# *Promoting Innovation and Economic Growth in Less Developed Territories*

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# Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).



I declare that my thesis consists of 79,174 words.

**The four chapters have been submitted to peer-reviewed journals. As of March 1st, 2018, the first chapter had been reviewed, with minor revisions requested.**

# Statement of conjoint work

I confirm that *Chapters 1* and *4* were co-authored with Professor Andrés Rodríguez-Pose, and that I contributed a minimum of 50% of this work.

J. Callum Wilkie

# Abstract

This thesis is about innovation and economic growth in less developed territories. It is motivated by the inadequacy of our understanding of innovation in lagging contexts. It is situated in the body of literature that examines and stresses the contextually-contingent nature of innovation. It does, however, branch out to probe the link between innovation and economic performance and contemplate the design of strategic approaches to promote the latter. It is composed of an introduction, four related chapters and a short conclusion.

*Chapter 1* relies on an investigation of a large sample of North American and European regions to assess whether all less developed regions are, from an innovation perspective, functionally the same. In particular, it addresses the issue of what makes the less developed regions of North America more innovative than their European counterparts.

*Chapter 2* expands the scope of the thesis to include the emerging world. It unpacks the processes of innovation hosted by China's more and less developed cities, respectively, with a view to identify and understand the differences between the sets of factors that drive and shape processes of innovation in them.

*Chapter 3* examines the relationship between innovation and economic performance in less developed regions. A comparison of two types of lagging regions in Europe is undertaken to explore the extent to which different types of economically disadvantaged regions are capable of transforming knowledge and innovation into economic dynamism, given their unique socioeconomic and institutional characteristics.

*Chapter 4* reflects on the strategic approaches that have been relied on to promote innovation and economic growth more generally. It reviews a handful of 'strategies of waste' and 'of gain' to ascertain insights into the steps policy-makers can take to maximise the likelihood that territorial development policies fulfil their potential and contribute to the reduction of territorial disparities.

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# INTRODUCTION

## I. Less developed territories: Forgotten but far from gone

Less developed territories the world over, be they cities, rural areas or entire regions, are often overlooked both in theory and in practice. Why? The answer, which is three-fold, is simple.

First, researchers have, on the one hand, what is now a longstanding interest in understanding and explaining why the world's most developed, economically successful places are the way they are. It has been observed that especially dynamic territories, in developed and developing contexts alike, share one key similarity: *most are densely populated, typically highly urbanised areas*. This, however, offers little in the way of an *explanation* for their dynamism. Accordingly, scholars set out to understand how density impels or facilitates economic performance.

Virtually all investigations and theorisations pointed in the same direction: the agglomeration of economic actors and activity gives rise to efficiency- and productivity-enhancing 'agglomeration externalities'. Agglomeration economies are defined, by Glaeser (2010:1) as "the benefits that come when firms and people locate near one another". They are, according to Duranton and Puga (2004), underpinned by three discrete 'mechanisms': "sharing, matching and learning".

The agglomeration of economic actors allows for the sharing of indivisible inputs; affords firms access to a greater variety of essential inputs and enables firms to spread or 'pool' risk (Combes and Gobillon, 2015:2). That is, when firms locate in close physical proximity, not only can the costs of typically larger-scale, fixed and often essential inputs and facilities be spread across several parties, other inputs to production processes can be sourced more easily, readily and, critically, locally and, in turn, with lower transactions costs. The risks incurred by firms are consequently lower. The investments that firms need make in fixed assets, facilities or inputs that are inevitably, with time, rendered obsolete are smaller and more easily amortised. Similarly, co-located firms need not be reliant on a single supplier and are thus able to

respond to disruptions in the supply chain or changes in input demands and requirements. *In short, co-location facilitates risk minimisation, cost reduction and the realisation of greater returns to investments in productivity activity*. The co-location of heterogeneous firms and workers also facilitates the "matching" (Duranton and Puga, 2004:23) both of firms with workers that are equipped with the competencies and skills they require and, conversely, of workers with firms that provide the tasks and resources to best exploit their knowledge and expertise. *This precise matching renders firms, and the labour they employ, more productive.* Finally, operation in close physical proximity promotes face-to-face interactions, cooperation and collaborations that function as conduits for the sharing, exchange and diffusion of knowledge and ideas (Marshall, 1890; Jacobs, 1969; Duranton and Puga, 2004; Storper and Venables, 2004). *Co-located firms are rendered more innovative and, in turn, productive, by this ready access to a diversity of knowledge types and sources.*

Evidence of these mechanisms at work, and the existence of the agglomeration externalities they give rise to, bred the perception that density and co-location are conducive to and supportive of firm and individual productivity; the sharing and combination of knowledge and, ultimately, the cultivation of innovation; and economic dynamism, most generally. Large, densely populated environments came to be seen as the places where efficiency could be maximised and economic performance would be optimised. The most economically developed, dynamic urban areas, in turn, moved firmly to the fore as the perceived drivers of regional or even national economic growth and have, accordingly, garnered much of the scholarly attention (Jacobs, 1969; Duranton, 2000; 2008; Fujita and Thisse, 2002; Glaeser, 2011).

Second, policy makers, on the other hand but very much following suit, have embraced the notion of developed, dynamic, urbanised areas being engines of growth (Colenbrander, 2016). They have, accordingly, developed a keen interest in the promotion of agglomeration and density; strategic efforts to concentrate, or reinforce the concentration of, economic actors and activity, oftentimes in already-more developed, dynamic areas, have become the norm in many parts of the world (e.g. World Bank, 2009). This focus on these areas reflects a desire to leverage the size, density and dynamism of more developed, established places and reap the efficiency benefits of the agglomeration economies they host. It is equally grounded in an

expectation that the dynamism of these places and the wealth they come to realise will with time, but more or less automatically and inevitably, spread to the less developed areas to which they are proximate. Lagging areas are, in turn, anticipated to be beneficiaries of investments made and actions undertaken in more developed, dynamic core areas. The pursuit of spatially-concentrated, agglomeration-impelled dynamism, *and not the promotion of more geographically widespread territorial development*, is therefore viewed by many as the most efficient way to promote growth at the broader regional or national level. Nowhere is this perception more strongly advocated for than in The World Bank's 2009 World Development Report (World Bank, 2009:xxi) which argues explicitly for the promotion of "unbalanced growth" asserting, in fact, that "to spread out growth is to discourage it".

Stated simply, policy approaches the world over have, following the aforementioned academic discourse, embraced the perceived power of agglomeration and density and prioritised the growth and physical expansion of already-more dynamic, developed places – asserting that wider benefits for the entirety of regions' or nations' populations would follow – over the reformation of less developed territories. *Again, it has been the most dynamic of territories that have featured prominently in the policy discourse*.

Third, and finally, there is what amounts to an anecdotal perception that it is in the most developed of areas where 'things' and processes of greatest interest and consequence happen, where opportunities exist, and with which we *should* be most interested and concerned. Large, dynamic places, cities in particular, are home to the best educated, creative and able people (Florida, 2005). They house the best universities and host the headquarters of the world's largest and most influential corporations (Sassen, 1991; Iammarino and McCann, 2013; Florida, 2017). Glaeser (2011) goes so far as to assert that it is, in fact, large, dynamic cities that make "[mankind] richer, smarter, greener, healthier and happier". No one, to my knowledge, has argued that less developed territories do the same.

All of this has directed the spotlight squarely and singularly towards the world's most developed, dynamic places. We understand them, from a theoretical perspective as drivers of growth; we have acted on this and prioritised their growth in

the pursuit of economy-wide development; and we have developed a general fascination with them that extends well beyond academia or policy-spheres. Less developed places have been relegated to little more than an afterthought.

The question we need to ask, however, is whether this is at all justifiable. Is there any reason, at all, to broaden our perspective and dig deeper into less developed places with the view to understand the diversity of oft-overlooked, underexplored processes that drive and shape growth and change in them? *Table I-1* suggests the answer may be yes.

*Table I-1* summarises the contributions of more and less developed territories,[1] respectively, to GDP and patenting in North America and Europe (the foci of *Chapter 1* and *3*) and China (the focus of *Chapter 2*). Two inferences are drawn from the uppermost three rows.

First, in North America, Europe and China alike, less developed territories in spite of their statuses as such, make – and, for some time, have made – significant contributions to aggregate GDP. They do not, axiomatically, contribute, from an economic output perspective, as much as their more developed counterparts. Their contributions are not, however, inconsequential. North America's and Europe's less developed regions accounted for 30.9% and 27.4% of their host economies' respective GDP in 2010. Similarly, China's lagging cities were responsible for 25.4% of Chinese economic output in 2014. Territories that together generate over a quarter of their respective economies' economic output *cannot*, simply stated, be overlooked.

Second, that these territories have, in spite of the deficiencies from which they suffer – many of which are expounded upon later in this introduction and throughout the thesis –, managed to make such substantive contributions to their respective economies is indicative of the potential with which they are endowed. That is, less developed places *have* cultivated and are hosting some measure of productive activity. Suitable policy actions could conceivably alleviate the efficiency-impairing

[1] In North America and Europe, 'less developed' regions are defined as those below a given threshold in terms of relative wealth in 2010; 90% of the average regional GDP per capita in Canada, the US, and Europe, respectively. In China, 'less developed' cities are defined as those whose GDP per capita fall below 75% of the national average. The conceptualisations are addressed in detail in *Chapters 1* and *2*.

constraints and barriers to which they are subject; increase the efficiency with which economic activity occurs; bolster their capacities to host and sustain productive activity and ultimately, enable these territories to make even more substantive contributions to regional or national economic growth and development. Ignorance of this potential is, to use the words of The World Bank's 2009 World Development Report, tantamount to discouraging it, and economic growth more generally.

Less developed territories can be overlooked no longer. This is something that scholars are becoming increasingly aware of and attuned to (e.g. Dijkstra et al., 2013; Rodríguez-Pose, 2018). Their potential, and the contributions they could conceivably make – and in some cases are already making – to the generation of economic output and the achievement of economic growth at a diversity of spatial scales are significant (Dijkstra et al., 2013:347). Our collective understanding of less developed territories, and specifically of many of the processes that unfold in them, has, however, suffered from the aforementioned preoccupation with the most dynamic, developed, oftentimes urban territories. There is, accordingly, huge scope for analytical exploration across a diversity of axes and areas to shore up a range of deficiencies of understanding. An especially acute and perhaps consequential deficiency relates to the innovative capacities and potential of these less developed territories.

It is often assumed that less economically developed territories are "innovation averse" (Rodríguez-Pose, 1999). That is, it is taken for granted that a range of structural, socioeconomic, institutional and even geographic deficiencies, all of which are addressed in some detail in *Section II* and throughout the chapters that compose this thesis, render these places incapable of generating innovation or cultivating and sustaining innovative activity. This assumption is, however, as *Table I-1* again illustrates, plainly untrue.

*Table I-1. GDP and patenting in more and less developed territories, North America, Europe and China*

| | North America (Provinces and States) | | Europe (TL2 Regions) | | China (Cities) | |
|---|---|---|---|---|---|---|
| | **2000** | **2010** | **2000** | **2010** | **2003** | **2014** |
| **Gross Domestic Product (Millions, USD/Yuan)** | | | | | | |
| All territories | $11,113,498 | $16,212,896 | $9,681,122 | $14,655,594 | ¥13,569,483 | ¥67,518,224 |
| More developed territories | 67.6% | 69.1% | 72.8% | 72.6% | 78.7% | 79.7% |
| Less developed territories | 32.4% | 30.9% | 27.2% | 27.4% | 27.1% | 25.4% |
| **Aggregate Patent Applications** | | | | | | |
| All territories | 42,726 | 46,342 | 34,195 | 43,598 | 136,860 | 1,669,373 |
| More developed territories | 78.9% | 79.2% | 89.1% | 87.8% | 90.4% | 88.7% |
| Less developed territories | 26.7% | 26.2% | 10.9% | 12.2% | 9.6% | 11.3% |

Note: Patent applications correspond to PCT patent applications for North America and Europe; Patent applications figures for China obtained from State Intellectual Property Office of the P.R.C; Europe figures reflect the TL2 regions analysed in *Chapter 1*.

Less developed areas *do* innovate less than their more developed counterparts. That said, they are not wholly incapable of producing innovative output.[2] In North America, for example, less developed territories were responsible for over a quarter (26.2%) of the continent's *total* PCT patent applications in 2010. The contributions of Europe's lagging regions in the same year were, admittedly, less impressive. They were, however, anything but insignificant; Europe's less developed regions produced 12.2% of these applications. China's lagging cities accounted for a similar proportion (11.3%) of the country's patent applications in 2014. In both the European and Chinese cases, that the share of patent applications generated by lagging areas has increased over the last 15 years suggesting they have, and are becoming, more engaged in their economies' respective knowledge and innovation systems (*Table I-1*).

