The concept of smart specialization is perhaps most important for laggard regions. However, the difficulty for these regions is that of measurement. Such regions are unlikely to engage systematically in innovation rendering its observation at the initial stages a daunting task.

In this paper we provide an alternative strategy in measuring innovative activity based on Intellectual Property Rights (IPRs). In a knowledge-driven economy the different types of intangible assets of a business are often more important and valuable than its tangible assets. A key subset of intangible assets is protected by what are labelled collectively as IPRs. These include trade secrets protection, copyright, design and trademark rights, and patents, as well as other types of rights. By fostering fair play in the marketplace, the IPR system benefits users, consumers and society at large by supporting the creation of innovative, new and improved products and knowledge.[1]

We proxy the innovative business activity in a region with the number of applications of various forms of IPRs of the region and examine whether international and domestic (regional) IPRs display similar patterns. Understanding regional domestic activity can provide valuable insights on whether these activities can fuel innovation activity of international impact. In doing so, we map the IPR activity filed at the domestic offices and two major international offices.

We focus on Greece's NUTS-3 regions as a testbed. Greece is an ideal case in point since the majority of its regions are laggard in terms of innovation activity. The country generally lags behind in innovation development. It holds the 19th position in the relevant charts among 27 Member States, deviating significantly from the European Union (EU) average (Innovation Union Scoreboard, 2015). The sharp decline in private investment after the world financial crisis has reduced the already low levels of private research and innovation expenditure within Greek regions. Reduced liquidity in the private sector combined with the limited funding provided by the banking sector to private investment especially to new businesses, significantly reduced resources available to support innovative enterprises. Among the various types of IPRs we concentrate on patent applications filed at the Hellenic Industrial Property Organization (HIPO) and the European Patent Office (EPO) originating from Greece's NUTS-3 regions. Similarly, we measure trademarks applications filed at Greece's General Secretariat for Commerce (GSC) and the European Union Intellectual Property Office (EUIPO).

Our paper contributes in three important areas. First, most of the literature on smart specialization approximates innovation activity via IPR activity in large patent offices as the EPO and the United States Patent and Trademark Office (USPTO); see (Kogler *et al.*, 2013; Boschma *et al.*, 2015; Petralia *et al.*, 2017; Apa *et al.*, 2018; Balland *et al.*, 2019, Santoalha 2019; Castellacci *et al.*, 2020; Mewes and Broekel 2020). However, laggard regions exhibit sparse activity in these types of IPRs. The main reasons are two: i) these offices have higher standards of novelty (Webster *et al.*, 2014) whereas domestic offices such as HIPO have lower standards, ii) filing and registering a patent in a large office such as the EPO is expensive with recent estimations reaching 30,000 Euros for validating a single patent across the 28 EU countries as of 2016 (Berger 2005; European Commission 2011). We contribute to this literature by examining IPR activity of modest quality and scope which however can function as input for international IPR activity signifying the upgrading and extraversion of regions' innovation activity. There are numerous studies examining domestic patents across countries and various contexts to capture the early stages of technological innovation activity (Gabaldón-Estevan *et al.*, 2018; Hall and Helmer, 2019),

1 "Intellectual Property: Powerhouse for Innovation and Economic Growth", 2 February 2011, ICC.