs were able to take more time to carefully prepare their start-up effort, influencing both the nature and execution of the business opportunity (Block and Sandner 2009). In particular, start-up conditions of the new firm are likely to be better for opportunity entrepreneurs, due to their better preparations. These start-up conditions, in turn, may have lasting effects on business performance (Martin 2002).

Summarising, based on the short review above, in terms of the occupational status dimension we consider the self-employed with employees to be of higher ‘quality’ (in terms of direct performance and overall contribution to the economy) compared to independent own-account workers, who in turn may be considered of higher ‘quality’ than dependent self-employed workers. Similarly, we also consider opportunity self-employed to be of higher ‘quality’ than necessity self-employed.

2.3 Hypotheses derivation

Having established that different forms of self-employment differ in quality, it is essential to identify the key attributes of the institutional framework that can lead to different forms of an *Entrepreneurial Society* (Audretsch 2007), i.e., that can alter the relative weight of different forms of self-employment in the labour market. The existing evidence on this issue is not just scarce but also mixed (e.g. McMullen et al. 2008; Román et al. 2011, 2013; Valdez and Richardson 2013;

² Thus, most previous studies focus on a single country (e.g. CRSE 2017). The only conditional analysis that characterizes dependent self-employed workers, compared with self-employed and paid employed in a cross-country comparable setting is the work by A. Millán and J.M. Millán (2017). Another related conditional analysis is that by A. Millán et al. (2018), which compares job satisfaction of independent own-account works and dependent self-employed workers. Also interesting is the work by Lyalkov et al. (2019), where the interrelation between the share of the self-employed workforce in a given country that can be considered ‘entrepreneurial’ and trademark registration at the country level is explored. In this work, both necessity entrepreneurs and dependent self-employed workers are considered ‘non-entrepreneurial’ types.

Congregado et al. 2014; Van Stel et al. 2014; Fuentelsaz et al. 2015). As an explanation of the absence of clear-cut results as regards the role of institutions, Freeman (2008) stresses that the effectiveness of a specific institutional set-up depends on contextual contingencies and complementarities arising from its several elements.

Freeman (2008) also suggests that there is not a single recipe for creating the aforementioned *Entrepreneurial Society*. In this sense, it is expected that the innovative environment of an economy plays an important role in the qualitative composition of entrepreneurship. Expenditures on R&D activities should positively affect knowledge spillovers, increasing the stock of technological capital and, thus, the number of entrepreneurial opportunities (Audretsch 1995; Kirzner 1997; Venkataraman 1997). Moreover, an advanced technological environment might create a self-selection effect where only the best and most qualified individuals dare to become entrepreneurs increasing the quality of entrepreneurship and its potential to generate employment (Acs and Audretsch 2003; Acemoglu et al. 2006; Crifo and Sami 2008).

A key tenet of industrial organisation research is the identification of R&D as a sunk fixed cost which thereby raises minimum efficient scale (MES) in industry (Martin 2002). Consequently, a higher MES provides a scale advantage to larger firms which among the self-employed disproportionately favours self-employed with employees over those who operate at the smallest possible scale on their own account. This gives rise to hypothesis 1.

Hypothesis 1: *Greater R&D investment will promote self-employment with employees over solo self-employment.*

Of course R&D is ‘a means to an end’ in terms of enabling firms to be innovative and to be more entrepreneurial. In modern economies more innovative and entrepreneurial firms involve freelancer solo self-employed workers in projects requiring more diverse and specialist expertise than they have available among their employees. Firms that make use of freelancers can also operate with more flexibility and agility than they could do if required to hire on an employee only basis. In fact, the innovation-driven economy has been associated with the rise in independent contractors with multiple clients who are paid very well and work as complements to employees (Burke 2012; Burke and Cowling 2015). Therefore, greater investments in R&D which gives rise to more innovation is likely to create more work opportunities for independent solo self-employed as opposed to the dependent solo self-employed which are less complements and more substitutes for employees (Burke and Cowling 2015). This gives rise to hypothesis 2:

Hypothesis 2: *Greater investment in R&D facilitates independence for solo self-employment over dependent solo self-employment.*

In economics, the main business *raison d’être* to invest in R&D is to generate new knowledge which in turn creates new profit opportunities that would not otherwise be available for exploitation (see for example, Martin, 2002). So correspondingly in the field of entrepreneurship Acs and Varga (2005) suggest that R&D process in society entails the creation of extra opportunities for the self-employed. But there is diversity in terms of how R&D filters through to affect different forms of self-employment. For example, higher levels of R&D generating new knowledge can specifically enable knowledge-based entrepreneurship (Audretsch and Keilbach 2007; Acs et al. 2013). By contrast, Dvoulety (2017) finds no statistical relation between R&D expenditures and entrepreneurship in the Nordic regions which supports Schmitz’s (1989) contention that imitative self-employment can draw on knowledge generated by foreign R&D. In addition, Holcombe (2003) argues that opportunities from R&D often manifest themselves in the development of an environment that promotes a general increase in profit opportunities. As a result, the exploitation of opportunities does not necessarily have to be carried out by the innovator who is undertaking the R&D but could be developed by other agents through imitation (Schmitz, 1989) and knowledge spillovers (Audretsch and Lehmann 2005; Acs and Varga 2005; Holcombe 2003). So, in terms of the demarcation between necessity and opportunity-driven self-

employment, since greater levels of investment in R&D create more opportunities, then for any given level of necessity/push forces into self-employment, one might logically expect that a greater proportion of the self-employed workforce will be opportunity-driven. This leads to hypothesis 3:

Hypothesis 3: *Greater investment in R&D promotes opportunity-driven self-employment over necessity-driven self-employment.*

3. Data and methods

3.1. Data and sample

Identifying the existing heterogeneity within the self-employed workforce is not straightforward due to data limitations. 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 identification of certain categories within self-employment. 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.³ These workers are interviewed about several working condition aspects, including physical environment, workplace design, working hours, work organization 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 creating 2 separate classifications of self-employed workers. 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 as (1) self-employed with employees; (2) independent own-account self-employed (i.e. self-employed without employees answering positively to the question on 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 on whether his/her firm generally has more than one client). For the clarity of our exposition, we will refer, hereinafter, 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 within the EU-28 territory. 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 5,141 observations.

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 own personal preference, because they had no other alternatives for work, due to a combination of both reasons, or due to neither of these reasons. Given 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 2,961 observations. Based on this information, we classify the observed set of self-employed workers within our dataset as (1) opportunity entrepreneur; (2) hybrid opportunity-necessity entrepreneur; (3) necessity entrepreneur; and (4) entrepreneur for other reasons. For clarification purposes, we will refer, henceforth, to this classification as *start-up motive*.

³ 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).

Table 1 below shows the distribution of observations for both classifications across the EU-28 countries.