The problem, however, is that the pervasiveness of the aforementioned assumption, coupled with a preoccupation with 'success stories', 'innovative hubs' and innovative processes in more developed, dynamic environments more generally, has led to a neglect of less developed, economically peripheral areas and a relative dearth of systematic econometric analyses of processes of innovation in them (Hall and Donald, 2009). The absence of these explorations has bred what is now a prevailing myth: namely, that processes of innovation, when they occur in lagging areas, unfold in relatively homogenous ways across otherwise heterogeneous lagging territories.

In short, we do not know how it is that these territories innovate nor are we able to identify the resources they draw upon to do. Moreover, because we cannot pinpoint what exactly is driving and shaping the innovative processes they host, we are not able to design effective policies to upgrade their innovative capacities, unlock their innovative potential or promote innovation-driven economic growth in them.

*This thesis represents a concerted effort to shore up this gap in the literature and understanding and, ultimately disprove the prevailing myth.*

[2] The suitability of patent statistics as proxies for innovation is addressed throughout the thesis. See, for example, *Footnote 3*.

### i. Overview

This thesis is about innovation and economic growth in less economically developed territories. The first two chapters explore the genesis of innovation in these environments, focusing specifically on the socioeconomic and structural factors that influence and shape it. The third chapter shifts the focus to the link between innovation and economic growth to assess the extent to which lagging regions are capable of mobilising innovation and transforming it into economic growth. The final chapter contemplates the promotion of economic growth and development in underdeveloped contexts and the actions policy-makers need consider as part of their efforts to do so.

It is situated in and contributes to the body of literature that examines, and, in turn, stresses the contextually-contingent nature of innovation. It branches out to touch on other relevant topics and issues relating to both the link between innovation and economic performance and the design of strategic approaches to promote the latter. It is, however, at its roots, an exploration of innovation, and related processes, in less developed environments.

The first two chapters of the thesis represent explicit, concerted efforts to fill this void. One is a macroeconomic comparative analysis of the drivers of innovation in lagging regions in North America and Europe, respectively. The other is a comparison of China's less developed cities to their more developed counterparts. The third chapter is a natural, necessary extension of the first two. It explores how the heterogeneity of lagging regions manifests itself not in the way they introduce innovation, but rather in the extent to which they are capable of transforming it into economic growth and dynamism. The final chapter is a more practical, policy-oriented application of the inferences drawn from both the chapters that precede it and a wider review of development approaches undertaken across the globe.

The remainder of this introductory chapter proceeds as follows: *Section II* introduces the theoretical points of departure for the thesis; exposes a prominent gap in the literature; and addresses the necessity of shoring up this deficiency of understanding. *Section III* summarises the four chapters that compose the thesis.

# II. Background, motivation and relevance

## i. Background

Two prevailing assumptions provide the point of departure for this thesis: The first is that processes of innovation are shaped and subject to influence by a diversity of forces, factors and territorial characteristics. They, in turn, are anticipated to unfold in ways that reflect the heterogeneity of the territories that host them. The second is that innovation occurs almost, if not entirely, exclusively in more economically developed territories. Each is addressed in turn.

*Innovation as a dynamic, contextually-contingent process*

The collective understanding of innovation has evolved considerably in recent decades (Marinova and Phillimore, 2003). Innovation was first understood as a linear, unidimensional and aspatial process. The so-called 'linear models of innovation' (e.g. MacLaurin, 1953; Grilliches, 1979) that exemplified early thinking on innovation proposed that knowledge and knowledge resources were transformed into innovation automatically and frictionlessly via processes that were largely unaffected by the socioeconomic, structural or institutional environments in which they took place (Crescenzi and Rodríguez-Pose, 2011). The implications associated with this perspective are twofold: First, it anticipates that efforts to increase the availability of knowledge 'inputs' will yield, more or less inevitably, proportional increases in innovative output. Second, it posits that processes of innovation unfold in homogenous ways across even the most heterogeneous territories.

The pervasiveness of these linear conceptualisations is reflected in the strategies policy-makers the world over have pursued to impel innovation (Godin, 2006). The prioritisation of R&D has become commonplace. These efforts to increase spending on knowledge-generating functions and activities are, according to linear models of innovation, sufficient in and of themselves to produce proportional increases in innovative output (Crescenzi and Rodríguez-Pose, 2011).

The inadequacy of linear models of innovation has, however, since been made apparent (e.g. Fagerberg, 1988; Rosenberg, 1994; Morgan, 1997). Notably, factors beyond the extent to which territories invest in R&D have been definitively linked to their capacities to generate innovative output suggesting that processes of innovation are considerably more multidimensional and integrated than originally conceived (Lundvall, 1992 Maurseth and Verspagen, 1999; Iammarino, 2005; Crescenzi and Rodríguez-Pose, 2012).

The depth of the stock of skilled human capital with which a territory is endowed, for example, shapes both its capacity to generate new knowledge and its facility for the absorption, internalisation and mobilisation of various types of knowledge and is, in that respect, a preeminent influence on its overall innovative capacity (Engelbrecht, 1997; Griffith et al., 2004; Crescenzi, 2005; Leiponen, 2005; Usai, 2011; Vogel, 2015). Its composition matters as well; younger and more diverse populations have been shown to be more innovative (Ottaviano and Peri, 2004; Crescenzi et al., 2007; Ozgen et al., 2011). Similarly, the way in which economic actors are distributed across space is profoundly important. Co-location facilitates both the processes of collective learning, interaction, collaboration and cooperation, and the sharing and localised diffusion of knowledge, ideas and information that are indispensable to the genesis of innovation (Bathelt et al., 2004; Storper and Venables, 2004). It also produces the more general efficiency-enhancing agglomeration externalities that to are conducive to the cultivation of innovation (Duranton and Puga, 2004; Rosenthal and Strange, 2004; Glaeser, 2010). Even the suitability of a territory's physical infrastructure and the nature of economic activities it hosts shape its innovative potential (e.g. Capello et al., 2012; Agrawal et al., 2017).

Extra-local influences must be considered as well. Knowledge inevitably 'spills over' the borders of the territories responsible for its generation (Audretsch and Feldman, 2004; Feldman and Kogler, 2010). These knowledge flows, deliberate or otherwise, represent exploitable sources of knowledge and catalysts for innovation for territories that can harness them (Bathelt et al., 2004; Moreno et al., 2005; Rodríguez-Pose and Crescenzi, 2008; Fitjar and Rodríguez-Pose, 2011, 2016; Rodriguez, 2014; Grillitsch and Nilsson, 2015). The extent to which territories are exposed to, and, in turn, capable of absorbing these inter-territorial knowledge flows will therefore affect

their overall innovative potential. Inter-territorial flows are, however, spatially-bound (Greunz, 2003; Moreno et al., 2005; Sonn and Storper, 2008; Rodríguez-Pose and Crescenzi, 2008). This implies that the innovative capacity of a particular territory is equally a function of where – specifically with reference to other territories and the knowledge-intensive activities they host – it is physically situated.

Finally, institutions have, also come to the fore in analyses of territorial innovativeness (Edquist and Johnson, 1997). A territory's innovative capacity cannot be abstracted from the quality and functioning of its formal and informal institutions (e.g. Morgan, 1997; Cooke and Morgan, 1998; Bathelt, 2003; Boschma, 2005; Crescenzi et al., 2013; Tebaldi and Elmslie, 2013; Murphy et al., 2015; Rodríguez-Pose and Di Cataldo, 2015; Storper et al., 2015; Balazs, 2017). Investments in knowledge-intensive activity and innovation are more likely to be made, and interaction, cooperation and collaboration more likely to occur, in environments underpinned by well-functioning, stable formal institutions and robustly developed, mature informal ones that serve to minimise uncertainty, inefficiencies and mistrust.

What followed from this maturation of understanding and appreciation for the multidimensionality of innovation was the realisation that processes of innovation were likely to unfold in different ways in different territories (Edquist and Chaminade, 2006; Crescenzi and Rodríguez-Pose, 2012). Because processes of innovation are governed by the above features, factors and attributes that themselves vary across space, it is anticipated that no two places will innovate in the same way nor will they mobilise the exact same set of resources to do so. Simply stated, the heterogeneity of territories is expected to manifest itself in the innovative processes they host.

This theoretical postulation is validated by empirical examination (e.g. Crescenzi et al., 2007, 2012; Usai, 2011; Fagerberg et al., 2014). Accordingly, the notion of innovation being a contextually-contingent process is subject to little debate. Coenen et al. (2015:487) observe, for example, that "[e]conomic geographers have repeatedly argued that regional characteristics and interactions at the regional scale are particularly important for knowledge creation and innovation processes". Similarly, Rodríguez-Pose and Crescenzi (2008:54) go so far as to assert that "it has now become widely accepted that innovation is a territorially-embedded process and cannot be fully

understood independent of the social and institutional conditions of every space". It is even thought, now, that local conditions, characteristics and factors actually 'shape' and 'support' the *diffusion* of the innovations generated by these contextually-contingent processes as well (Rekers, 2016).

*Innovation as a developed territory phenomenon*

In the developed and emerging world alike, it is a country's most economically developed, dynamic cities and regions that generate the bulk of its innovation and host the majority of its knowledge-intensive, innovative activity (e.g. Usai, 2011; Belderbos et al., 2017). In the United States, for example, it is the metropolitan areas of San Jose, New York, San Francisco, Los Angeles and Boston that produce the greatest number of patents and top the innovation table (USPTO, 2017). In Canada, Toronto, Ottawa-Hull, Vancouver and Montreal represent the country's "innovation hotbeds" (Breau et al., 2014: 361). In the United Kingdom, it is London, and the South East more generally, that excel in both 'intangible investment in innovative property' (i.e. scientific and non-scientific R&D) and the more general generation of innovative output (Melachroinos and Spence, 2013; Centre for Cities, 2017). Elsewhere, the capital cities of Paris, Tokyo and Mexico City dominate the innovative landscapes of France, Japan and Mexico, respectively (Rodríguez-Pose and Wilkie, 2016). The same is true of India, where Bangalore, Chennai, Delhi, Hyderabad and Mumbai lead the way (Mitra, 2007). Innovative activity is, as *Chapter 2* illustrates, similarly spatially concentrated in China as well (Fan et al., 2012; Fu, 2015; Wang and Li, 2016).

Why this is so is generally well understood and relates back to the contextually-contingent, multidimensional nature of innovation. More developed territories attract and host multinational enterprises (Sassen, 1991; Klier and Testa, 2002; Bell and Fageda, 2008; Goerzen et al., 2013). They cultivate and are home to entrepreneurs and small and medium enterprises (Bosma and Schutjens, 2009; Stam, 2009). They house top universities, research institutes and a diversity of other organisations, both public and private (Feldman and Florida, 1994; Florida, 2017). These actors invest in R&D functions and engage in other knowledge-generating, innovative activities meaning that innovation-inducing knowledge, ideas and information tend not to be in short supply. They also draw on the skilled human capital with which more dynamic

territories tend to be well endowed and leverage it not only to generate new knowledge but, perhaps more importantly, to apply it and other sources of knowledge in productive ways, oftentimes commercially viable ways (Berry and Glaeser, 2005; Florida, 2005; Lee et al, 2010; Moretti, 2012).

The innovativeness of these actors and, by extension, the more developed territories that host them benefits from the extent to which they are spatially concentrated as well. Their proximity facilitates the exchange and sharing of knowledge – in more formal, structured and deliberate ways and via informal, unplanned interactions – that is so closely associated with the genesis of innovation (Bathelt et al., 2004; Storper and Venables, 2004). Similarly, it affords these actors the opportunity to collaborate and cooperate to combine competencies, knowledge bases and resources in their pursuit of technological progress (e.g. Drejer and Vinding, 2005; Ponds et al., 2007; Narula and Santangelo, 2009).

All of these actors and processes exist and unfold on 'economics fabrics' that are more *ex ante* amenable to knowledge-intensive activity; they feature generally more technologically-sophisticated, higher-valued added functions and industries (e.g. Capello et al., 2012; Csómos and Tóth, 2016). Moreover, the efficient, transparent and stable formal institutions that underpin more developed areas provide a framework within which economic activities, innovative ones included, can transpire unencumbered by regulatory inefficiencies, unnecessarily high transactions costs and other efficiency-impairing actions or obstacles (North, 1991; 1992). Similarly, the mature, established informal institutions that regulate behaviours and practices in these territories make the aforementioned interactions both more likely and more meaningful and impactful (Morgan and Cooke, 1998; Rodríguez-Pose and Storper, 2006; Rutten and Boekema, 2007; Alguezaui and Filieri, 2010; Laursen et al., 2012).

