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Science, technology, and innovation for economic competitiveness: The role of smart specialization in less-developed countries

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ABSTRACT

Smart specialization (SS) is a policy concept that has gained significant momentum in Europe despite a frail theoretical background and implementation difficulties. These challenges become critical in the case of less-developed economies that often lack regional autonomy, a strong STI base, and local capabilities to identify and sustain such SS strategies. Combining elements from evolutionary economics and the export-led literature, I propose a framework that anchors the role of SS in the national innovation policy of such laggards, as a complementary avenue for improving competitiveness and growth. Moreover, to assist policy makers in lagging regions or countries, I advance a diagnostic tool to identify potential areas for SS, and also address the systemic and the regional-sectoral bottlenecks in these domains. I exemplify the use of this tool in the case of Bulgaria by using a large battery of quantitative and qualitative indicators from publicly available data. This type of investigation may be useful for other less-developed economies to kick-start this process and identify prima facie SS candidates.

1. Introduction

International competitiveness is heralded worldwide as the ultimate economic objective of a government (Porter, 1990). While competitiveness is affected by many factors, innovation, in the form of scientific discovery and creation of new technologies, has been widely acknowledged as one of its main drivers (Cameron, 1996; Freeman, 2002; Gibson and Naquin, 2011; Hall and Jones, 1999; Rosenberg, 2004; Wang et al., 2007). This link has become even more important in the wake of the recent economic crisis, as more and more countries seek to secure sustainable sources of economic growth (Aghion et al., 2009). Subsequently, science, technology and innovation (STI) are increasingly targeted by concerted policy efforts (Filippetti and Archibugi, 2011), in an attempt to reduce countries' economic reliance on financial or real estate markets (Blanchard et al., 2012).

Among such initiatives, smart specialization (SS) is a recent concept that seeks to rekindle growth in Europe and reduce its productivity deficit vis-à-vis global leaders (Foray et al., 2009; Giannitsis and Kager, 2009). Borrowing arguments from trade theory, such as comparative advantage and factor endowments, the SS framework stresses the need for regions and countries to prioritize selected vertical areas (*specialization*) by building on existing strengths and assets (*smart*) as a base for innovation-driven growth (Foray et al., 2011). In particular, this SS process relies heavily on entrepreneurial discovery, and prescribes different innovation strategies for "leading regions" (i.e., develop General Purpose Technologies – GPTs-) and "following regions" (i.e., apply GPTs in their existing core-activities).

Despite its overwhelming success in the European arena, the SS concept has several limitations, which I argue to be particularly salient for less-developed countries. First, while the simplicity of the concept remains the main selling point, its theoretical rifts (Foray et al., 2009) are exacerbated in less-developed settings. Thus, the key role of entrepreneurs in bolstering new areas of excellence (Morgan, 2013), the tacit nature of knowledge involved Camagni and Capello (2013), the missing ties to economic objectives (Van Oort et al., 2015), the fuzzy role of central governments (Charles et al., 2012) and foreign firms (Radosevic and Stancova, 2015), all need to be better addressed in the SS debate, as they prove to be remarkable obstacles for a smooth implementation of SS strategies (McCann and Ortega-Argilés, 2016). Second, in less-developed countries, SS efforts are likely to face atypical obstacles, such as lack of a critical STI mass (Giannitsis and Kager, 2009), limited commercialization opportunities (Morgan, 2013), underdeveloped clusters (Brochler and Kalentzis, 2017), and weak regional autonomy (Healy, 2016). Thus, SS strategies in these contexts are inherently more likely to follow a traditional top-down trajectory (Kominos et al., 2014), given the lack of entrepreneurial ecosystems (Aidis et al., 2008), heavy reliance on public (Krammer, 2009) and foreign (Krammer, 2014) sources of innovation, and the danger of stalling in regional "technological lock-ins" (Giannitsis and Kager, 2009). Finally, SS does not account specifically for the systemic nature

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of innovation (Lundvall, 1992), which mandates coordinated policies to tackle the fragmentation of innovation systems (Edquist, 2011) and the development of clusters (Phillips et al., 2016). Commonly, such actions target systemic issues (e.g., support of scientific and R & D activities, taxation, education, STI collaboration, etc.) are difficult to address at the regional level given the massive level of investments required.

This study addresses some of these limitations and proposes several contributions. First, incorporating insights from evolutionary economics and the export-led growth literature, it provides an overarching framework that maps SS into the regional and national systems of innovation, linking them with downstream economic growth and competitiveness. In this framework, SS strengthens the vertical links between STI and economic actors, translating competitive advantage from the knowledge domain to the economic one through viable commercialization strategies and entrepreneurial efforts. Furthermore, this approach suggests that a mix of complementary policies (i.e., SS prescriptions for regional and sectoral aspects, combined with national initiatives to tackle systemic deficiencies in economic, knowledge and STI domains) is best suited for stimulating innovation-driven growth in less-developed settings.

Second, it proposes a novel methodology to assist policy makers in these countries to identify fruitful (i.e., "smart") areas of specialization, and also address some of the critical challenges in these domains. In doing so, it infers that SS policies must ultimately cater to greater socio-economic objectives (i.e., increased competitiveness, more jobs, higher growth etc.) of the region/country. Given the importance of exports for future economic performance (Hausmann and Klinger, 2008), this diagnostic employs a series of quantitative and qualitative analyses to examine the composition and evolution of exports and identifies promising areas for potential SS strategies. It also examines both systemic and SS-specific deficiencies as a basis for first-stage policy prescriptions in these areas, ones that can be further distilled after consultations with all relevant stakeholders (Foray and Rainoldi, 2013).