--- Insert Table 1 about here ---

3.2. Dependent variables

We aim to study whether the R&D effort in a given economy affects the qualitative composition of self-employment and, in particular, the relative weights of our different entrepreneurship types in total entrepreneurship. To this end, we generate the following discrete non-ordered variables from the information on occupational status within self-employment and start-up motive described above:

- (i) a discrete non-ordered variable equaling 1 for self-employed with employees, 2 for independent own-account self-employed workers, and 3 for dependent self-employed workers
- (ii) a discrete non-ordered variable equaling 1 for opportunity entrepreneurs; 2 for hybrid opportunity-necessity entrepreneurs, 3 for necessity entrepreneurs; and 4 for entrepreneur for other reasons.

3.3. Main independent variables

The fundamental role of technological activities, as drivers of entrepreneurial success and hence of economic development, urges countries to promote innovation in their economies (Van Stel et al. 2014). Therefore, in order to capture the presence and commitment to technological effort and innovation activities in each of the considered economies, our regressions on the relative weight of different entrepreneurship types and reasons include the 5 years 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. In order to make fairer comparisons between countries, Eurostat provides this information expressed (i) as *Purchasing Power Standards* –PPS– per inhabitant at constant 2005 prices⁴; and (ii) as percentage of GDP. The periods 2006-10 and 2011-15 are used to generate focal variables values for 2010 and 2015 respectively. Table 2 below shows figures as regards this indicator for the EU-28.

--- Insert Table 2 about here ---

Commitment to R&D varies from industry to industry, from country to country and from year to year. However, we observe that Nordic countries (Denmark, Finland and Sweden), together with Continental countries (Austria, Belgium, France, Germany, Luxembourg and The Netherlands) consistently rank high on the scale of R&D spenders across the EU-28 area. In contrast, some Mediterranean countries (Cyprus, Greece and Malta), Baltic States (Lithuania and Latvia) and East-European countries (Bulgaria, Croatia, Poland, Romania and Slovakia) normally rank low in the same scale. Although imperfect, the direct relationship between these investments and some macroeconomic indicators based on GDP is revealed.

3.4. Control variables

In order to isolate the effect of our hypotheses-related variables, the empirical models also include a set of explanatory variables that are known to influence self-employment participation (see e.g. Evans and Leighton 1989; Blanchflower and Oswald 1998; Carrasco 1999; Román et al. 2011, 2013; Congregado et al. 2014; Parker 2018): educational attainment, job-related aspects (tenure, working hours, business sector) and some demographic indicators (gender, immigrant, age, cohabitation status, children, health status).

⁴ 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 €.

In order to control for the business cycle and some structural differences between countries, the empirical models also include GDP growth rates and GDP per inhabitant for periods 2010 and 2015, which we collect from Eurostat, and a period 2015 (vs. 2010) dummy. Table 2 above also presents country-level information concerning GDP growth rates and GDP per inhabitant for the countries in our sample.

Definitions of all model variables are provided in the Appendix.

3.5. Methodology

To explore whether R&D effort in an economy affects the qualitative composition of entrepreneurship, we use non-ordered discrete choice models (multinomial logit). Standard errors are adjusted for intra-countries correlation by clustering.

4. Results

4.1. Descriptive analysis

We aim to explore how our different self-employment types and reasons affect their earnings and whether R&D effort affects their relative weight in a given economy. Table 3 below compares these groups.

--- Insert Table 3 about here ---

We first explore occupational status within self-employment. About 31.7% of our sample are self-employed with employees. We observe in our sample that, compared to the other types, self-employed with employees are more often male, better educated, more often to work in industry, construction and commerce and hospitality sectors, more often with partner and with children, they work the longest hours, feel the healthiest and also have the highest earnings. These figures suggest the appropriateness of the category of self-employed with employees in order to capture those more entrepreneurial forms of self-employment. About 58.4% and 9.9% of the workers in our sample are, respectively, independent own-account self-employed and dependent self-employed workers. When comparing both groups, dependent self-employed workers are lower educated, older, more likely to have worse health perception, and far more likely to work in the agricultural sector than independent own-account self-employed. Furthermore, they have lower earnings.

When concentrating on start-up motive (only available for the EWCS 2015), a similar characterization of our relevant groups is revealed. However, the shares of belonging to these groups varies substantially with respect to those obtained for our entrepreneurship types. In particular, 60.7% of our sample report to be opportunity entrepreneurs. We observe, inter alia, they are in our sample more often male, better educated, they have better health perception, and they work the longest hours. Moreover, they have the highest earnings. As regards their necessity entrepreneurs counterparts, this group accounts for 19.9% of our sample. These self-employed workers present the lowest educational attainment levels and more often work in the agricultural sector. Furthermore, they have the lowest earnings. Finally, the groups of hybrid entrepreneurs and entrepreneurs for other reasons account for 16.4% and 3% of our sample. Both categories present intermediate positions in terms of education levels and earnings.

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 2 specifications aimed to explore the role of expenditures on R&D over different occupational statuses. Similarly, Table 5 in subsection 4.2.2 shows the results from 2 specifications devoted to investigate the role of expenditures on R&D over different start-up motives. The following structure is used to present these results in Tables 4 and 5. First, average

predicted probabilities of belonging to different categories (in terms of occupational status or start-up motive) are indicated at the top of each specification. These predicted probabilities are useful to understand the relative importance of our marginal effects, presented below. Specifically, 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, section 4.2.3 presents some robustness checks which are part of the analysis.

4.2.1 Relationship between R&D and occupational status within self-employment types

Table 4 below presents models 1A–1B aimed to test our hypotheses on the relationship between GERD over different self-employment types. GERD is expressed as PPS per inhabitant at constant 2005 prices in model 1A whereas GERD as percentage of GDP is used in model 1B. To explore whether R&D effort affects the qualitative composition of entrepreneurship, we use non-ordered discrete choice models (multinomial logit). Standard errors are adjusted for intra-countries correlation in models 1A–1B by clustering.

--- *Insert Table 4 about here* ---

In coherence with Hypotheses 1 and 2, we observe that the qualitative composition of European self-employment is positively influenced by GERD in terms of a higher relative weight of self-employed with employees and a lower relative weight of dependent self-employed workers. In particular, model 1A shows that each additional PPS per inhabitant in R&D effort increases the likelihood of being self-employed with employees by about 0.03% and decreases the likelihood of being dependent self-employed worker by about 0.09%. Similarly, model 1B demonstrates how each additional 1% of GDP devoted to expenditures on R&D increases the chances of being self-employed with employees by about 9% and decreases the likelihood of being dependent self-employed worker by about 24%.