Simply stated, the innovative edge that more developed territories tend to enjoy is a function of the suitability of their socioeconomic and institutional contexts. All of the prerequisites for innovation are fulfilled in these environments. They are, as a result conducive in most, if not all, relevant respects to the cultivation and hosting of knowledge-intensive, innovative activity.

The opposite is largely true for less economically developed territories (Rodríguez-Pose, 1999; 2001). They channel fewer resources to the performance of R&D and other knowledge-generating activities than their more developed counterparts; an outcome that is attributable, at least in part, to the difficulties they face attracting, cultivating or, in some cases, retaining entrepreneurs and firms. Their inability to attract these actors is both a cause and consequence of the human and physical capital deficiencies from which less developed territories are thought to suffer. This underinvestment in R&D coupled with the aforementioned dearth of skills and capital hamper the generation, circulation and application of knowledge and place obvious limits on their innovative potential.

Even more fundamentally, the underlying economic fabrics of less developed territories tend to be weaker, from an innovation perspective, than those of their more developed counterparts (e.g. Rodríguez-Pose and Wilkie, 2017). They are often dominated by smaller, less dynamic firms that operate in more traditional industries and are engaged in less technologically sophisticated activities and functions. This renders their economic fabrics both less likely to introduce knowledge and even less receptive to it. Institutional deficiencies are ubiquitous in these environments as well. Their formal institutions tend to be less efficient, established or clearly defined (e.g. Rodríguez-Pose and Di Cataldo, 2015). This makes corruption, rent-seeking and other efficiency-impairing behaviours more likely. Their informal institutions are often similarly underdeveloped. These institutional weaknesses distort incentives and limit opportunities and avenues to pursue innovation or engage in economic activity more generally.

Finally, many less developed territories are burdened simply by geography. Economic peripherality often coincides with geographic isolation. Many less developed territories are therefore not sufficiently proximate to their regions' or countries' more developed, more innovative hubs to be exposed to spatially-bound knowledge flows that emanate from them (e.g. Rodríguez-Pose and Crescenzi, 2008:63). Opportunity to supplement locally-generated knowledge with that which is generated extra-locally is, in turn, minimal.

Taken together, a range of socioeconomic, institutional and geographic factors and characteristics render less developed territories less likely to generate knowledge; less exposed to extra-local sources of it; and, ultimately, less able to apply it and transform it into tangible, applied innovation.

**ii. Motivation**

These two stylised facts lie very much at the fore of the study of the economic geography of innovation. They have, however, led to other assumptions being made both about the way innovative activity is distributed and the way innovative processes unfold across space. More specifically, the relative innovativeness of more developed territories has given rise, first, to a perception that less developed territories are largely incapable of cultivating and sustaining innovation and knowledge-intensive, innovative activity. It has also come to be assumed, because of both the perceived pervasiveness of the deficiencies by which less developed areas are burdened and their presumed un-innovativeness, that *when* these underdeveloped territories innovate, they do so in a relatively homogenous way. That is, it is anticipated that processes of innovation unfold in more or less the same manner irrespective of where they occur or how heterogeneous the territories that host them may actually be.

The former assumption is, as alluded to in *Section I*, easily disproved (e.g. *Table I-1*). Less developed areas are less innovative. They are not, however, entirely incapable of generating innovation. *Chapter 1*, in fact, reveals that North America's less developed regions do not lag far behind Europe's *more* developed ones in terms of their respective innovative capacities. Similarly, *Chapter 2* confirms, and is premised on the fact, that while innovation is very much a developed city phenomenon in the Chinese context, the country's less developed cities are far from wholly un-innovative.

There is, however, greater uncertainty surrounding the latter assumption. Theoretically, conceptualisations of processes of innovation as contextually-contingent and reflective of the heterogeneity of the territories that host them would lead us to expect it to be untrue. Empirically, however, it remains ambiguous.

Because much of the world's innovative activity occurs in more economically developed contexts, studies have tended to focus on these territories with a view to understand how and why they have achieved their innovative success and expose the dynamics that underpin their respective innovation systems. The study of innovation in less developed environments has suffered from this preoccupation. There is a relative death of literature examining processes of innovation in less dynamic, economically disadvantaged territories. Moreover, what little there is has tended to focus on single territories, be they cities, regions or countries, and rely on more in-depth, survey-driven and/or case study-based approaches (e.g. Doloreux et al., 2007; Fitjar and Rodríguez-Pose, 2011, 2013; Pinto et al., 2015; Stephens et al., 2013; Varis et al., 2014; Kudic et al. 2015). Systematic, macroeconomic and, critically, comparative analyses are needed if the second of two aforementioned assumptions is to be adequately tested and either validated or disproved.

*It is this pronounced gap in the literature that I aim to fill.*

**iii. Relevance**

One needs to look no further than the link between innovation and economic growth to understand the relevance of this research and the necessity of shoring up the aforementioned deficiency in understanding. Innovation *is* a catalyst for economic growth (e.g. Solow, 1957; Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1994; Acs, 2002). Territories with robust innovative capacities will grow faster and more sustainably than those without; *the more innovative a territory, the greater its potential for growth and dynamism* (e.g. Howells, 2005).

Upgrading the innovative capacities of less developed territories should therefore be viewed as an avenue worth pursuing to impel economic growth in and increase the dynamism of these lagging areas. Similarly, the promotion of innovation in less developed territories could go a long way in reducing the intra-national spatial disparities in economic performance that have emerged and continue to grow in developed and developing contexts alike. One of the reasons why more economically developed territories are exactly that is, in many cases, they have cultivated robust innovative capacities that exceed those of their less developed neighbours. If

innovation remains as spatially polarised along socioeconomic lines as it is now, the gulfs between countries' more and less developed territories will only widen; the growth of more developed territories will, because of their relative innovativeness, outpace that of their less innovative, less developed counterparts. Inequalities will worsen, constraining the growth potential not only of underdeveloped territories, but of more developed ones as well (Cingano, 2014; Ostry et al., 2014). Social discontent and political instability are also likely to spread with what we have seen recently can be disastrous consequences, as *Chapter 4* does in fact acknowledge.

The innovative capacities of these less developed territories are unlikely to grow organically; policies geared towards both the promotion of innovation and the translation of that innovation into economic growth are, in that respect, unavoidable. These approaches will need to be tailored to the specificities of the territories in which they are to be pursued. Not only have a-spatial, territorial-blind policies proven largely ineffective in the pursuit of innovation and economic growth (e.g. Barca et al., 2012), innovative processes are, for the reasons outlined above, especially affected by where they take place to the point where a failure to account for relevant contextual conditions in the design of strategic approaches could completely undermine their effectiveness.

The design of strategic approaches for the promotion of innovation and economic growth in less developed territories is therefore predicated on the development of a robust understanding of the territorially-unique characteristics and features that condition both processes of innovation and the processes by which innovation is transformed into economic growth (e.g. Tödtling and Trippl, 2006). It is impossible for policy-makers to devise effective territorially-specific policies to promote either without understanding exactly how these processes unfold in the territories for which they are responsible and, more importantly, the forces and factors by which they are impelled, shaped, or, alternatively, impaired.

The macroeconomic analyses of processes of innovation in less developed territories undertaken in *Chapters 1* and *2* provide policy-makers with an indication of the levers that need, or are available, to be pulled in heterogeneous underdeveloped contexts to *stimulate* innovation. With this knowledge, resources can be precisely

targeted towards exploiting the exact opportunities or advantages with which a territory is endowed or addressing the bottlenecks and inefficiencies by which it is plagued, and not wasted on efforts to address factors that are theoretically relevant but, in practice, have little bearing on its innovative capacity. Similarly, the explorations of the link between innovation and economic performance upon which *Chapter 3* is based, reveals whether, and to what extent, less developed territories can mobilise innovation in the pursuit of economic growth and dynamism. It, in turn, provides a sense of if, and what, additional, concurrent steps may be needed to ensure that the innovation-oriented development policies pursued in less developed environments actually deliver on their mandate. Of course, all of these inferences, conclusions and insights are for not, from a policy perspective, if policy-makers are unable to incorporate them in the design and eventual implementation of integrated, balanced territorial specific development strategies. Herein lies the value of *Chapter 4*.

*Simply stated, not only does this thesis offer direly needed and previously unavailable insights into processes of innovation in less developed territories that, in turn, inform the design of spatially-sensitive innovation policies for them, it provides an indication of whether these policies will be sufficient to impel growth in the territories in which they are pursed, and, moreover, of the steps that can be taken to make sure they do so.*

## III. The chapters

The thesis is composed of four related chapters and a short conclusion. The first and fourth chapters are co-authored with Professor Andrés Rodríguez-Pose. The second and third are my own work.

The first and second chapters focus explicitly on the dynamics of innovation in less developed environments. *Chapter 1* compares the socioeconomic factors that drive innovation in North America's less developed regions to those at play in their European counterparts. *Chapter 2* contrasts processes of innovation in China's less developed cities to those hosted by their more developed neighbours. The third chapter examines innovation in less developed contexts through a different lens. *Chapter 3*

probes the link between innovation and economic performance; it assesses the extent to which two subsets of the European Union's most underdeveloped regions are capable of transforming knowledge and innovation into economic dynamism. The final chapter thinks critically and more practically about the promotion of economic growth and dynamism in the less developed territories with which the thesis is immediately concerned. It reviews a handful of successful and unsuccessful development strategies to ascertain insights into the steps that should be taken to maximise the likelihood that territorial development policies fulfil their potential, impel growth and contribute to the reduction of territorial disparities. The *Conclusion* summarises the chapters that compose the thesis, addresses the policy implications associated with their respective conclusions and offers avenues and suggestions for continued research.

Each of the chapters is summarised in the following subsections.

**1. Innovating in less developed regions: What drives patenting in the lagging regions of Europe and North America**

Not all less developed, lagging regions are the same. They are, however, in spite of their demonstrable heterogeneity, often 'bundled' together for the purposes of innovation policy design and implementation. This chapter attempts to determine whether such bundling is warranted by conducting a regional level investigation for Canada and the United States, on the one hand, and Europe, on the other, to, first, identify the structural and socioeconomic factors that drive patenting in the less developed regions of North America and Europe, respectively; and, second, explore how these factors differ between the two contexts.

The comparative analysis upon which the chapter is based covers 71 less and 81 more developed regions in Europe and 27 less and 34 more developed provinces and states in Canada and the United States. It reveals that processes of innovation unfolding on either side of the Atlantic Ocean are governed by distinctly different combinations of factors, territorial attributes and influences.

Innovation in North America's less developed regions is a function of the application of knowledge generated by R&D activities undertaken by the institutes of higher education they host; the mobilisation of knowledge flows emanating from the innovative efforts of private sector entities operating beyond their borders; the ready availability of skilled human capital; the youthfulness of their populations; and innovation-inducing externalities that arise from the co-location of economic actors and activity. Processes of innovation in Europe's lagging regions are, conversely, driven by private sector investment in R&D; their exposure to a variety of inter-regional knowledge spillovers; the depth of the pools of skilled labour they are home to; and agglomeration externalities. Additionally, there is evidence to suggest that these regions struggle to mobilise their youth in the pursuit of innovation and, that their innovative potential may be hampered by the types of economic activities and industries they host.

The analysis also indicates that the set of factors and influences that shape processes of innovation in North America's and Europe's less developed regions, respectively, are more similar to those at play in their more developed counterparts than to one another. This latter finding suggests that innovation systems are more likely to exist across differentially developed but physically proximate (i.e. within continent) territories than across similarly developed, but geographically dispersed ones.

## 2. Innovating in lagging cities: A comparative exploration of the dynamics of innovation in Chinese cities

This chapter is similar to the first in that it explores the genesis of innovation in less developed territories. It differs, however, in two critical respects: First, it is situated in the emerging world. Second, it is a comparison not of disparate lagging territories, but rather of a country's less developed areas to their more developed counterparts. Additionally, it is conducted at the urban as opposed to the regional level.

Innovation in China is, as it is elsewhere in the world, spatially polarised. The country's more developed cities host the majority of its knowledge-intensive, innovative activity. Its less developed ones are, however, engaged in the knowledge

economy and are introducing innovative output, albeit to a more limited extent. This chapter sets out to expose how it is that they do so. It relies on an econometric investigation of 283 Chinese cities to address two related research questions: First, what are the socioeconomic and structural factors that govern processes of innovation in China's more and less developed cities, respectively? And second, how do these factors differ between the two types of cities?

