



# Distance to the frontier and the perception of innovation barriers across European countries



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## ABSTRACT

Barriers to innovation have mainly been studied in a single country context. This paper studies differences in the perception of innovation barriers between innovative and non-innovative firms for 18 EU countries. The countries are grouped by their distance to the technological frontier using Community Innovation Surveys for the years 2002–2004 and 2004–2006. The results show that knowledge barriers related to the availability of skilled labour, innovation partners and technological knowledge are more important for firms located in countries close to the frontier, while the opposite is true regarding the availability of external finance. Moreover, while the share of innovators decreases with the distance to the technological frontier, the share of firms not interested or in no need of innovation increases. This is consistent with the idea that as firms approach the technological frontier, they increasingly need to focus on the creation of own knowledge and the adoption of innovation-based growth strategies to stay competitive.

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## 1. Introduction

Innovation is increasingly seen as a key means of sustaining economic growth and welfare. As a result, many governments implement policies geared towards providing incentives for firms to engage in or increase the intensity of their innovation activity. This places the idea of innovation barriers centre stage within innovation policy.<sup>1</sup> At the firm level, barriers may arise internally, for example due to organisational routines, or externally, due to market, government or system failures. In this study, we focus on barriers external to the firm which may emerge when the firm interacts with other firms, agents or institutions in the economic and innovation system in order to carry out its innovative activities. Issues such as a lack of availability of finance for innovative activities, a lack of technological knowledge or market opportunities for innovation, a lack of connectivity in the innovation system that impedes innovative collaboration, and the availability of skilled labour are related to the institutional and market context of an economy.

Analysing barriers to innovation – rather than determinants of innovation – allows for a focused view on the innovation process at the firm level, especially from an innovation policy perspective. Analysing barriers may be valuable for the identification of any bottlenecks limiting innovative activity, i.e. of which factors most constrain innovative activity among the myriad factors potentially affecting innovation. The drawback of this perspective is the requirement for detailed, survey-based evidence. This evidence is not easy to gather in a coherent framework. Probably as a result, past research did not systematically focus on the differences in innovation barrier perception across countries. Many recent innovation barrier studies focus on single countries (e.g., D'Este et al., 2012; Savignac, 2008; Galia and Legros, 2004); to the best of our knowledge, we do not know of any other study of barriers to innovation in a cross-country context.

We contribute to the literature by investigating differences in perception of barriers to innovation across countries characterised by diverse levels of development. We use two waves of the Community Innovation Survey (for the years 2004 and 2006) to study differences between 18 European countries with regard to barriers to innovation. These countries are quite different in terms of their economic and technological development. The 'distance to the frontier' approach acknowledges the specific role of 'appropriate institutions' (e.g. Aghion and Howitt, 2006) at different stages of development. As countries reach the highest level of development,

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<sup>1</sup> Barriers are also referred to in the literature as obstacles or constraints.

firms increasingly need to switch to innovation-based strategies to maintain their competitive advantage. Own innovation-based growth strategies require different inputs in terms of e.g. innovation finance, skills, technological knowledge, etc. than strategies based on technological catching-up or absorption of existing technologies.

We group countries by their distance to the frontier as we expect that varying growth requirements will affect the perception of barriers to innovation. If own innovation becomes more important as a competitive strategy, it is likely that firms in countries close to the frontier assess innovation barriers as more important than firms in countries far from the frontier and that they perceive innovation barriers differently. The systematic variation of the perception of innovation barriers across countries has not received the consideration it deserves but is likely very important also for national innovation policies, especially if appropriate innovation policies change with the distance to the technological frontier.

Our results show that countries close to the frontier feature the highest share of R&D innovators, while countries far from the frontier show the highest share of non-innovative firms not interested in innovation. Firms in countries close to the frontier are more likely to assess knowledge barriers, in particular skill barriers, as important, while firms in countries far from the frontier are more likely to assess financial barriers as important. This is consistent with our expectations.

The paper is organised as follows: The next section provides a background discussion of innovation barriers for our research. Section 3 presents the data and the method. Section 4 presents the results. Section 5 concludes the paper.

## 2. Innovation barriers at the firm level: literature background

We first summarise the evidence on the relationship between the perception of innovation barriers and firm types at the single-country level as a basis for our discussion of cross-country differences. It will be important to see how the impact of innovator types and firm characteristics on the perception of innovation barriers carries over to a cross-country analysis characterised by varying levels of development.