Turning to the results for our control variables, we observe how education, tenure and the number of working hours increase the chances of being self-employed with employees and decrease the likelihood of being both independent own-account worker and dependent self-employed worker. As regards tenure, we find a non-linear, inverted U-shaped impact on self-employed with employees likelihood where the turning point is reached after 28 years of experience in the company or organization. Conversely, we find a U-shaped effect on chances of being both independent own-account worker and dependent self-employed worker, where the turning points are reached with 30 and 26 years of tenure, respectively. A similar pattern is observed for working hours. Thus, there is also a positive (non-linear) association between working hours and the likelihood of being self-employed with employees, where the quadratic term begins to dominate the linear term at 64 working hours per week. Conversely, there is a negative (non-linear) relation between hours of work and the likelihood of being an independent own-account worker or a dependent self-employed worker, where the turning points are reached at 63 and 69 working hours per week, respectively. Since self-employed individuals are distinguished by the effort (e.g. working more hours is associated with being more job satisfied among the self-employed; Millán et al. 2013), the positive (negative) association between working hours and the more (less) entrepreneurial forms of self-employment cannot be a surprising result. We also find that females are less likely to be self-employed with employees and more likely to be independent own-account workers. Regarding place of birth, being an immigrant increases the chances to be dependent self-employed. Cohabitation is also positively associated with the chances of being self-employed with employees and negatively associated with the likelihood of being independent own-account worker. We also find a negative effect of dependent children on the options to be dependent self-employed worker. Reporting good health also seems to be positively associated with the chances to be self-employed with employees and negatively linked with the likelihood

of being dependent self-employed worker. Thus, our findings lend support to the view that an entrepreneurial career may have some health benefits (e.g. Stephan and Roesler 2010). Finally, being both self-employed with employees and dependent self-employed worker was more probable in 2015 whereas being independent own-account worker was more likely in 2010.

4.2.2 Start-up motive

Table 5 below presents models 2A–2B aimed to test our hypothesis on the relationship between GERD over different entrepreneurship reasons. GERD expressed as PPS per inhabitant at constant 2005 prices is used in model 2A whereas GERD is expressed as percentage of GDP in model 2B. Non-ordered discrete choice models (multinomial logit) are also used in these models, in which standard errors are also adjusted for intra-countries correlation by clustering.

--- Insert Table 5 about here ---

In concordance with Hypothesis 3, we observe that the qualitative composition of the European self-employed workforce is positively influenced by GERD in terms of a higher relative weight of opportunity entrepreneurs and a lower relative weight of necessity entrepreneurs. In particular, model 2A shows as each additional PPS per inhabitant in R&D effort increases the likelihood of being an opportunity-driven entrepreneur by about 0.02% and decreases the likelihood of being a necessity-driven entrepreneur by about 0.05%. Similarly, from model 2B we also observe as each additional 1% of GDP devoted to expenditures on R&D increases the chances of being opportunity entrepreneur by about 5% and decreases the likelihood of being necessity entrepreneur by about 13%.

Other covariates are also analysed. Thus, we observe how education, tenure and the number of working hours increase the chances of being opportunity entrepreneur and decrease the likelihood of being necessity entrepreneur. As regards tenure, we find a non-linear, inverted U-shaped impact on the probability of being an opportunity entrepreneur where the quadratic term begins to dominate the linear term after 35 years of experience. In contrast, we observe a U-shaped effect on the probability of being a necessity entrepreneur where the quadratic term begins to dominate the linear term after 33 years of tenure. A similar pattern occurs for working hours. Thus, a positive (inverted U-shaped) impact on opportunity entrepreneurship probabilities is also observed for working hours, where the turning point is reached at 51 working hours per week. Conversely, the effect of working hours on the probability of being a necessity entrepreneur is observed to be negative (U-shaped), where the turning point is reached at 47 working hours per week. Stated otherwise, we observe again a positive association between working hours and the more entrepreneurial forms of self-employment. We also find that females are less likely to be opportunity entrepreneurs. Cohabitation is also positively associated with the probability of being opportunity entrepreneur and negatively associated with the likelihood of being necessity entrepreneur. The same result is observed for those reporting good health which also supports the view that an entrepreneurial career may have some health benefits. Finally, GDP per inhabitant also seems to be positively associated with the chances to be opportunity entrepreneur and negatively linked with the likelihood of being necessity entrepreneur.

4.2.3 Robustness checks

We performed 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 subsections 4.2.1 and 4.2.2, all models incorporated controls for intra-countries correlation. These approaches indicate no major changes relative to simple pooled regressions (not presented for brevity). *Third*, the robustness of our t-statistics was verified by re-estimating them from variance–covariance matrices of the coefficients obtained by bootstrapping. And *fourth*, we have obtained similar results by considering national unemployment rates (Eurostat) as alternative measure of macroeconomic conditions. All results as regards these robustness checks are available upon request.

5. Conclusions

We investigated the impact of country R&D on the allocation of self-employment across different types, where types are identified based on two dimensions: occupational status and start-up motive. We first conducted a literature review to establish which of our identified ‘types’ of self-employment may be considered to be of higher ‘quality’ in terms of direct firm performance. This is important since the high-performing types are expected to provide a relatively bigger contribution to economy and society so policy makers may want to target especially these high-quality types. We found in our review that particularly the self-employed with employees and the opportunity self-employed can be regarded as higher performers. In addition, the descriptive statistics of our data set also revealed that, compared to their counterparts, these types of entrepreneurs were on average higher educated, worked longer hours and felt more healthy.

This study makes both theoretical and empirical contributions. Theoretically, it explains why knowledge investment is likely to support various self-employment types differently. Empirically, this study demonstrates that the level of a country’s R&D expenditures increases the share of self-employed with employees and opportunity self-employed at the cost of the shares of dependent self-employed and necessity self-employed. Since the former types were found to be the high-performing types in our literature review, our results imply that higher R&D expenditures increase the quality of a country’s self-employment population. This is an important finding as it confirms the existence of substantial knowledge spillovers from R&D, stimulating particularly more promising forms of entrepreneurship at the cost of less promising forms.

Our paper has implications for R&D policy. Evaluation of R&D policies, either in the form of tax credits or R&D subsidies, typically focuses on the amount of additional R&D spending by private firms as a result of receiving tax credits or subsidies (Busom et al. 2014). An important measure in this regard is the ‘bang for the buck’, which measures the extra R&D spending per euro or dollar of subsidy or tax credit received. Evaluation studies typically find that this ‘bang for the buck’ is substantial and often lies between 1 and 2 (Hall and Van Reenen 2000; Mohnen and Lokshin 2010). The present study shows that R&D policy may have wider implications than stimulating private R&D investments. In particular, if successful, it may also increase the quality of self-employment in a country. Still, policy makers are advised not just to stimulate R&D levels but also to carefully consider the strictness of their Intellectual Property Rights (IPR). A fine balance is required between protecting the rights of innovators (who benefit from strict IPR) and facilitating knowledge spillovers to occur (by means of less strict IPR) (Burke and Fraser 2012).