The analysis reveals that the innovative processes and, in turn, the innovation systems hosted by China's more developed cities are, most fundamentally, more complex, integrated and mature than those of their less developed counterparts. The country's more and less developed cities alike leverage the knowledge generated by their R&D activities, the inter-city knowledge spillovers to which they are exposed and their human capital endowments to generate innovation. More developed cities, however, do so considerably more efficiently and realise comparatively high returns from these knowledge inputs. Moreover, while the innovative capacities of China's more developed cities are enhanced by innovation-inducing agglomeration externalities and the industrially-biased economic fabrics by which they are underpinned, those of their less developed counterparts are seemingly hampered by fundamental infrastructural deficiencies and an inability to mobilise the large populations they are home to. Further evidence of the relative maturity of the innovation systems hosted by China's more developed cities is found in the knowledge resource-related synergies from which their innovative capacities benefit. These synergies are both scarcer and, when they emerge, considerably weaker in the country's less developed cities.

## 3. Innovation and economic growth in the European Periphery: Comparing Europe's lagging regions

In zeroing in on the relationship between innovation and economic performance, this chapter adopts a perspective that is different to that of the preceding two.

Innovation is a preeminent driver of regional economic growth and dynamism. This does not, however, mean that *all* territories are equally capable of transforming

knowledge and innovation into economic growth: less developed territories are, because of the socioeconomic, structural and institutional deficiencies by which they tend to be plagued, anticipated to display the weakest facility for doing so. Of course, lagging regions are, as this introduction has stressed, heterogeneous entities. This heterogeneity is likely to manifest itself in the extent to which these territories are able to mobilise and productively exploit innovative activity in the pursuit of growth.

*Chapter 3* is motivated by this assertion. Its overarching aim is to assess the extent to which different types of economically disadvantaged regions are capable of translating different types and sources of knowledge and innovation into economic dynamism. The chapter is based on a comparative econometric analysis of Europe's 'low-income' and 'low-growth regions'. Accordingly, the questions that guide the analysis are: (a) Are low-growth and low-income regions equally capable of transforming knowledge *and* innovation into economic growth? And (b) are processes of economic growth in low-income and low-growth regions, respectively, governed by the same, more broadly-defined set of socioeconomic and institutional forces?

The analysis validates the aforementioned assertion. It reveals that low-income and low-growth regions are differentially capable of translating different sources of knowledge and innovation into economic performance. Low-income regions have a marked facility the translation of locally generated innovation into economic dynamism. The same cannot be said for their low-growth counterparts. They rely not on their own innovative activities, but rather on extra-locally generated knowledge and innovation to impel growth. It is also observed that the differences between the two types of lagging regions extend to the more general set of socioeconomic, structural and institutional factors that govern processes of growth in them.

**4. Strategies of gain and strategies of waste: What determines the success of development intervention?**

The final chapter of the thesis is its most applied. There is scope in virtually all less developed territories for the implementation of development policies and strategies to stimulate economic growth. Development interventions are not, however, created equal; their track-record includes instances of success and failure. The relevant

question therefore relates not to whether less developed territories should pursue development interventions in the pursuit of economic growth and dynamism, but rather how they should go about designing interventions to maximise the likelihood of them succeeding.

*Chapter 4* offers a comprehensive, holistic answer to this question. It tables four principles that, if followed, increase the likelihood that a development policy, whether it be innovation-oriented or otherwise, achieves its objective. First, interventions must operate across and address more than one development axis. Second, robust diagnoses of local economic conditions should be undertaken to facilitate both the tailoring of interventions to the specificities of the territory in which they are to be pursued and their targeting towards specific weaknesses, and deficiencies or, conversely, advantages or opportunities. Third, the design of interventions must reflect where on the development spectrum the territory for which they are designed is situated. Fourth, actions and initiatives to promote institutional upgrading and efficiency should be integrated directly into development interventions.

The chapter also proposes a taxonomy of development strategies that serves to provide more general guidance relating to how they should be designed for territories at different points in their development trajectories. The taxonomy is based on the premise that development strategies must balance what we term complexity – understood as a function of the number and diversity of the individual elements by which the strategy is composed – and breadth of strategic scope – understood as the narrowness of the development outcomes or objectives by which the strategy is guided – in ways that reflect the nature of the specific development challenges by which a particular territory is faced.

The four lessons and this more general guidance are distilled from a review of a handful of successful – 'strategies of gain' – and unsuccessful – 'strategies of waste' – development strategies. The review includes a mix of the four types of interventions that have dominated the policy landscape in recent decades: (1) infrastructure-oriented; (2) inward investment-oriented; (3) innovation and/or human capital-oriented; (4) cluster-based. The chapter's overarching conclusion is that the potential of spatially-sensitive, territorial development interventions is considerable, but that

their impact will be modest if lessons are not learned from the past and the above principles and guidance are ignored.

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# 1. INNOVATING IN LESS DEVELOPED REGIONS: WHAT DRIVES PATENTING IN THE LAGGING REGIONS OF EUROPE AND NORTH AMERICA

## 1.1. Introduction

The spatial concentration of innovative activity in large and economically advanced cities and regions – often to the detriment of less developed areas – is a well-documented phenomenon (e.g. Feldman and Florida, 1994; Sun, 2003; Bettencourt et al., 2007; Mitra, 2007; Crescenzi et al., 2012; Foddi and Usai, 2013; Breau et al., 2014). Yet, the processes that drive innovation in more and less developed areas, in spite of the spatial and socioeconomic similarities they often display, are far from homogeneous (e.g. Crescenzi et al., 2007; 2012; Usai, 2011; Fagerberg et al., 2014) and vary considerably from one context to another.

Because of the tendency of innovation to congregate in more socioeconomically developed centres, a great deal is known about how processes of innovation transpire in these types of environments. We know much less, however, about how innovation unfolds in economically disadvantaged contexts and, more importantly, about how processes of innovation vary across them (Virkkala, 2007; Hall and Donald, 2009). This research aims to shed light on how innovation processes occur in less developed regions by examining whether processes of innovation, and the factors that impinge upon them, differ substantially across heterogeneous lagging contexts. In particular, it addresses the issue of what makes the relatively less developed areas of North America more innovative than those of Europe.

Two related questions lie at the heart of this research: (a) what factors govern processes of innovation in North America's and Europe's economically disadvantaged regions? And (b) how do these factors differ between the two contexts? A macroeconomic investigation of provinces and states in Canada and the United States, on the one hand, and regions in Europe – the OECD's Territorial Level 2 (TL2) regions –, on the other, between 2000 and 2010 is conducted to address the two questions.

Innovation is, for reasons addressed in *Section 1.4*, proxied in the econometric analysis by patent applications.[3] The research is, therefore, an exploration of the key factors, features, and attributes that explain interregional differences in patenting activity. Patents have, despite their problems, been frequently employed as an indicative and reasonably reliable barometer of a territory's capacity to introduce commercially viable, tangible, and applied innovations (e.g. Furman et al., 2002). The econometric analysis therefore serves as the basis for the formulation of insights into processes of innovation in the contexts with which this research is immediately concerned and, more specifically, into the socioeconomic factors that drive, shape, and mediate these processes. These inferences must, however, be interpreted with a cognisance of the limitations associated with the use of patent statistics as a proxy for innovation and with the appropriate degree of caution they warrant. Moreover, while interesting and insightful in and of themselves, the inferences drawn from the econometric exercise should be viewed as exploratory in nature and are as much points of departure for further research and exploration as they are 'standalone' conclusions.

This research makes contributions of both an academic and policy-oriented nature. Generally, work on innovation in less developed contexts has consisted of in-depth, often survey-driven investigations of single countries or regions (e.g. Doloreux et al., 2007; Virkkala, 2007; Doloreux and Dionne, 2008; Isaksen and Onsager, 2010; Fitjar and Rodríguez-Pose, 2011a,b; Jauhiainen and Moilanen, 2012; Fitjar and Rodríguez-Pose 2013; Pinto et al., 2015; Stephens et al., 2013; Mayer and Baumgartner, 2014; Varis et al., 2014; Kudic et al. 2015; Pelkonen and Nieminen, 2016). While this research has shed considerable light on innovation in what are thought to be relatively disadvantaged environments, a need for systematic research to facilitate the drawing of conclusions that go from the particular to the more general remains. The chapter, because of its cross-continent, comparative orientation, is supplemental to the work that has been and is being conducted at the case-study and

[3] The use of patent statistics is, nevertheless, problematic not least because patent statistics do not capture all, or all types of innovations generated in or by an economy. A great deal of innovation, especially process and incremental innovation remains unpatented. Moreover, some sectors have a much greater propensity to patent than others. That said, there is no better proxy for innovation available, at the time of writing, for regions in North America and Europe. Patent statistics, despite their problems, remain the only reliable and comparable quantification of innovative activity occurring at a regional level in these two contexts. The rationale behind the use of patents as a proxy for innovation is further elaborated in *Section 1.4.2.1*.

microeconomic level.[4] Its most general overarching objective is to contribute to the development of innovation policies for North America's and Europe's lagging regions.

The empirical analysis, covering 71 less and 81 more developed regions in Europe as well as 27 less and 34 more developed provinces and states in Canada and the United States, respectively, suggests that while there are some similarities between the factors that govern innovation in North America's and Europe's lagging regions, a number of not inconsequential differences between the two continents prevail. Of the similarities, the most prominent relate to the positive relationships between innovation and both the availability of skilled human capital and the agglomeration of economic activity, as well as to the relevance of interregional knowledge flows to the generation of innovation. Differences relate to the types of R&D expenditure that are linked to regional innovativeness and to the role of R&D knowledge flows for innovation in lagging areas. In addition, the sets of factors that mediate processes of innovation in the lagging regions of both North America and Europe, respectively, seem to bear a closer resemblance to those that drive innovation in their more developed neighbours in the same continent than to those at play in their lagging counterparts on the opposite side of the Atlantic.

The remainder of the chapter is structured as follows: *Section 1.2* addresses the motivation for the work and presents the theoretical framework within which it is situated. *Section 1.3* explores trends in R&D expenditure and patenting in North America and Europe. *Section 1.4* introduces the empirical methodology, model, and variables employed in the analysis. *Section 1.5* presents and interprets the results of the econometric analysis. *Section 1.6* concludes by summarising the analysis and deriving a series of preliminary policy implications and avenues for future research.

[4] While other researchers have conducted analyses of innovation from comparative perspectives comparable to the one employed here (e.g. Crescenzi et al., 2007, 2012; Usai, 2011; Fagerberg et al., 2014), none, to our knowledge, have focused explicitly on the dynamics and drivers of innovation in less socioeconomically developed, lagging regions.

## 1.2. The puzzle of innovating in lagging regions

Two tenets have come to dominate our understanding of the economic geography of innovation. The first is that more economically developed territories are more innovative than their less developed counterparts. The second is that processes of innovation and the factors that influence them are as heterogeneous as the territories in which they occur.

The intention of the following section is to engage with these two beliefs with a view to expose some of the tension between the ways in which they are often approached or applied. It is this tension that ultimately serves as the theoretical motivation for this exploratory research and the questions that guide it.

### 1.2.1. The less/more developed dichotomy

Lagging regions are generally thought to be less innovative than more economically advanced ones. While certain economically disadvantaged areas have managed, often against the odds, to develop a considerable innovative capacity (e.g. Virkkala, 2007; Doloreux et al., 2007; Doloreux and Dionne, 2008; Fitjar and Rodríguez-Pose, 2011a,b; 2013; Jauhiainen and Moilanen, 2012), the dominating view is that innovation tends to cluster in a relatively limited number of more developed areas (Feldman and Florida, 1994; Sun, 2003; Bettencourt et al., 2007; Mitra, 2007; Crescenzi et al., 2007; 2012; Foddi and Usai, 2013; Breau et al., 2014).

The dynamism of more developed territories in terms of innovative activity is frequently attributed to a host of socioeconomic and institutional factors. These areas generally have an abundance of skilled human capital, better technological infrastructure and ample physical capital (Feldman and Florida, 1994; Florida, 2003; 2005; Bettencourt et al., 2007). They concentrate public organizations and private firms that benefit from the externalities associated with co-location and agglomeration. Firms reap the benefits of economies of scale, specialisation and diversification and of the localised circulation of knowledge (e.g. Jacobs, 1969; Glaeser et al., 1992; Anselin et al. 1997; Henderson, 1999; Audretsch and Feldman, 2004; Duranton and Puga,

2004; Andersson et al., 2005; Carlino et al., 2007). Economic centres are also understood to be more institutionally suitable for innovative activity (Rodríguez-Pose 1999; 2001). The agglomeration of economic actors is associated with the emergence of "intricate institutional systems" that support the diffusion and exchange of knowledge and the collaborations and interactions fundamental to processes of innovation (Fitjar and Rodríguez-Pose, 2011a:557).