### 2.1. The perception of innovation barriers by different innovator types

The perception of innovation barriers is associated with the innovation behaviour of firms. Most available research concentrates on the perception of barriers among innovative firms or treats non-innovative firms as an undifferentiated group. Arundel (1997), Mohnen and Rosa (2002), Baldwin and Lin (2002), Galia and Legros (2004), Mohnen and Röller (2005), Iammarino et al. (2009) and Hözl and Friesenbichler (2010) find that innovative firms attach higher importance to innovation barriers than non-innovators do. Within the group of innovating firms, the obstacles were considered more relevant by firms featuring high innovation and R&D intensities than by firms which do not undertake own R&D to achieve product or process innovation. Therefore, the answers to survey questions on innovation barriers were generally considered as (innovative) firms' revealed assessment of the obstacles and as a measure of their ability to overcome them (revealed barriers).

Although barriers interpreted in such a way could be seen as a positive sign of firm performance, as their occurrence is associated with more intense innovative activity, existing empirical research finds a negative impact of revealed barriers on innovative activity in terms of delaying, abandoning or not initiating innovative projects (Canepa and Stoneman (2007) for English firms; Galia and

Legros (2004) for French firms; Mohnen et al. (2008) for Dutch firms). Criscuolo et al. (2010) conclude that barriers to innovation are negatively correlated with sales from innovative products by Finnish firms. Pellegrino and Savona (2013) find using panel data that barriers to innovation have a significant negative effect on the propensity to innovate. This suggests that innovating is difficult for firms, because of the cost, knowledge and market factors involved.

The puzzling evidence on the positive correlation between the intensity of innovative activities and the perception of barriers (while finding a real negative impact of barriers on innovative activity!), is most likely due to not differentiating between non-innovative firms according to their desire to innovate.

Savignac (2008) uses a French firm survey based on the CIS methodology to examine the impact of financial innovation barriers on innovative activity. She finds that, when controlling for the endogeneity of financial constraints and distinguishing between non-innovative firms seeking to innovate and those not seeking to innovate, the probability of carrying out innovative activity is significantly reduced by the existence of financial constraints for French manufacturing firms. Hence, Savignac (2008) is among the first to find that barriers matter for non-innovative firms when the subset of firms interested in innovation is taken.

Using CIS data for the UK, D'Este et al. (2008, 2012) distinguish between revealed barriers to innovation and deterring barriers. The first result from firms' engagement in innovation activity – as firms innovate, they become aware of the associated difficulties. Detering barriers, on the other hand, prevent firms from engaging in innovation activities. They find, in the case of cost and market barriers to innovation, a non-linear relationship between the degree of engagement in innovation activities and perception of barriers, so that some non-innovative firms are deterred by barriers when they try to engage in innovation activity; some other, innovative firms are referred to as “revealing” barriers the more they engage in innovation activities, i.e. they learn more about the difficulties of innovation. Revealed barriers to innovation may thus be seen as mirroring learning effects which arise from the engagement in innovative activity. Non-innovative firms aspiring to be innovative perceive deterring barriers, while firms that are not interested in innovation do not perceive any kind of barrier.

Such an analysis which differentiates between different types of non-innovative firms is crucial for us to correctly examine the impact of the distance to frontier on the perception of innovation barriers. We need to differentiate between those who aspire to be innovative and those who have simply no need for innovation as they pursue different competitive strategies. We expect the share of the latter firm innovator type to be particularly high in countries far from the frontier and low in countries close to the frontier.

We implement this distinction by using a method which is different from the one used by D'Este et al. (2012). There are two reasons for this: The UK questionnaire is slightly different from the standardised European questionnaire as regards the section on barriers to innovation, and we have 18 countries in our sample and are interested primarily in differences across countries. Thus we develop a different methodology. However, we will use the terminology (revealed and deterring barriers to innovation) suggested by D'Este et al. (2012).

### 2.2. Factors affecting the perception of innovation barriers: Distance to the frontier

In this paper we use the concept of technology frontier at the country level. It has a long tradition in the Schumpeterian innovation literature; e.g. Dosi (1982, 9. 154) denotes the technological frontier as “the highest level reached upon a technological path with respect to the relevant technological and economic dimensions”. Recent literature based on Schumpeterian growth models

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