A limitation of our study is that our data is cross-sectional in nature so that we are not able to investigate the dynamics behind the occupational choices that the respondents have made. For instance, a proportion of independent own-account workers will expand their business at a later stage to become self-employed with employees. In this regard, some own-account workers deliberately start out small using a lean start-up strategy so that they are more flexible and agile when they want to expand later on (Burke et al. 2018). Arguably these self-employed belong to the ‘high-quality’ types but because our data base is a snapshot in time, we are not able to identify them as such. Another limitation concerns the aggregate nature of country R&D expenditures. Possibly, different sources of R&D expenditures (e.g. business enterprises, higher education institutions, government) may have different effects on the allocation of self-employment types.

Nevertheless, we suggest that our results are not only a good starting point for an analysis of the effect of R&D on the qualitative composition of a country’s population of entrepreneurs, but they also suggest a promising avenue for further research. Thus, given that strict IPR may be favourable for innovative entrepreneurs but unfavourable for imitative entrepreneurs (Burke and Fraser 2012), it would be interesting to explore how country-level R&D, the strictness of IPR, and their interaction relate to the ‘quality’ and performance (i.e., earnings, survival, or employment growth) of a population of entrepreneurs. In addition, the horizons of the present

enquiry could be broadened by extending the analysis to other countries and periods. Finally, future research may also focus on other country-level determinants of the allocation of entrepreneurship across different types, and on exploring different categorisations to capture the heterogeneity of self-employment.

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Tables (to be inserted in the text)

Table 1: Occupational status within self-employment and start-up motive across the EU-28

Country	Occupational status within self-employment 2010			Occupational status within self-employment 2015			Start-up motive ^a 2015			
	1	2	3	1	2	3	1	3	3	4
	<i>SEwE</i>	<i>IOA</i>	<i>DSEW</i>	<i>SEwE</i>	<i>IOA</i>	<i>DSEW</i>	<i>Opp</i>	<i>Hyb</i>	<i>Nec</i>	<i>Oth</i>
Austria	33.3	62.5	4.2	33.7	56.6	9.6	39.1	29.9	16.1	14.9
Belgium	35.3	64.7	0.0	38.5	53.6	7.8	77.4	10.8	5.1	6.7
Bulgaria	31.8	56.1	12.1	32.2	63.3	4.4	66.7	21.1	12.2	0
Croatia	41.5	49.1	9.4	30.2	52.8	17.0	39.7	37.9	22.4	0
Cyprus	41.8	42.5	15.7	35.4	56.7	7.9	77.3	9.9	12.8	0
Czech Republic	27.2	63.1	9.7	29.5	63.9	6.6	50.8	18.5	29.2	1.5
Denmark	56.4	41.0	2.6	34.3	62.9	2.9	81.0	7.1	11.9	0
Estonia	38.3	55.3	6.4	51.8	37.5	10.7	59.4	21.9	12.5	6.3
Finland	30.4	60.7	8.9	39.6	49.3	11.2	80.3	6.3	11.3	2.1
France	26.5	70.4	3.1	37.4	57.1	5.5	65.3	12.2	18.4	4.1
Germany ^b	---	---	---	49.6	45.3	5.0	56.5	19.0	22.4	2.0
Greece	20.6	66.4	13.0	35.2	50.8	13.9	45.9	24.9	26.8	2.4
Hungary	34.8	57.6	7.6	31.3	53.1	15.6	25.7	31.4	31.4	11.4
Ireland	25.9	62.4	11.8	38.9	47.6	13.5	69.1	17.6	11.8	1.5
Italy	28.5	65.4	6.2	32.2	58.2	9.6	55.8	19.5	22.1	2.6
Latvia	35.7	57.1	7.1	40.0	45.0	15.0	37.5	34.4	26.6	1.6
Lithuania	12.8	63.8	23.4	30.9	54.4	14.7	56.4	25.6	17.9	0
Luxembourg	36.4	59.1	4.5	45.5	49.1	5.5	76.2	6.3	12.7	4.8
Malta	38.3	53.3	8.3	20.8	73.6	5.6	68.8	17.5	12.5	1.3
Netherlands	25.9	65.4	8.6	28.2	67.1	4.7	73.1	7.7	14.4	4.8
Poland	19.2	63.8	16.9	31.0	53.4	15.5	49.2	23.1	20.0	7.7
Portugal	23.8	68.8	7.5	25.5	51.1	23.4	40.6	37.6	17.8	4.0
Romania	21.3	59.6	19.1	27.1	41.7	31.3	54.2	35.6	10.2	0
Slovakia	21.0	61.9	17.1	20.0	60.0	20.0	66.7	20.8	11.1	1.4
Slovenia	36.2	60.6	3.2	28.2	50.9	20.9	64.2	15.0	15.0	5.8
Spain	30.6	66.1	3.2	30.1	63.1	6.8	47.9	31.2	19.5	1.4
Sweden	35.2	64.8	0.0	32.7	61.2	6.1	86.5	5.8	7.7	0.0
United Kingdom	24.6	66.2	9.2	25.0	62.1	12.9	71.1	16.4	10.5	2.0
EU-28 (unweighted)	30.9	60.3	8.9	33.4	55.1	11.6	60.1	20.2	16.5	3.2

Notes: N = 5,141; *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; ^a The information about start-up motive is only available within the EWCS 2015. ^b Germany has to be excluded from our sample for 2010 due to missing data in relevant variables.

Data source: EWCS 2010, 2015.