Likewise, several factors constrain the innovative capacity of less developed areas. Most prominent among them are socioeconomic and institutional deficiencies and geographic isolation. These contextual deficiencies relate to the weakness of their 'local economic fabrics', insufficient stocks of human and physical capital, and the absence of the formal and informal institutions that would normally function as the backbone of 'innovation prone' environments (Rodríguez-Pose, 2001:280, 281). These shortcomings are thought to stifle the generation, local circulation, and application of knowledge. Physical isolation, on the other hand, places many of these areas beyond the geographic limits of knowledge spillovers emanating from more innovative territories (e.g. Moreno et al., 2005; Sonn and Storper, 2008; Rodríguez-Pose and Crescenzi, 2008), and in doing so, bars them from absorbing and exploiting economically useful knowledge generated elsewhere.

Stated simply, the resource endowments, socioeconomic fabrics, institutional infrastructures and, in some cases, the geographic/physical 'situations' of lagging regions differ vastly from those of their more economically advanced counterparts. More relevantly here, these differences tend to be reflected in and are ultimately responsible for their respective – often radically different – innovative capacities. The contextual conditions in lagging regions, in particular, are generally thought to be less conducive to the development and sustenance of robust innovative capacities. It is on the basis of these observations that the first implicit hypothesis of this research is formed: namely that because economically disadvantaged regions tend to be characterised by structural, socioeconomic, and institutional fabrics that are *less conducive* to innovation than those of their more developed counterparts, processes of innovation in lagging regions, if and when they unfold, will stand in stark contrast to those transpiring in more economically developed areas.

### 1.2.2. Regional innovation as a contextually-contingent process

The understanding of innovation processes and of what shapes them has evolved considerably from the earliest linear models (e.g. Maclaurin, 1953). Processes of innovation are now widely understood not only as only complex and dynamic, but also subject to influence by a variety of socioeconomic, institutional, and political characteristics unique to the environments in which they take place (Edquist and Chaminade, 2006:125, 126).

While investment in R&D and knowledge generation have long been associated with the genesis of innovation (e.g. Grilliches, 1979), other research has teased out links between a multitude of factors and territories' innovative capacities. These include, but are not limited to: the supply and quality of human capital (Romer, 1990; Glaeser, 1999; Andersson et al., 2005; Crescenzi, 2005; Lee et al., 2010; Pater and Lewandowska, 2015); the skills composition of pools of labour (Florida, 2002; Ottaviano and Peri, 2005; Storper and Scott, 2009; Özgen et al., 2011); the agglomeration of economic activity and the knowledge-related externalities with which it is associated (Duranton and Puga, 2004; Storper and Venables, 2004); the capacity to absorb non-local knowledge (Bathelt et al., 2004); and the quality and functioning of local institutions (Rodríguez-Pose and Di Cataldo, 2015). These analyses often reveal pronounced differences between the factors that affect innovation, their relative importance and, critically, the way in which they interact with one another across geographies.

Consequently, innovation processes differ depending on the context in which they take place. The territorially-specific nature of regional innovation becomes evident in comparative analyses which have unveiled pronounced differences between the territorial dynamics of innovation in different parts of the world. Recent empirical research has revealed, for example, that the exact sets of factors that influence processes of innovation in the United States, the European Union, India, and China, respectively, and the extent to and manner in which each relevant factor does so, vary considerably across the four economies (Crescenzi et al. 2007; 2012).

The research's second hypothesis is founded on this notion that processes of innovation are highly contingent on local context and conditions. More specifically, it is posited that while less developed areas may, as mentioned earlier, share some broad similarities, processes of innovation in what remain heterogeneous regions *will not* transpire in the same or perhaps even similar ways.

### 1.2.3. Do lagging areas innovate in the same way?

While the cross-context diversity of processes of innovation is increasingly acknowledged, an implicit tendency to presume that all economically disadvantaged environments (a) innovate less and (b) that they do so in relatively homogenous ways remains. Insufficient agglomeration, poor accessibility, and weak socioeconomic and institutional endowments curtail innovation and offer limited alternatives for technological change. Hence, innovation policies tend to be similar for all lagging areas, regardless of local conditions. But is this truly the case? Do these regions, irrespective of geography and contextual conditions, innovate less and, more importantly, do they do so in similar ways?

Relying on a comparison between North America and Europe, this chapter sets out to assess whether all lagging regions are functionally the same from an innovation perspective. Two related research questions inform the analysis: (a) what are the socioeconomic factors that influence processes of innovation in North America's and Europe's lagging regions, respectively? And (b) how do these factors differ between the two contexts?

The regions that compose the continents with which we are concerned have been categorised purely in accordance with their respective levels of economic development. More specifically, 'less developed' or 'lagging'[5] regions are, for the purposes of the analysis, defined as those below a given threshold in terms of relative wealth in 2010: 90% of the average regional GDP per capita in Canada, the US, and Europe, respectively.[6]

[5] Regions that are not classified as lagging are referred to as 'more developed regions'.

[6] 90% of the average GDP per head is also the threshold the EU employs to distinguish between more developed and less developed and transition regions.

## 1.3. Knowledge generation and innovation in North America's and Europe's lagging regions

Prior to delving into the econometric analysis, let us consider both the basic 'inputs' to and 'outputs' of innovation process in North America and Europe. The input we focus on is R&D expenditure. R&D investment is by no means the only input to processes of innovation. It is, however, intimately linked to the generation and absorption of "new economic knowledge" (Audretsch and Feldman, 2004) and is the only input for which there is reliable and comparable data at the regional level for both North America and Europe. For outputs, we consider patent applications – again a not uncontroversial measure of innovation (*see Footnote 3*) – but the only one for which comparable data exist.

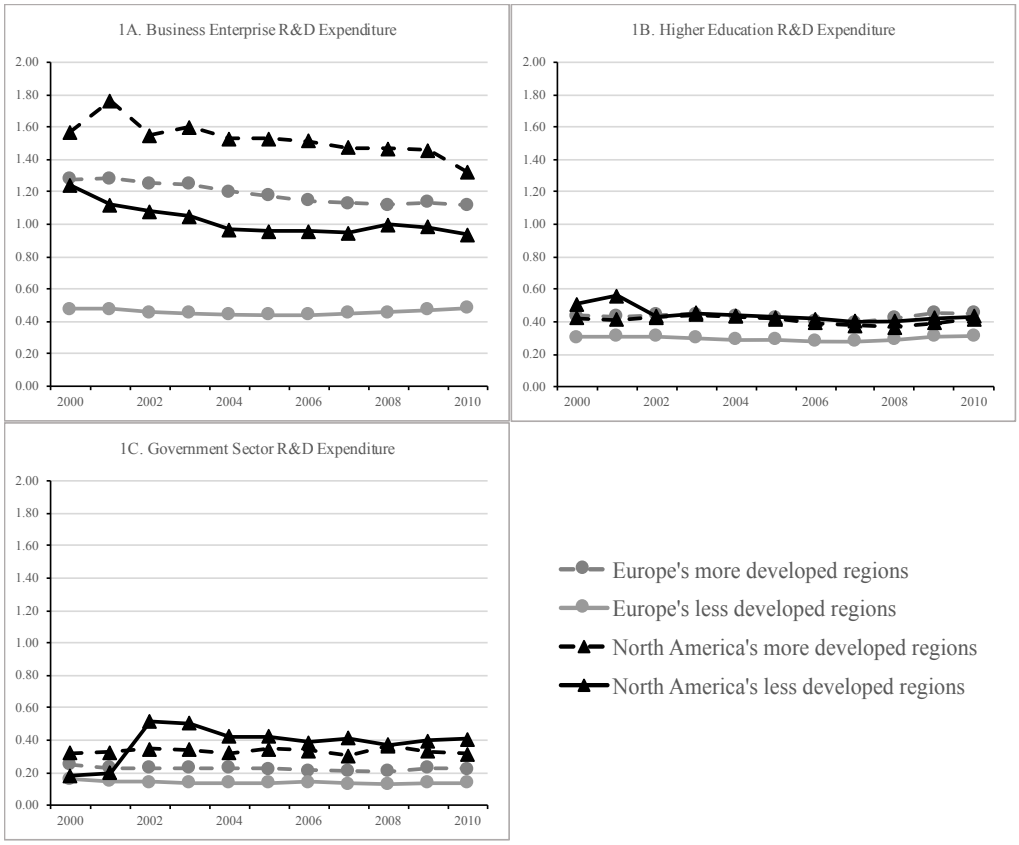
*Figure 1.1* illustrates expenditure trends in business enterprise (*Panel 1A*), higher education (*Panel 1B*) and government sector (*Panel 1C*) R&D in both the lagging and the more developed regions of North America and Europe. Three inferences can be drawn from the figures.

First, business enterprise is the most prominent type of R&D expenditure across North American and European regions, regardless of level of development (*Figure 1.1, Panel 1A*). There are, however, considerable differences in business R&D expenditure across different types of territories. North America's more developed regions invest considerably more in business enterprise R&D than their lagging counterparts. In 2010, for example, the continent's more developed regions spent 1.32% of their GDP on business enterprise R&D. Its lagging regions, by comparison, directed an average of only 0.94%. A much greater gulf exists in Europe. In 2010, business enterprise R&D expenditure accounted for 1.12% of the GDP of its more developed regions and only 0.48% of its economically disadvantaged ones.

Second, the balance between private and public R&D varies between the two continents, and between their less developed regions in particular (*Figure 1.1, Panels 1B* and *1C*). In North America's lagging regions, the public effort represented 45% of the 1.8% of GDP invested in R&D in 2010. In Europe, the involvement by the private

sector was less prominent, and public investment accounted for 0.5% of GDP in a total investment in R&D which hovered around 1% of GDP.

*Figure 1.1. Average regional R&D expenditure by sector as a percentage of GDP, 2000-2010*




**Authors' elaboration**

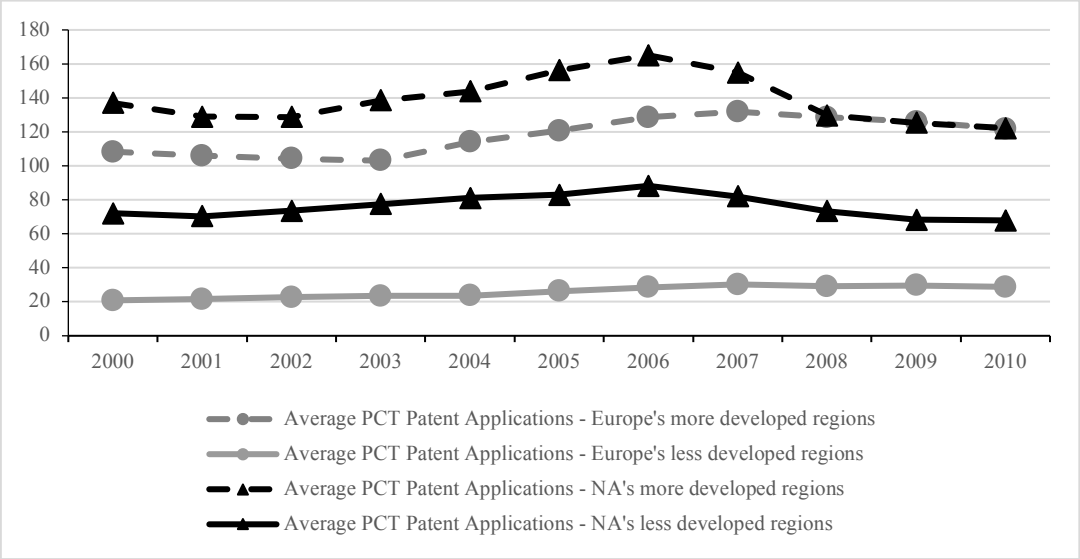
Third, levels of public R&D investment in North America's lagging regions – that is both higher education and government R&D – are reasonably comparable to those in its more developed regions (*Figure 1.1, Panels 1B* and *1C*). In 2010, higher education R&D expenditure accounted for an average 0.43% of GDP in lagging regions and 0.42% in more advanced ones (*Figure 1.1, Panel 1B*). Likewise, the continent's more developed regions spent, on average, 0.32% of their GDP on government sector R&D, while their less developed counterparts directed 0.41% of GDP to these activities (*Figure 1.1, Panel 1C*). By contrast, levels of public R&D in Europe's lagging regions were well below those of its more developed regions. In 2010, for example, Europe's more developed regions directed, on average, 0.45% and 0.23% of their GDP towards higher education and government sector R&D, respectively (*Figure 1.1, Panels 1B* and *1C*). Lagging regions, on the other hand,

invested 0.31% and 0.14% of their GDP in the two types of R&D (*Figure 1.1, Panels 1B* and *1C*).