The empirical part of the paper employs this diagnostic tool in the case of Bulgaria, an EU "laggard" in both economic and STI terms. The results of this exercise show that, despite its heavy reliance on exports (almost 60% of its GDP), Bulgarian competitiveness has virtually stalled over the last decades. Its low-sophistication export basket is a result of weak innovation performance and a significant mismatch between scientific and research capabilities in the country. Examining detailed export potential data, I identify five promising areas for SS in Bulgaria that cover both manufacturing and services, and different technological regimes (from low-, i.e., "Copper and Iron" or "Food", to high-tech industries such as "Pharmaceuticals" or "ICT"). Subsequent analyses examine these SS candidates from several vantage points (i.e., usage of existing STI capabilities, entrepreneurial intensity, regional distribution, strategic opportunities). Incorporating all these insights, I propose several policy recommendations for each SS candidate area that address concomitantly the systemic and region-sector issues. This exercise is informative for Bulgaria to identify or refine its development strategies. Furthermore, it validates the use of this diagnostic tool as a valuable instrument for policy-makers in less-developed countries to start the SS conversation with relevant stakeholders (e.g., firms, civil society, institutes, and universities).

2. The role of smart specialization policies in the innovation systems-economic competitiveness nexus

Policy makers in both developed and developing nations frequently depict competitiveness as the pinnacle of economic policies. However, despite its apparent simplicity, competitiveness often remains difficult to grasp in practice. While some define it as the ability to secure desirable economic outcomes (e.g., job creation, high living standards, foreign investments, etc.), others see it as local characteristics (e.g., low wages, high-skilled labor force, low inflation, etc.) that form a favourable environment for economic activities. Besides this confusing dichotomous usage of the term, most definitions capture competitiveness in a multidimensional setting, which induces additional problems in identifying what exactly means to *be competitive*, and at which *level* it should be measured. Therefore, the main criticisms in the literature regarding this concept point to issues such as the arbitrary nature of measures employed, aggregation issues, and great conceptual overlap with productivity measures (Krugman, 1994; Jenkings, 1998; Reichel, 2002). Nonetheless, competitiveness indexes and rankings remain extremely popular in practitioners' circles (Acs et al., 2014; Herrmann et al., 2012; IMD, 2015; WEF, 2015) as a base for policy interventions to enhance performance both at the micro (firms, entrepreneurs, clusters) and macro (sectors, regions, and economies) levels (Porter, 1990).[1] However, a clearer method to identify the micro underpinnings of competitive advantage is to examine trade and specialization patterns at the more disaggregated (i.e., product, niche, or industry) levels (Alcalá and Ciccone, 2004). This allows us to identify competitive advantage and its subsequent contributions to regional and national performance via productivity effects (Castellacci, 2008a) and economic growth (Imbs and Warcziag, 2003; Hausmann and Klinger, 2008).

Innovation, in the form of scientific discovery and creation of new technologies, remains the most important source of economic competitiveness (Hall and Jones, 1999; Freeman, 2002; Rosenberg, 2004; Castellacci, 2008a; Gibson and Naquin, 2011). This fact has become even more salient in the wake of the crisis, when all countries are seeking more sustainable sources of economic growth (Aghion et al., 2009), often in the form of strong innovation systems (IS) that capitalize on superior scientific and technological assets (Filippetti and Archibugi, 2011). Nevertheless, spurring innovation performance is not an easy task given its sectoral specificity and systemic nature (Castellacci, 2008a). Therefore, when analyzing the impact of innovation on economic competitiveness one must carefully account for systemic and industrial particularities that affect the creation, diffusion and exploitation of knowledge among different actors in these innovation systems (Tödtling and Trippl, 2005; Krammer, 2016).

Following these ideas, Fig. 1 synthesizes the main lessons stemming from this literature (Mulder et al., 2001), conceptualized across three distinct dimensions (i.e., *systemic*, *knowledge* and *economic*) and with distinct implications for *policy*.

From a *systemic* perspective (see Fig. 1), innovation can be conceptualized across different levels of analysis, i.e., national, regional or sectoral (Nelson and Winter, 1977; Dosi, 1988; Malerba, 2002), and as a result of a complex web of interactions between institutions, actors, and supporting infrastructures. All these systems are closely intertwined and exhibit numerous feedback loops to other elements from the knowledge and respectively, economic context. Such links have been extensively documented by prior studies on trade competitiveness (Fagerberg, 1988; Dosi et al., 1990), productivity differentials (Hall and Jones, 1999), firm performance (Melitz, 2003) industrial dynamics (Fagerberg et al., 1997; Castellacci, 2008b), external learning (Clerides et al., 1998) and absorptive capacity (Cohen and Levinthal, 1990). Besides national and sectoral systems of innovation, regional drivers are equally important for competitiveness (Feldman and Audretsch, 1999; Delgado et al., 2012). Hence, concentration of STI activities (Breschi and Malerba, 2001), knowledge spillovers (Jaffe et al., 1993; Bottazzi and Peri, 2003; Breschi and Lissoni, 2009) and successful industrial clusters (Bresnahan and Gambardella, 2004; Phillips et al., 2016), support the need for regional tailored innovation policies (Cooke, 2001; Tödtling and Trippl, 2005).

Within the *knowledge* realm, research (both basic and applied) is an important prerequisite for innovation (Rosenberg, 1990; Pavitt, 1991). Hence, increasing the competitiveness of the scientific base yields

[1] These indexes provide a good overview of the competitive position of a country internationally. However, they tend to aggregate subjectively heterogeneous factors (i.e., from quality of institutions to infrastructure), which makes them less useful for regional policy analyses.