Table 2: GERD and GDP for the EU-28

Country	GERD as % of GDP				GERD PPS per inhabitant at constant 2005 prices				GDP growth rate				GDP PPS per inhabitant			
	Rank#	2006-10	Rank#	2011-15	Rank#	2006-10	Rank#	2011-15	Rank#	2010	Rank#	2015	Rank#	2010	Rank#	2015
Austria	5	2.54	4	2.93	5	793.4	2	942.7	15	1.8	24-25	1.1	5	126	3	130
Belgium	7	1.92	7	2.32	8	563.6	7	682.9	8	2.7	23	1.4	7-8	120	8	118
Bulgaria	27	0.48	25	0.70	27	48.9	27	79.9	19-21	1.3	8	3.6	28	44	28	47
Croatia	20	0.80	23	0.79	21	111.5	24	104.2	25	-1.5	13	2.4	25	59	26	59
Cyprus	28	0.41	27	0.47	23	101.9	25	102.8	19-21	1.3	16-18	2	13	100	16-17	82
Czech Republic	16	1.28	10	1.83	15	263.7	13	385.3	9-10	2.3	3	5.3	17-18	83	15	87
Denmark	3	2.73	3	2.95	4	803.7	5	863.6	11-14	1.9	22	1.6	4	129	5	127
Estonia	14	1.29	11	1.82	17	193.1	15	291	9-10	2.3	20-21	1.7	21-22	65	20-21	75
Finland	1	3.54	1	3.28	2	1,006.70	3	906	7	3	27	0.1	9	116	9	109
France	6	2.10	8	2.22	9	558.9	9	596.1	11-14	1.9	24-25	1.1	10-11	108	11	105
Germany	4	2.59	5	2.86	6	744.3	4	890.6	4	4.1	20-21	1.7	7-8	120	7	124
Greece	22	0.61	22	0.80	19	137.3	23	142.7	28	-5.5	28	-0.3	15	85	22	69
Hungary	18	1.04	16	1.31	18	154.3	18	200.3	23	0.7	9-10	3.4	21-22	65	23-24	68
Ireland	12	1.40	13	1.47	10	478.1	10	530.8	11-14	1.9	1	25.1	3	130	2	181
Italy	17	1.16	17	1.29	14	295.9	14	306.5	16-17	1.7	26	1	12	104	12	95
Latvia	23	0.57	26	0.66	26	76.1	26	94.4	27	-3.9	11	3	26	53	25	64
Lithuania	19	0.80	19	0.96	20	113.9	21	160.7	18	1.6	16-18	2	24	60	20-21	75
Luxembourg	11	1.61	15	1.31	3	989.8	6	802	3	4.9	12	2.9	1	257	1	267
Malta	24	0.56	24	0.75	22	111.3	19	168	6	3.5	2	9.6	16	84	13	93
Netherlands	8	1.70	9	1.96	7	568	8	654.2	19-21	1.3	16-18	2	2	134	4	129
Poland	21	0.62	20	0.89	24	86.3	22	146	5	3.6	7	3.8	23	62	23-24	68
Portugal	13	1.33	14	1.34	16	262.6	17	254.1	11-14	1.9	19	1.8	19	82	18-19	77
Romania	26	0.49	28	0.45	28	48.6	28	48	26	-2.8	5-6	3.9	27	51	27	56
Slovakia	25	0.50	21	0.87	25	84.2	20	165.7	2	5	5-6	3.9	20	74	18-19	77
Slovenia	9	1.69	6	2.43	12	375.3	11	519.9	22	1.2	14-15	2.3	17-18	83	16-17	82
Spain	15	1.28	18	1.27	13	309.2	16	285.3	24	0	9-10	3.4	14	96	14	91
Sweden	2	3.39	2	3.25	1	1,018.80	1	1,007.40	1	6	4	4.5	6	125	6	125
United Kingdom	10	1.64	12	1.65	11	455.9	12	463.5	16-17	1.7	14-15	2.3	10-11	108	10	108
EU-28 (unweighted)		1.43		1.60		384.1		421.2		1.6		3.45		97.3		99.6

Notes: Countries are ranked from higher to lower GERD and GDP; Data source: Eurostat.

Table 3. Descriptive statistics for occupational status within self-employment and start-up motive

	Occupational status within self-employment						Start-up motive ^a							
	1		2		3		1		2		3		4	
	<i>Self-employed with employees 2010, 2015</i>	<i>Independent own-account self-employed worker 2010, 2015</i>	<i>Independent own-account self-employed worker 2010, 2015</i>	<i>Independent own-account self-employed worker 2010, 2015</i>	<i>Dependent self-employed worker 2010, 2015</i>	<i>Dependent self-employed worker 2010, 2015</i>	<i>Opportunity Entrepreneur 2015</i>	<i>Opportunity Entrepreneur 2015</i>	<i>Hybrid opportunity-necessity entrepreneur 2015</i>	<i>Hybrid opportunity-necessity entrepreneur 2015</i>	<i>Necessity Entrepreneur 2015</i>	<i>Necessity Entrepreneur 2015</i>	<i>Entrepreneur for other reasons 2015</i>	<i>Entrepreneur for other reasons 2015</i>
# observations	N = 1,630		N = 3,003		N = 508		N = 1,796		N = 485		N = 590		N = 90	
% observations	31.7%		58.4%		9.9%		60.7%		16.4%		19.9%		3%	
Variables	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Educational attainment														
Basic education ^c	0.036		0.072		0.130		0.031		0.056		0.110		0.056	
Secondary education ^c	0.603		0.620		0.687		0.587		0.625		0.663		0.589	
Tertiary education ^c	0.361		0.308		0.183		0.382		0.320		0.227		0.356	
Job aspects														
Tenure (<i>1 – 53</i>)	13.70	10.03	12.01	10.20	13.73	12.18	13.83	10.59	12.14	10.15	11.63	11.08	14.76	12.41
Working hours (<i>15 – 98</i>)	48.66	12.78	44.59	14.64	44.12	16.06	45.05	13.19	44.04	13.67	43.28	15.29	42.13	16.45
Net monthly earnings - PPP \$ of 2015 (<i>1 – 55,211</i>)	2954	2555	2011	1795	1590	1457	2617	2615	1956	1320	1618	1182	1897	1289
Business sector dummies														
Agriculture ^c	0.091		0.114		0.386		0.107		0.130		0.197		0.178	
Industry ^c	0.110		0.094		0.098		0.102		0.095		0.078		0.111	
Construction ^c	0.133		0.120		0.087		0.119		0.118		0.119		0.078	
Commerce and hospitality ^c	0.330		0.250		0.100		0.234		0.264		0.222		0.178	
Transport ^c	0.036		0.040		0.065		0.037		0.047		0.056		0.033	
Financial services ^c	0.029		0.034		0.026		0.028		0.029		0.025		0.044	
Public administration and defence ^c	0.004		0.002		0.004		0.001		0.002		0.002		0.011	
Education ^c	0.012		0.020		0.018		0.020		0.025		0.031		0.033	
Health ^c	0.048		0.059		0.043		0.061		0.035		0.046		0.078	
Other services ^c	0.206		0.267		0.173		0.290		0.256		0.225		0.256	
Demographic characteristics														
Female ^c	0.309		0.402		0.382		0.354		0.375		0.415		0.522	
Immigrant ^c	0.123		0.119		0.126		0.137		0.126		0.134		0.133	
Age (<i>18-65</i>)	45.20	10.36	44.82	10.90	46.57	11.46	45.96	10.62	45.14	10.82	46.34	11.00	46.31	11.57
Cohabiting ^c	0.790		0.699		0.693		0.724		0.705		0.659		0.744	
Children under 14 ^c	0.345		0.306		0.230		0.307		0.320		0.271		0.222	
Health (1-5)	4.05	0.76	3.99	0.77	3.81	0.81	4.11	0.73	3.93	0.79	3.74	0.81	4.00	0.76

Notes: Notes: N = 5,141 for occupational status within self-employment; N = 2,961 for start-up motive; ^a The information about start-up motive is only available within the EWCS 2015; ^c Dummy variable; Data source: EWCS 2010, 2015.