Summarizing, while North America's economically disadvantaged regions lag behind its more developed ones in terms of business enterprise R&D expenditure, the two types of regions direct, on average, similar amounts to both types of public R&D activities. The implications of this are twofold: First, differences in aggregate R&D expenditure between North America's more and less developed regions are attributable to differences in private rather than public investment. Second, lagging regions in North America are less disadvantaged in terms of R&D investment than European ones relative to their respective more advanced counterparts. That is, not only do levels of business enterprise R&D expenditure in more developed regions exceed those of lagging regions by a much greater margin in Europe than they do in North America, Europe's lagging regions also invest less, on average, in public R&D activities than their more developed neighbours. Comparable differences in public R&D investment are not observed between the less and more developed regions of North America. Overall, lagging regions in North America would seem more favourably positioned to produce innovation than their European counterparts.

On the output side, patent application trends are broadly consistent with those observed in R&D expenditure (*Figure 1.2*). In both North America and Europe, more developed regions are, on average, significantly more innovative than lagging ones. Moreover, there has been a degree of convergence in the innovative performance of the more advanced regions of the two continents. Between 2000 and 2006, North America's more developed regions were decidedly more innovative than their European counterparts. By the end of the period of analysis, however, the two economies' more developed regions were producing similar numbers of patent applications per million inhabitants. In 2010, North America's more developed regions generated, on average, 122.22 applications per million inhabitants, while in Europe the same category of regions produced a comparable 121.76.

*Figure 1.2. Average regional PCT patent applications per million inhabitants, 2000-2010*




**Authors' elaboration**

There remains, however, a pronounced discrepancy between the respective innovative performances of lagging regions on either side of Atlantic – North America's lagging regions are markedly more innovative in per capita terms than their European counterparts (*Figure 1.2*). While the innovative gap between the two economies' less developed regions did decrease marginally between 2000 and 2010, the 28.71 patent applications per million inhabitants produced by Europe's lagging regions in 2010 was more than doubled by the 67.91 applications per million inhabitants generated by similarly disadvantaged regions in North America.

A portion of the pronounced difference between the innovative output produced by North America's lagging regions and that by Europe's less developed ones may be explicable by the classification of certain American states that were once among the country's most developed – including, for example, Michigan, Ohio and perhaps even, recognising the former prominence of St. Louis, Missouri – as less developed areas. These states are today – and were throughout the period of analysis – lagging states. Decades-long processes of economic decline, and, more recently, the global financial crisis, reversed the economic fortunes of what once were prosperous states. It is possible, however, that the economic dynamism these states achieved largely on the back of more industrial, manufacturing-type activities in the early- to mid-20$^{th}$ century endowed these regions with an above average innovative capacity

some of which has proved resilient to the processes of economic decline by which they have been plagued. It is unlikely, however, that the gulf between the innovative capacities of lagging regions of the two continents is explicable entirely by the long-since-passed economic success of a small handful of states and the 'legacy effects' with which they are possibly associated. That said, this history should not be overlooked and needs to be acknowledged as part of the efforts to understand the differences between North America's and Europe's lagging regions.

In short, *Figures 1.1* and *1.2* reveal sizable differences between lagging regions in North America and those in Europe. More specifically, it becomes apparent that Europe's lagging regions are more disadvantaged in terms of R&D expenditure, and investment in business R&D functions in particular, than their North American counterparts. Moreover, Europe's less developed regions also lag behind North America's in patent production, suggesting that the innovative capacity of North America's lagging regions is greater than that of their European peers. The geography of patent production in North America and Europe is summarized in *Appendix 1*.

## 1.4. Methodology

### 1.4.1. The model

The econometric model assumes the form of a 'modified regional knowledge production function' (Ó hUallacháin and Leslie, 2007) within which regional innovative capacity is a function of regional investment in knowledge generation; the innovative activities occurring in neighbouring regions; and a vector of socioeconomic factors.

The basic model is specified as follows:

$$y_{i,t} = \beta R\&D_{i,t} + \theta WR\&D_{i,t} + X_{i,t}'\delta + \varepsilon_{i,t}$$

Where:

| | |
|---|---|
| $y$ | represents regional innovative performance proxied by patent intensity; |
| $R\&D$ | depicts regional investment in R&D activities; |
| $WR\&D$ | represents average R&D expenditure in neighbouring regions; |
| $X$ | is a vector of socioeconomic factors; |
| $i,t$ | represent region and time, respectively |

### 1.4.2. The variables

#### *1.4.2.1. The dependent variable*

The dependent variable is patent applications per million inhabitants. Patent applications reflect the introduction of commercially viable, applied innovations (Furman et al., 2002) and as a result, are an oft-employed barometer of a territory's innovative capacity. Despite their shortcomings, patent application statistics are the most suitable option for cross-country comparative econometric analyses. We opt to use Patent Cooperation Treaty ('PCT') patent applications. This decision is motivated by the comparative nature of the research. Crescenzi et al. (2012:1062) highlight, citing the OECD (2009:66), that PCT patent applications function as "'worldwide patent application[s]' [that are] much less biased than national applications".

Prior to proceeding, it must be stressed that there is considerable debate surrounding the suitability of patent applications as a proxy for innovative capacity. Detractors assert that many innovations are not patented either because they are not legally patentable or because inventors have opted not to patent them (Desrochers, 1998:57, 58). Patent applications offer a reasonably reliable measure of specifically commercially viable, more tangible innovation – especially that which is generated

by/in sectors and industries with higher propensities to patent (e.g. Mäkinen, 2007; Fontana et al., 2013). They do not, however, as noted by Capello and Lenzi (2014:189), reflect "innovative efforts that can be developed either in the form of process, marketing, and organisational innovations or in the form of product innovation not [necessarily] obtained via research and patenting activities". We are therefore only able to observe certain types of innovations and certain dimensions of a region's overall innovative capacity. Hence, while patents are a generally accepted proxy for innovation, they do not capture *all* types of innovative activity. Similarly, the validity of patent statistics as a measure of innovativeness is adversely affected by biases in the types of innovations that are patented (i.e. product versus process) and by variability in the propensity of firms in different industries and of different sizes to patent (Desrochers, 1998:58). In spite of these well-documented limitations, patent application statistics remain the most frequently used proxy for innovation, often out of necessity. Moreover, their use does not impede the formulation of exploratory and indicative comparative insights into innovation in the types of environments with which this research is concerned. As Trajtenberg (1990:183) observes, they are "the only observable manifestation of inventive activity with a well-grounded claim for universality".

#### *1.4.2.2. The independent variables*

Processes of regional innovation are subject to influence by any number of factors. This research is most immediately concerned with those of a structural and socioeconomic nature.[7] Theoretical and empirical literature has identified a host of variables that reflect the socioeconomic and structural influences that are among the preeminent shapers of processes of knowledge creation and application and, ultimately, innovation. We incorporate these variables into the empirical model. They are the following.

[7] Influences on innovative processes are by no means confined to those considered here. We have, however, because of the aims of the study and the documented relevance of these factors, as well as the availability of data for comparative analysis, elected to focus on socioeconomic and structural influences. This is not to discount the relevance of other regional factors or assets including, for example, formal and informal institutional conditions and arrangements, or other intangible assets or competencies. That said, issues related to, in the first instance, data availability and, in the second, the less tangible and thus quantifiable nature of certain influences and factors explain the exclusion of such factors from the econometric analysis that follows.

*R&D expenditure*

The first of our independent variables are measures of regional R&D expenditure, expressed, including the spatially-lagged ones, as percentages of GDP.

R&D activities are intrinsically linked to processes of innovation (e.g. Grilliches, 1979). Regional investment in R&D is a central determinant of a region's capacity to generate new, economically useful knowledge as well as to absorb externally generated knowledge and innovations (Cohen and Levinthal, 1990; Griffith et al., 2003; 2004; Vogel, 2015).

We disaggregate regional R&D expenditure into three sub-categories: (a) business enterprise; (b) higher education; and (c) government sector R&D. The motivation for doing so is twofold. First, from a more theoretical perspective, certain types of R&D expenditure are more readily associated with the generation of innovation than others (Malecki, 1991, Rodríguez-Pose, 1999). Business R&D, on the one hand, is, as Guellec and Van Pottelsberghe de la Potterie (2004:355) note, more readily linked to the generation of "new goods and services, [with] higher quality of output and new production processes". Higher education and government sector R&D expenditure, on the other hand, are more commonly associated with advances in "scientific, basic knowledge and [public missions]" and the maintenance and expansion of the "stock of knowledge available for the society" (Guellec and Van Pottelsberghe de la Potterie, 2004:356).

Second, as illustrated in *Section 1.3*, there are marked differences in the allocation of R&D resources across public and private functions between North America and Europe, and again between their more developed and less developed regions. The consideration of the three subclasses of R&D expenditure is therefore necessary to develop nuanced insights into the returns to R&D in the lagging regions of both North America and Europe.

*R&D knowledge flows*

Returns to R&D investment are often realised beyond the borders of the region undertaking it (Audretsch and Feldman, 2004; Feldman and Kogler, 2010). Exposure to interregional knowledge flows and externally generated knowledge and innovation is a non-negligible influence on the innovativeness of a territory (e.g. Fritsch and Franke, 2004; Bathelt et al., 2004; Moreno et al., 2005; Cabrer-Borrás and Serrano-Domingo, 2007; Sonn and Storper, 2008; Rodríguez-Pose and Crescenzi, 2008; Fitjar and Rodríguez-Pose, 2011a,b; Rodríguez, 2014; Grillitsch and Nilsson, 2015).

We have therefore, following, among others, Crescenzi et al. (2007), developed two types of spatially-lagged R&D expenditure variables to explore the relationship between exposure to interregional knowledge spillovers and regional innovative capacity. The spatially-lagged R&D variables reflect the R&D expenditure of neighbouring regions and are constructed for all three subcategories of R&D expenditure.[8]

The spatially-lagged variables, and specifically the spatial weights matrices used in their calculation, were constructed using GIS software (ESRI's ArcGIS). The first type of spatially-lagged variable uses first-order contiguity-based spatial weights and is included to estimate the influence of exposure to shorter distance knowledge flows on regional innovativeness. The construction of this first type of spatially-lagged variable does *not* involve the calculation of distances between regions. Rather, the software is used to identify the regions that are contiguous to a given region. A 'queen' conceptualisation of contiguity is employed; if a region shares a border or a vertex with the region of interest, it is assigned a weight of one. Non-contiguous regions are assigned a weight of zero.

This first-type of spatially-lagged R&D variable is calculated as follows:

$$WR\&D_i = \sum_j R\&D_j \left(\frac{Contig_{ij}}{\sum_j Contig_{ij}}\right) \qquad \forall i \neq j$$

[8] The methodology detailed below is also employed in the construction of the spatially-lagged variables relied upon in *Chapters 2* and *3*.

Where $R\&D_j$ is the R&D expenditure of neighbouring region *j* and $Contig_{ij}$ is indicative of whether region *j* is contiguous to region of interest *i*; $Contig_{ij}$ assumes a value of one if this is true, and a value of zero if false.

The second type uses inverse-distance spatial weights to capture longer distance knowledge flows. The construction of this second class of spatially-lagged variable *does*, on the other hand, require the measurement of distances between the regions considered in the analysis. The distance between two regions is measured, using GIS software, as the straight-line (i.e. 'as the crow flies') distance between their respective centroids (the calculated, literal geographic centre of a region). Regions are, in turn, assigned a weight that reflects the inverse of their respective straight-line distances from the region of interest; all regions in the sample are therefore awarded a weight greater than zero.

This second type of spatially-lagged variable is calculated as follows:

$$WR\&D_i = \sum_j R\&D_j \left(\frac{1/d_{ij}}{\sum_j 1/d_{ij}}\right) \qquad \forall i \neq j$$

Where $R\&D_j$ is the R&D expenditure of neighbouring region *j* and $d_{ij}$ is the straight-line distance between neighbouring region *j* and region of interest *i*.

*Skills in the labour force*

As indicated in the theoretical section, human capital and the availability of suitably skilled labour are key for regional innovation. Accordingly, a higher educational attainment variable is used to assess the relationship between regional innovativeness and the skills available in a region. Similarly, the efficient mobilisation of local human resources is linked to a region's innovativeness (Rodríguez-Pose, 1999). Regional unemployment is therefore included to explore the link between the "productive employment of human resources" (Crescenzi et al., 2007:684) and regional innovation.

*Industrial composition*

Certain industrial compositions or 'mixes' are more conducive to innovation than others (e.g. Capello et al., 2012). Employment in industry – the International Standard Industrial Classification (ISIC) rev. 3 and rev. 4 "employment, industry, including energy", with data expressed as a percentage of total regional employment – is used to assess the relevance of a region's industrial composition to its innovative capacity.

*Agglomeration*

The link between agglomeration and innovation is explored, as customary in related literature, using regional population density (e.g. Moreno et al., 2005; Crescenzi et al., 2007; 2012; Usai, 2011; Paci et al., 2014). Density represents a proxy for the co-location of economic actors and the agglomeration of economic activity.

*Demographics and development*

The percentage of the population aged 15-24 is included to control for regional demographic composition, the relevance of which to innovation has been verified by empirical examination (e.g. Frosch and Tivig, 2007; Poot, 2008). GDP per capita is added to control for a region's relative wealth and overall level of socioeconomic development.

## 1.5. Results and analysis

The model is estimated using time and geographical[9] fixed-effects and random-effects at the regional level, and with robust standard errors. The analysis considers the TL2 regions of Canada, the United States, and a large selection of European

[9] Country fixed-effects are employed for the European estimations. In the North American case they are replaced by macro-region (Canada, Southern United States, North-Eastern United States, Mid-Western United States, and Western United States) fixed-effects to enhance the comparability of the empirical analysis.

countries for the eleven-year period between 2000 and 2010. A complete list of the countries and regions included is provided in *Appendices 2-5*.[10]

The decision to employ TL2 regions as the unit of analysis is not an arbitrary one and is, in fact, based on three factors. First, the comparative nature of the research requires the use of comparable spatial units. TL2 regions have been uniformly defined by the OECD, making them comparable across the countries considered in the empirical analysis. Second, the TL2 level is the regional level for which the data necessary to conduct the type of comparative econometric analysis performed here is available and is as complete as possible. Third, and perhaps, most importantly, the TL2 level is the level for which many regional policies, including those geared towards the promotion of innovation, are designed and at which they implemented. Many of the European TL2 regions examined are classified by the European Commission's nomenclature system as 'NUTS2' regions. This NUTS2 level is defined by the Commission as the spatial level at which regional policies are applied.[11] In those cases where the TL2 classification differs from the NUTS2 level, the TL2 classification includes territories with a considerable degree of regional autonomy. These include, for example, German *Länders* and Belgian regions. Similarly, in North America, many of the programmes and strategies pursued to catalyse innovation and upgrade regional innovative potential are the responsibility of states in the US and provinces in Canada.[12]

The section is structured as follows: *Sections 1.5.1* and *1.5.2* present the estimation results for both the lagging and the more economically advanced regions of North America and Europe respectively.[13] In both of these sections, results for the

[10] The analysis considers all of the North American and European TL2 regions for which there is suitable data. Data is available for all US States and Canadian provinces. Unfortunately, there are several regions in Europe – mainly in Finland, Italy and Poland – for which suitable data does not yet exist. Consequently, these regions are not, in spite of a concerted effort, captured by the analysis.

[11] NUTS Overview (Eurostat): http://ec.europa.eu/eurostat/web/nuts/overview

[12] In 2015, the Canadian province of Ontario, for example, released a multifaceted innovation agenda entitled "Seizing Global Opportunities: Ontario's Innovation Agenda" (Ontario Ministry of Research and Innovation, 2015). The overarching aim of the strategy is to deliver "a high and sustainable level of prosperity, and healthy communities, that provide high-quality jobs and better lives for people in Ontario" (p. 1).

[13] The tables provided to summarise the results of the empirical analysis include only a selection of the model specifications employed in the analysis. While a concerted effort has been made not to do so, *Sections 1.5.1* and *1.5.2* do reference, albeit infrequently, model specifications not included in the four tables provided.

more developed, non-lagging, regions are discussed with reference to lagging ones. *Section 1.5.3* compares the estimation results for North America's economically disadvantaged regions to those for their European counterparts.[14]

### 1.5.1. North America

*Less developed regions*

*Table 1.1* presents the estimation results for the economically disadvantaged, lagging regions of North America.

We begin the analysis with an examination of the links between the three types of R&D expenditure and regional innovative capacity. Regional investment in higher education R&D is positively and statistically significantly associated with regional patent generation across all specifications of the model in which it is included (*Specifications 3, 4*). Business enterprise and government sector R&D expenditure are not, however, statistically significantly linked to regional innovative output (*Specifications 1, 2, 5, 6*).

A positive relationship also emerges between skilled human capital and innovation. The tertiary educational attainment variable is positively and statistically significantly related to regional patent intensity (*Specifications 1-6*). The agglomeration of economic activity and the youthfulness of a region's demographic composition are associated with regional innovativeness as well. The coefficients of the population density (*Specifications 1-5*) and the percentage of the population aged 15-24 variables (*Specifications 1, 2, 5, 6*) are positive and statistically significant across most specifications of the model. Conversely, neither the unemployment rate (as a proxy for a region's capacity to mobilise its human capital) nor employment in industry (a proxy for the industrial structure of a region's economy) is linked to regional innovative output (*Specifications 1-6*).

[14] The objective of this analysis is to provide insights of a more indicative and exploratory nature. Consequently, the focus of the analysis remains on the 'direction' and significance of coefficients and, importantly, on the extent to which the direction and significance of relationships hold across the many specifications of the model.

*Table 1.1. North America's less developed regions*

| | North America, less developed regions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GDP per capita (ln) | 0.791 | 0.918* | 0.893 | 0.861 | 0.744 | 0.694 |
| | (0.531) | (0.542) | (0.643) | (0.647) | (0.633) | (0.640) |
| Business enterprise R&D (BERD) (ln) | 0.0115 | 0.0245 | | | | |
| | (0.0585) | (0.0615) | | | | |
| Higher education R&D (HERD) (ln) | | | 0.132*** | 0.132*** | | |
| | | | (0.0496) | (0.0493) | | |
| Government sector R&D (GOVERD) (ln) | | | | | -0.0424 | -0.0440 |
| | | | | | (0.0322) | (0.0329) |
| Spatially-lagged BERD (contiguity) (ln) | 0.315** | | | | | |
| | (0.132) | | | | | |
| Spatially-lagged BERD (inverse) (ln) | | 1.343** | | | | |
| | | (0.661) | | | | |
| Spatially-lagged HERD (contiguity) (ln) | | | 0.0667 | | | |
| | | | (0.127) | | | |
| Spatially-lagged HERD (inverse) (ln) | | | | 0.547 | | |
| | | | | (0.401) | | |
| Spatially-lagged GOVERD (contiguity) (ln) | | | | | -0.0299 | |
| | | | | | (0.0508) | |
| Spatially-lagged GOVERD (inverse) (ln) | | | | | | -0.164 |
| | | | | | | (0.133) |
| Tertiary educational attainment | 0.0468*** | 0.0429** | 0.0343* | 0.0326* | 0.0381** | 0.0374* |
| | (0.0171) | (0.0179) | (0.0179) | (0.0180) | (0.0187) | (0.0191) |
| Unemployment rate | -0.0150 | -0.0194 | -0.0167 | -0.0147 | -0.0108 | -0.0110 |
| | (0.0238) | (0.0248) | (0.0261) | (0.0255) | (0.0261) | (0.0257) |
| Employment in industry | -0.0248 | -0.0213 | -0.0160 | -0.0168 | -0.0233 | -0.0235 |
| | (0.0177) | (0.0191) | (0.0200) | (0.0206) | (0.0198) | (0.0200) |
| Population density (ln) | 0.203** | 0.182* | 0.205* | 0.198* | 0.193* | 0.204 |
| | (0.0919) | (0.102) | (0.111) | (0.116) | (0.117) | (0.125) |
| Percentage of the population aged 15-24 | 0.0568** | 0.0747** | 0.0523 | 0.0375 | 0.0511* | 0.0467* |
| | (0.0242) | (0.0295) | (0.0321) | (0.0282) | (0.0305) | (0.0279) |
| Constant | -5.745 | -7.743 | -6.675 | -5.764 | -5.351 | -4.964 |
| | (5.330) | (5.314) | (6.320) | (6.432) | (6.280) | (6.309) |
| Macro-region F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Time F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 297 | 297 | 297 | 297 | 297 | 297 |
| Overall R2 | 0.7826 | 0.7495 | 0.6866 | 0.6745 | 0.6636 | 0.6563 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

In North America's less developed regions, exposure to interregional knowledge flows matters for regional innovative capacity. A positive and statistically

significant relationship exists between a region's innovative output and its exposure to both short- and long-distance business enterprise R&D flows (*Specifications 1, 2*). The coefficients of the spatially-lagged higher education and government sector R&D variables, by comparison, are not statistically significant in any of the specifications (*Specifications 3-6*).

*More developed regions*

While there are numerous similarities between the innovation processes transpiring in North America's lagging regions and those unfolding in their more economically advanced counterparts, there are also noticeable differences. The estimation results for the more developed regions of North America are presented in *Table 1.2*.

Three prominent similarities between the sets of factors that govern processes of innovation in the less and more developed regions of North America emerge. First, both higher education R&D expenditure (*Specifications 3, 4*) and tertiary educational attainment (*Specifications 1-6*) play an important role in innovative processes in both areas. A positive and statistically significant relationship between the agglomeration of economic activity and regional patent intensity is also evident in both contexts (*Specifications 1-6*).

Moreover, as is true for its lagging regions, patent generation is not consistently and robustly linked to regional unemployment (*Specifications 1-5*);[15] employment in industry (*Specifications 1-6*); or investment in government sector R&D (*Specifications 5, 6*) in North America's more economically advanced regions.

In spite of these similarities, two critical differences between the two types of regions are brought to light by the analysis. First, business enterprise R&D expenditure, which is not significantly linked with the generation of innovative output in the continent's less developed regions, is positively and statistically significantly

[15] *Specification 6* is one of *only* two model specifications run in which regional unemployment is significantly linked to regional innovativeness. This minimal frequency with which this significant relationship is insufficient cause to assert that regional unemployment is robustly associated with innovation.

connected with the innovative capacity of its more developed ones (*Specification 1*). Second, the positive, significant relationship between exposure to business enterprise R&D knowledge flows and patent intensity observed in North America's lagging areas disappears in its richer ones (*Specifications 1, 2*).

There is some cursory evidence to suggest that the innovative capacity of North America's more economically developed areas may be negatively and significantly linked with exposure to long-distance business enterprise R&D knowledge flows. One interpretation of this negative relationship is, following Crescenzi et al. (2012:1075), that the concentration of innovative activity in certain regions may "promote the outflow of knowledge from neighbouring [ones]". The analysis also reveals a positive and significant relationship between regional patent propensity and exposure to long-distance government sector R&D knowledge flows in these regions that is not seen in their lagging neighbours (*Specification 6*). The two aforementioned relationships, however, *only* hold in model specifications that *do not* include regional business R&D expenditure.

Neither exposure to shorter-distance R&D knowledge flows of any kind, nor exposure to longer-distance higher education R&D spillovers are linked to regional innovative output in North America's more developed regions (*Specifications 1, 3, 4, 5*).

A final point of divergence between the two types of regions in North America relates to the relevance of regional demographic compositions. The innovativeness of North America's more developed regions is not connected to the youthfulness of their respective populations like it is in the continent's lagging regions. (*Specifications 1-6*).