Table 4. Determinants of different *occupational statuses within self-employment –Discrete choice non-ordered models (multinomial models)–*

# Specification	1A									1B								
	1			2			3			1			2			3		
Occupational status within self-employment	Self-employed with employees			Independent own-account self-employed worker			Dependent self-employed worker			Self-employed with employees			Independent own-account self-employed worker			Dependent self-employed worker		
Average predicted probability (y)	0.32			0.58			0.10			0.32			0.58			0.10		
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	$\frac{dy}{dx}$	$\frac{dy/dx}{y}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy/dx}{y}\%$	t-statistic
Expenditure on R&D: GERD																		
- PPS per inhabitant at constant 2005 prices (48 – 1,019)	9.7E-05	0.03	3.01***	-6.3E-06	-1.1E-03	-0.17	-9.1E-05	-0.09	-3.78***									
- as % of GDP (0.41 – 3.54)										0.03	8.63	3.14***	-3.7E-03	-0.64	-0.38	-0.02	-23.9	-3.73***
Educational attainment																		
Basic education ^c (ref.)																		
Secondary education ^c	0.11	34.7	4.73***	-0.08	-14.5	-3.10***	-0.03	-25.4	-1.39	0.11	34.9	4.79***	-0.08	-14.3	-3.07***	-0.03	-27.4	-1.49
Tertiary education ^c	0.20	63.2	7.71***	-0.13	-23.0	-4.50***	-0.07	-66.5	-3.40***	0.20	63.4	7.76***	-0.13	-22.9	-4.46***	-0.07	-68.2	-3.46***
Job aspects																		
Tenure (1 – 60)	0.01	3.96	5.94***	-0.01	-1.31	-3.42***	-4.9E-03	-4.95	-4.02***	0.01	3.96	5.94***	-0.01	-1.32	-3.43***	-4.9E-03	-4.94	-4.01***
Tenure (squared)	-2.2E-04	-0.07	-3.92***	1.3E-04	0.02	2.15**	9.5E-05	0.10	3.20***	-2.2E-04	-0.07	-3.93***	1.3E-04	0.02	2.15**	9.5E-05	0.10	3.21***
Working hours (15 – 98)	0.02	5.36	7.38***	-0.01	-2.34	-5.85***	-3.3E-03	-3.35	-2.93***	0.02	5.35	7.37***	-0.01	-2.34	-5.85***	-3.3E-03	-3.35	-2.92***
Working hours (squared)	-1.3E-04	-0.04	-5.90***	1.1E-04	0.02	4.70***	2.4E-05	0.02	2.07**	-1.3E-04	-0.04	-5.88***	1.1E-04	0.02	4.70***	2.4E-05	0.02	2.05**
Business sector dummies																		
Agriculture ^c	-0.11	-35.5	-4.50***	-0.09	-15.1	-3.07***	0.20	203.1	9.45***	-0.11	-35.3	-4.48***	-0.09	-15.0	-3.06***	0.20	202.1	9.42***
Industry ^c	0.01	3.29	0.38	-0.04	-6.62	-1.33	0.03	28.6	1.75*	0.01	3.10	0.36	-0.04	-6.60	-1.33	0.03	29.0	1.78*
Construction ^c (ref.)																		
Commerce and hospitality ^c	0.07	21.5	2.99***	-0.04	-6.62	-1.62	-0.03	-29.9	-2.61***	0.07	21.5	2.98***	-0.04	-6.61	-1.62	-0.03	-29.8	-2.60***
Transport ^c	-0.06	-18.7	-1.72*	-0.02	-3.34	-0.51	0.08	79.8	3.14***	-0.06	-18.7	-1.72*	-0.02	-3.27	-0.50	0.08	79.4	3.13***
Financial services ^c	-0.05	-17.2	-1.40	0.03	5.12	0.70	0.02	25.0	0.95	-0.06	-17.4	-1.42	0.03	5.11	0.70	0.03	25.7	0.97
Public administration and defence ^c	0.10	31.8	0.78	-0.17	-29.7	-1.33	0.07	73.7	0.79	0.10	31.1	0.76	-0.17	-29.6	-1.32	0.07	75.3	0.80
Education ^c	-0.10	-31.9	-2.03**	0.06	10.4	1.09	0.04	40.8	1.13	-0.10	-31.8	-2.03**	0.06	10.4	1.09	0.04	40.5	1.12
Health ^c	-0.07	-20.8	-1.95*	0.03	4.39	0.68	0.04	40.8	1.63	-0.07	-20.7	-1.94*	0.03	4.51	0.70	0.04	39.8	1.60
Other services ^c	-0.06	-17.5	-2.36**	0.05	8.17	1.91*	7.7E-03	7.81	0.59	-0.06	-17.5	-2.37**	0.05	8.20	1.92*	0.01	7.81	0.59
Demographic characteristics																		
Female ^c	-0.04	-14.0	-3.19***	0.04	7.59	2.93***	1.8E-04	0.18	0.02	-0.04	-14.0	-3.18***	0.04	7.56	2.92***	2.4E-04	0.24	0.03
Immigrant ^c	-0.01	-2.72	-0.44	-0.03	-5.21	-1.39	0.04	39.5	2.57**	-0.01	-2.68	-0.43	-0.03	-5.27	-1.41	0.04	39.7	2.59***
Age (18 – 65)	-3.0E-03	-0.94	-0.59	4.4E-03	0.76	0.83	-1.5E-03	-1.49	-0.50	-3.0E-03	-0.95	-0.59	4.5E-03	0.77	0.84	-1.5E-03	-1.50	-0.50
Age (squared)	1.1E-05	3.6E-	0.20	-3.2E-05	-0.01	-0.53	2.0E-05	0.02	0.61	1.2E-05	3.8E-03	0.21	-3.2E-05	-0.01	-0.54	2.0E-05	0.02	0.61
Cohabiting ^c	0.07	22.9	4.79***	-0.07	-11.8	-4.15***	-4.0E-03	-4.09	-0.42	0.07	22.9	4.79***	-0.07	-11.7	-4.15***	-4.2E-03	-4.21	-0.43
Children under 14 ^c	0.02	5.46	1.09	0.01	1.23	0.42	-0.02	-24.8	-2.48**	0.02	5.36	1.07	0.01	1.27	0.43	-0.02	-24.7	-2.47**
Health (1 – 5)	0.01	4.58	1.70*	-4.1E-03	-0.71	-0.45	-0.01	-10.5	-1.93*	0.01	4.62	1.71*	-4.1E-03	-0.71	-0.45	-0.01	-10.7	-1.96**
Macroeconomics indicators																		
GDP growth rate (-5.5 – 25.1)	6.1E-04	0.19	0.37	-6.5E-04	-0.11	-0.36	4.6E-05	0.05	0.04	2.8E-04	0.09	0.17	-6.6E-04	-0.11	-0.37	3.8E-04	0.38	0.37
GDP PPS per inhabitant (44 – 267)	3.6E-05	0.01	0.13	-6.4E-05	-0.01	-0.20	2.8E-05	0.03	0.14	3.1E-04	0.10	1.39	-7.3E-05	-0.01	-0.29	-2.4E-04	-0.24	-1.50
Wave																		
2015 ^c	0.04	11.2	2.69***	-0.06	-10.57	-4.28***	0.03	26.4	3.02***	0.04	11.0	2.64***	-0.06	-10.5	-4.25***	0.03	26.7	3.05***
Log likelihood																		
	-4,266.2									-4,266.1								

Notes: N = 5,141; ^c 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 reflects the impact for a discrete change of the dummy variable from 0 to 1; * $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$; The maximum correlation is 0.54 (between age and tenure), and the VIFs values (from model 3B) range from 1.05 to 1.78. Thus, multicollinearity does not pose a concern, especially in consideration of the large size of our sample; Data source: EWCS 2010, 2015.

Table 5. Determinants of different *start-up motives –Discrete choice non-ordered models (multinomial models)–*

# Specification	2A												2B											
	1			2			3			4			1			2			3			4		
Start-up motive	Opportunity entrepreneur			Hybrid opportunity-necessity entrepreneur			Necessity entrepreneur			Entrepreneur for other reasons			Opportunity entrepreneur			Hybrid opportunity-necessity entrepreneur			Necessity entrepreneur			Entrepreneur for other reasons		
Average predicted probability (p)	0.61			0.16			0.20			0.03			0.61			0.16			0.20			0.03		
Independent variables (x)	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic	$\frac{dy}{dx}$	$\frac{dy}{dx}\%$	t-statistic
Expenditure on R&D: GERD																								
- PPS per inhabitant at constant 2005 prices (48 – 1,007)	1.2E-04	0.02	2.61***	-6.2E-05	-0.04	-1.62	-9.5E-05	-0.05	-2.21**	3.3E-05	0.11	2.25**												
- as % of GDP (0.45 – 3.28)													0.03	5.22	2.47**	-0.02	-9.39	-1.51	-0.03	-13.2	-2.30**	0.01	32.8	2.43**
Educational attainment																								
Basic education ^b (ref.)																								
Secondary education ^b	0.18	30.5	4.32***	-0.02	-9.30	-0.44	-0.17	-85.6	-4.09***	9.0E-04	2.95	0.06	0.19	30.9	4.39***	-0.02	-9.82	-0.47	-0.17	-86.4	-4.12***	8.9E-04	2.94	0.06
Tertiary education ^b	0.26	43.1	5.76***	-0.02	-10.9	-0.49	-0.25	-123.2	-5.66***	2.0E-03	6.56	0.13	0.26	43.4	5.82***	-0.02	-11.3	-0.51	-0.25	-123.7	-5.68***	1.7E-03	5.72	0.11
Job aspects																								
Tenure (1 – 60)	0.01	2.20	4.88***	-1.0E-03	-0.63	-0.47	-0.01	-6.12	-5.70***	-9.4E-05	-0.31	-0.10	0.01	2.20	4.87***	-1.0E-03	-0.63	-0.47	-0.01	-6.13	-5.70***	-8.1E-05	-0.27	-0.09
Tenure (squared)	-1.9E-04	-0.03	-2.62***	-1.3E-05	-0.01	-0.21	1.8E-04	0.09	3.29***	1.9E-05	0.06	0.82	-1.9E-04	-0.03	-2.63***	-1.2E-05	-0.01	-0.21	1.9E-04	0.09	3.30***	1.8E-05	0.06	0.80
Working hours (15 – 98)	0.01	1.42	3.05***	-7.3E-05	-0.04	-0.03	-0.01	-3.17	-2.97***	-2.2E-03	-7.32	-2.62**	0.01	1.42	3.04***	-6.5E-05	-0.04	-0.03	-0.01	-3.17	-2.97***	-2.2E-03	-7.26	-2.60**
Working hours (squared)	-8.4E-05	-0.01	-2.75***	-3.9E-06	-2.4E-03	-0.16	6.7E-05	0.03	2.89***	2.1E-05	0.07	2.35**	-8.4E-05	-0.01	-2.74***	-4.1E-06	-2.5E-	-0.16	6.7E-05	0.03	2.89***	2.1E-05	0.07	2.33**
Business sector dummies																								
Agriculture ^b	-0.09	-14.3	-2.32**	0.01	8.25	0.46	0.06	30.2	1.94*	0.01	42.9	0.89	-0.09	-14.3	-2.32**	0.01	8.33	0.46	0.06	30.2	1.94*	0.01	42.1	0.88
Industry ^b	0.03	4.63	0.75	-1.5E-03	-0.94	-0.05	-0.04	-19.4	-1.32	0.01	39.8	0.79	0.03	4.51	0.73	-1.1E-03	-0.68	-0.04	-0.04	-19.2	-1.30	0.01	39.4	0.78
Construction ^b (ref.)																								
Commerce and hospitality ^b	-4.1E-03	-0.67	-0.13	0.02	12.8	0.84	-0.02	-8.16	-0.64	-7.0E-04	-2.29	-0.06	-4.3E-03	-0.71	-0.14	0.02	12.9	0.85	-0.02	-8.22	-0.65	-5.2E-04	-1.70	-0.04
Transport ^b	-0.09	-14.2	-1.76*	0.02	12.4	0.52	0.06	30.7	1.46	4.8E-03	15.7	0.24	-0.09	-14.2	-1.76*	0.02	12.5	0.52	0.06	30.6	1.46	4.8E-03	15.8	0.24
Financial services ^b	-0.05	-8.24	-0.84	0.01	9.08	0.32	0.02	8.77	0.34	0.02	57.9	0.74	-0.05	-8.35	-0.85	0.02	9.40	0.33	0.02	8.89	0.35	0.02	57.8	0.74
Public administration and defence ^b	-0.24	-38.9	-0.90	0.08	47.9	0.37	-0.03	-16.9	-0.22	0.19	629.4	0.96	-0.24	-38.8	-0.89	0.08	50.2	0.38	-0.03	-16.5	-0.21	0.19	612.1	0.94
Education ^b	-0.12	-19.8	-1.84*	3.4E-03	2.09	0.07	0.11	55.9	1.82*	0.01	16.5	0.24	-0.12	-19.6	-1.83*	3.3E-03	2.03	0.07	0.11	55.0	1.79*	0.01	20.0	0.28
Health ^b	0.01	2.33	0.29	-0.04	-27.4	-1.28	0.02	12.3	0.56	0.01	20.5	0.37	0.02	2.54	0.31	-0.05	-27.6	-1.30	0.02	11.7	0.54	0.01	21.2	0.38
Other services ^b	0.03	4.64	0.88	-0.01	-3.07	-0.20	-0.02	-11.5	-0.89	-1.9E-04	-0.62	-0.02	0.03	4.61	0.87	-4.9E-03	-3.00	-0.20	-0.02	-11.5	-0.88	-1.6E-04	-0.53	-0.01
Demographic characteristics																								
Female ^b	-0.04	-6.36	-1.97**	-2.6E-03	-1.60	-0.17	0.02	12.2	1.51	0.02	55.8	2.22**	-0.04	-6.43	-1.99**	-2.5E-03	-1.51	-0.16	0.02	12.3	1.53	0.02	55.6	2.22**
Immigrant ^b	-0.01	-1.96	-0.45	-0.01	-6.00	-0.48	0.02	11.5	1.02	-1.2E-03	-3.90	-0.12	-0.01	-2.07	-0.47	-0.01	-5.77	-0.46	0.02	11.6	1.03	-1.0E-03	-3.35	-0.10
Age (18 – 65)	-2.8E-03	-0.47	-0.42	-8.4E-04	-0.51	-0.16	0.01	2.60	0.96	-1.5E-03	-4.96	-0.63	-2.9E-03	-0.48	-0.43	-8.1E-04	-0.50	-0.15	0.01	2.62	0.97	-1.5E-03	-5.00	-0.63
Age (squared)	2.1E-05	3.5E-03	0.28	6.9E-06	4.2E-03	0.11	-3.8E-05	-0.02	-0.63	9.9E-06	0.03	0.37	2.2E-05	3.7E-03	0.29	6.3E-06	3.9E-03	0.11	-3.9E-05	-0.02	-0.64	1.0E-05	0.03	0.37
Cohabiting ^c	0.04	6.49	1.88*	-0.01	-4.71	-0.46	-0.04	-21.5	-2.46**	0.01	36.9	1.66*	0.04	6.47	1.87*	-0.01	-4.62	-0.45	-0.04	-21.5	-2.46**	0.01	36.8	1.66*
Children under 14 ^c	-0.01	-1.68	-0.45	0.02	11.0	0.99	0.01	4.11	0.43	-0.02	-52.6	-2.27**	-0.01	-1.74	-0.47	0.02	11.0	0.99	0.01	4.31	0.46	-0.02	-53.0	-2.29**
Health (1 – 5)	0.09	14.8	7.86***	-0.02	-14.9	-2.70***	-0.07	-33.2	-7.28***	9.0E-04	2.97	0.22	0.09	14.9	7.90***	-0.02	-15.1	-2.73***	-0.07	-33.4	-7.33***	1.0E-03	3.45	0.25
Macroeconomics indicators																								
GDP growth rate (-0.3 – 25.1)	5.0E-04	0.08	0.22	-2.5E-03	-1.54	-1.32	3.5E-03	1.74	1.79*	-1.5E-03	-4.78	-1.51	-1.1E-04	-0.02	-0.05	-2.2E-03	-1.33	-1.18	3.8E-03	1.91	2.05**	-1.5E-03	-4.98	-1.61
GDP PPS per inhabitant (47 – 267)	7.2E-04	0.12	1.69*	-1.6E-05	-0.01	-0.05	-7.7E-04	-0.39	-1.92*	6.7E-05	0.22	0.57	1.1E-03	0.18	3.28***	-2.2E-04	-0.13	-0.82	-1.0E-03	-0.52	-3.33***	1.6E-04	0.51	1.61
Log likelihood	-2,828.4												-2,828.1											

Notes: N = 2,961; ^b 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 reflects the impact for discrete change of the dummy variable from 0 to 1; * $0.1 > p \geq 0.05$; ** $0.05 > p \geq 0.01$; *** $p < 0.01$; The maximum correlation is 0.54 (between age and tenure), and the VIFs values (from model 4B) range from 1.07 to 1.82. Thus, multicollinearity does not pose a concern, especially in consideration of the large size of our sample; Data source: EWCS 2015.

Appendix. Variable definitions

Variable	Description
Dependent variables	
Relative weight of different occupational statuses and start-up motives	
Occupational status	Variable equals 1 for workers who declare being self-employed with employees; 2 for workers who declare being independent own-account self-employed worker (i.e. those 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); and 3 for workers who declare being dependent self-employed worker worker (i.e. those 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 motive	Variable equals 1 for workers who declare being opportunity entrepreneur (i.e. those who declare having become self-employed mainly through own personal preferences); 2 for workers who declare being hybrid opportunity-necessity entrepreneur (i.e. those who declare having become self-employed due to a combination of both reasons: own personal preferences and no other alternatives for work); 3 for workers who declare being necessity entrepreneur (i.e. those who declare having become self-employed because had no other alternatives for work); and 4 for workers who declare being entrepreneur for other reasons (i.e. those who declare having become self-employed due to neither of these reasons). This variable is only available for wave 2015.
Main independent variables	
Expenditure on R&D	
GERD PPS per inhabitant at constant 2005 prices	These variables include expenditure on research and development by business enterprises, higher education institutions, as well as government and private non-profit organisations. Both variables are generated for the periods 2006-10 and 2011-15 (Data source: Eurostat).
GERD as % of GDP	5 years average Gross Domestic Expenditure on R&D expressed as Purchasing Power Standards –PPS– per inhabitant at constant 2005 prices.
	5 years average Gross Domestic Expenditure on R&D expressed as % of GDP.
Control variables	
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 aspects	
Tenure	Years of experience in the company or organization.
Working hours	Working hours per week.
Business sector dummies	
Agriculture	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is A = Agriculture, forestry and fishing.
Industry	Dummy equals 1 for 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) are B = Mining and quarrying, C = Manufacturing, D = Electricity, gas, steam and air conditioning supply, and E = Water supply; sewerage, waste management and remediation activities.
Construction	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is F = Construction.
Commerce and hospitality	Dummy equals 1 for 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) are G = Wholesale and retail trade; repair of motor vehicles and motorcycles, and I = Accommodation and food service activities.
Transport	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is H = Transportation and storage.
Financial services	Dummy equals 1 for 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) are K = Financial and insurance activities, and L = Real estate activities.
Public administration and defence	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is O = Public administration and defence; compulsory social security.
Education	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is P = Education.
Health	Dummy equals 1 for workers whose code of main activity of the local unit of the business, by means of the Nomenclature of Economic Activities (NACE rev. 2, 2008) is Q = Human health and social work activities.
Other services	Dummy equals 1 for 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) are J = Information and communication, M = Professional, scientific and technical activities, N = Administrative and support service activities, R = Arts, entertainment and recreation, S = Other service activities, T = Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use, and U = Activities of extraterritorial organisations and bodies.
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 workers.
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.
Macroeconomic indicators	
GDP growth rate	Annual growth rate of GDP volume. Its calculation is intended to allow comparisons of the dynamics of economic development both over time and between economies of different sizes. For measuring the growth rate of GDP in terms of volumes, the GDP at current prices are valued in the prices of the previous year and the thus computed volume changes are imposed on the level of a reference year; this is called a chain-linked series. Accordingly, price movements will not inflate the growth rate (source: Eurostat).
GDP PPS per inhabitant	The volume index of GDP per inhabitant in PPS is expressed in relation to the EU28 average set to equal 100. If the index of a country is higher than 100, this country's level of GDP per head is higher than the EU average and vice versa.
Wave	
2015	Dummy equals 1 for observations corresponding to the EWCS 2015 and 0 for observations corresponding to the EWCS 2010.
Country dummies	
	28 dummies equaling 1 for individuals living in the named country: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

Notes: Data source: EWCS.