*Table 1.2. North America's more developed regions*

| | North America, more developed regions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GDP per capita (ln) | -0.147 | -0.124 | 0.293 | 0.329 | -0.0277 | 0.00245 |
| | (0.215) | (0.209) | (0.213) | (0.216) | (0.229) | (0.231) |
| Business enterprise R&D (BERD) (ln) | 0.0883* | 0.0811 | | | | |
| | (0.0519) | (0.0542) | | | | |
| Higher education R&D (HERD) (ln) | | | 0.367** | 0.367** | | |
| | | | (0.182) | (0.183) | | |
| Government sector R&D (GOVERD) (ln) | | | | | 0.0235 | 0.0250 |
| | | | | | (0.0280) | (0.0283) |
| Spatially-lagged BERD (contiguity) (ln) | -0.0153 | | | | | |
| | (0.0849) | | | | | |
| Spatially-lagged BERD (inverse) (ln) | | -0.306 | | | | |
| | | (0.258) | | | | |
| Spatially-lagged HERD (contiguity) (ln) | | | -0.00778 | | | |
| | | | (0.0909) | | | |
| Spatially-lagged HERD (inverse) (ln) | | | | -0.172 | | |
| | | | | (0.326) | | |
| Spatially-lagged GOVERD (contiguity) (ln) | | | | | 0.0178 | |
| | | | | | (0.0356) | |
| Spatially-lagged GOVERD (inverse) (ln) | | | | | | 0.161* |
| | | | | | | (0.0878) |
| Tertiary educational attainment | 0.0427*** | 0.0431*** | 0.0343** | 0.0343** | 0.0376*** | 0.0367*** |
| | (0.0146) | (0.0145) | (0.0152) | (0.0156) | (0.0139) | (0.0137) |
| Unemployment rate | -0.0321 | -0.0303 | -0.0299 | -0.0299 | -0.0356 | -0.0360* |
| | (0.0223) | (0.0218) | (0.0191) | (0.0190) | (0.0223) | (0.0213) |
| Employment in industry | 0.0273 | 0.0264 | 0.0227 | 0.0199 | 0.0224 | 0.0185 |
| | (0.0227) | (0.0227) | (0.0237) | (0.0228) | (0.0240) | (0.0230) |
| Population density (ln) | 0.211** | 0.214** | 0.193* | 0.189* | 0.208** | 0.191* |
| | (0.0913) | (0.0948) | (0.113) | (0.113) | (0.102) | (0.107) |
| Percentage of the population aged 15-24 | -0.0936 | -0.0992 | -0.0926 | -0.0870 | -0.0969 | -0.0950 |
| | (0.0652) | (0.0655) | (0.0706) | (0.0718) | (0.0737) | (0.0711) |
| Constant | 5.421** | 5.358** | 1.217 | 0.693 | 4.434* | 4.390* |
| | (2.261) | (2.237) | (2.191) | (2.378) | (2.551) | (2.602) |
| Macro-region F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Time F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 374 | 374 | 374 | 374 | 374 | 374 |
| Overall R2 | 0.6813 | 0.6743 | 0.5522 | 0.5475 | 0.5941 | 0.5749 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

### 1.5.2. Europe

*Less developed regions*

*Table 1.3* presents the estimation results for Europe's lagging regions.

Of the three types of R&D expenditure, only investment in business enterprise R&D – which is rather limited in Europe's less developed regions – is consistently significantly linked to the generation of innovative output. The coefficient for business enterprise R&D expenditure is positive and significant in all specifications of the model in which it is included (*Specification 1, 2*). By contrast, there is no significant association between regional innovation and higher education R&D (*Specification 3, 4*) or government sector R&D expenditure (*Specification 5, 6*), which together represent half of the R&D effort in Europe's lagging regions.

Human capital endowments are linked to innovative capacity. A positive and statistically significant relationship is found between educational attainment and regional patent intensity (*Specification 1, 3, 4, 5, 6*). The agglomeration of economic activity is also positively and significantly related to regional innovativeness (*Specification 1-6*) as is employment in industry in the majority of model specifications (*Specifications 3-6)*. Interestingly, the statistical significance of the latter relationship only holds in specifications of the model that *do not* control for business enterprise R&D expenditure, suggesting that industrial structure is not immediately relevant to the generation of innovative output in regions with sufficiently high levels of business R&D investment (*Specifications 1, 2*).

The association between the youthfulness of a region's population and its innovativeness is significant but negative (*Specifications 1-6)*. Regional unemployment is not robustly linked to patent generation (*Specifications 1-6).*

*Table 1.3. Europe's less developed regions*

| | Europe, less developed regions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GDP per capita (ln) | 0.759** | 0.687** | 0.543 | 0.527 | 0.647* | 0.670* |
| | (0.317) | (0.338) | (0.383) | (0.412) | (0.360) | (0.364) |
| Business enterprise R&D (BERD) (ln) | 0.226*** | 0.228*** | | | | |
| | (0.0667) | (0.0651) | | | | |
| Higher education R&D (HERD) (ln) | | | 0.0927 | 0.104 | | |
| | | | (0.0594) | (0.0637) | | |
| Government sector R&D (GOVERD) (ln) | | | | | 0.0293 | 0.0263 |
| | | | | | (0.0284) | (0.0286) |
| Spatially-lagged BERD (contiguity) (ln) | 0.110 | | | | | |
| | (0.0690) | | | | | |
| Spatially-lagged BERD (inverse) (ln) | | 1.128** | | | | |
| | | (0.570) | | | | |
| Spatially-lagged HERD (contiguity) (ln) | | | 0.207** | | | |
| | | | (0.0917) | | | |
| Spatially-lagged HERD (inverse) (ln) | | | | 1.096 | | |
| | | | | (0.693) | | |
| Spatially-lagged GOVERD (contiguity) (ln) | | | | | -0.0748 | |
| | | | | | (0.0829) | |
| Spatially-lagged GOVERD (inverse) (ln) | | | | | | 0.385* |
| | | | | | | (0.234) |
| Tertiary educational attainment | 0.0189* | 0.0166 | 0.0207* | 0.0201* | 0.0205* | 0.0211** |
| | (0.0106) | (0.0111) | (0.0109) | (0.0111) | (0.0105) | (0.0103) |
| Unemployment rate | 0.00448 | 0.00237 | 0.0104 | 0.00906 | 0.00970 | 0.00939 |
| | (0.00573) | (0.00609) | (0.00654) | (0.00656) | (0.00648) | (0.00646) |
| Employment in industry | 0.00271 | 0.00272 | 0.00901* | 0.00972* | 0.00797* | 0.00857* |
| | (0.00455) | (0.00472) | (0.00490) | (0.00509) | (0.00481) | (0.00494) |
| Population density (ln) | 0.263*** | 0.260*** | 0.288*** | 0.304*** | 0.278*** | 0.306*** |
| | (0.0817) | (0.0799) | (0.0992) | (0.103) | (0.0999) | (0.0956) |
| Percentage of the population aged 15-24 | -0.140*** | -0.137*** | -0.164*** | -0.170*** | -0.172*** | -0.162*** |
| | (0.0310) | (0.0297) | (0.0329) | (0.0350) | (0.0355) | (0.0343) |
| Constant | -3.685 | -2.974 | -1.161 | -0.133 | -2.379 | -2.162 |
| | (3.398) | (3.583) | (4.097) | (4.713) | (3.821) | (3.951) |
| Macro-region F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Time F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 768 | 768 | 757 | 757 | 768 | 768 |
| Overall R2 | 0.8650 | 0.8654 | 0.8432 | 0.8447 | 0.8478 | 0.8478 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The coefficients of the spatially-lagged variables suggest that exposure to interregional knowledge flows *is* of relevance to processes of innovation in the less

developed regions of Europe. More specifically, there is evidence of a positive and statistically significant relationship between regional innovative capacity and exposure to long-distance business enterprise; short- and long-distance higher education[16]; and long-distance government sector R&D knowledge flows, respectively (*Specifications 2, 3, 6*).

The coefficient for tertiary educational attainment is, however, not significant in *Specification 2* which includes the spatially-lagged variable for long-distance business enterprise R&D knowledge flows. This hints at the importance of long-distance business R&D knowledge flows to the innovativeness of Europe's lagging regions. Exposure to short-distance business enterprise and to short-distance government sector R&D spillovers are not robustly linked to regional innovativeness (*Specifications 1, 5*).

*More developed regions*

As is very much the case in the North American context, there are a number of similarities between the set of factors that governs processes of innovation in Europe's more developed regions and that which explains the innovative capacity of their more economically disadvantaged neighbours. Once again, however, these similarities are matched by several significant differences. *Table 1.4* presents the estimation results for Europe's more developed regions.

In terms of similarities, business R&D expenditure is the only type of R&D expenditure that is consistently significantly linked to patent intensity in both contexts (*Specifications 1, 2*). Regional innovativeness in lagging and non-lagging regions alike is also found to be positively and significantly associated with the percentage of adults with a tertiary education and with regional population density (*Specifications 1-6*). Similarly, the negative relationship between the youthfulness of a region's population and its innovativeness that was observed in the continent's less developed regions is visible in its more developed ones as well (*Specifications 1-6*).

[16] The relationship between regional patent propensity and exposure to long-distance higher education knowledge flows is statistically significant in specifications in which levels of business enterprise R&D are controlled for.

Exposure to longer-distance business enterprise and longer-distance government sector R&D knowledge flows is also positively and significantly linked to regional innovation in both environments (*Specifications 2, 6*). Short-distance business enterprise and short-distance government sector R&D knowledge spillovers are not robustly linked to the generation of patents in either type of region (*Specifications 1, 5*).

A number of important differences, however, emerge between Europe's lagging and non-lagging regions. First, the coefficient of the short-distance higher education R&D knowledge spillover variable is negative and statistically significant for more developed areas (*Specification 3*). This suggests that Europe's more economically developed regions may be drawing knowledge resources away from neighbouring areas. Relatedly, there is no indication of a statistically significant relationship between exposure to longer-distance higher education R&D knowledge flows and regional innovative output in Europe's more economically advanced regions (*Specification 4*).

Second, the mobilisation of human capital – proxied by the unemployment rate – is significantly linked to regional innovative capacity in Europe's more developed regions but not in lagging ones (*Specifications 1-6*). Finally, the significant and positive relationship between industrial employment and patenting observed in the Europe's lagging regions does not hold in richer areas (*Specifications 1-6*).

*Table 1.4. Europe's more developed regions*

| | Europe, more developed regions | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GDP per capita (ln) | 0.161 | 0.171 | -0.0990 | -0.0905 | -0.0908 | -0.0666 |
| | (0.195) | (0.196) | (0.240) | (0.233) | (0.245) | (0.241) |
| Business enterprise R&D (BERD) (ln) | 0.266*** | 0.269*** | | | | |
| | (0.0733) | (0.0754) | | | | |
| Higher education R&D (HERD) (ln) | | | -0.0577 | -0.0594 | | |
| | | | (0.0597) | (0.0597) | | |
| Government sector R&D (GOVERD) (ln) | | | | | 0.0184 | 0.0379 |
| | | | | | (0.0382) | (0.0306) |
| Spatially-lagged BERD (contiguity) (ln) | 0.0237 | | | | | |
| | (0.0565) | | | | | |
| Spatially-lagged BERD (inverse) (ln) | | 0.510** | | | | |
| | | (0.222) | | | | |
| Spatially-lagged HERD (contiguity) (ln) | | | -0.0767* | | | |
| | | | (0.0448) | | | |
| Spatially-lagged HERD (inverse) (ln) | | | | -0.703 | | |
| | | | | (0.475) | | |
| Spatially-lagged GOVERD (contiguity) (ln) | | | | | 0.0941 | |
| | | | | | (0.0850) | |
| Spatially-lagged GOVERD (inverse) (ln) | | | | | | 0.810* |
| | | | | | | (0.483) |
| Tertiary educational attainment | 0.0167*** | 0.0166*** | 0.0201*** | 0.0197*** | 0.0162** | 0.0167** |
| | (0.00568) | (0.00572) | (0.00741) | (0.00746) | (0.00674) | (0.00666) |
| Unemployment rate | -0.0157* | -0.0152* | -0.0138* | -0.0137* | -0.0159* | -0.0166** |
| | (0.00816) | (0.00813) | (0.00827) | (0.00833) | (0.00854) | (0.00837) |
| Employment in industry | 0.00760 | 0.00801 | 0.00792 | 0.00845 | 0.00818 | 0.00880 |
| | (0.00596) | (0.00574) | (0.00638) | (0.00633) | (0.00649) | (0.00646) |
| Population density (ln) | 0.105* | 0.110** | 0.163*** | 0.165*** | 0.172*** | 0.152** |
| | (0.0539) | (0.0526) | (0.0561) | (0.0552) | (0.0599) | (0.0611) |
| Percentage of the population aged 15-24 | -0.0725*** | -0.0641*** | -0.0998*** | -0.0996*** | -0.100*** | -0.0947*** |
| | (0.0172) | (0.0168) | (0.0207) | (0.0202) | (0.0206) | (0.0199) |
| Constant | 2.904 | 2.674 | 5.493** | 4.749** | 5.850** | 6.722*** |
| | (1.871) | (1.896) | (2.323) | (2.258) | (2.395) | (2.480) |
| Macro-region F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Time F.E. | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 888 | 888 | 884 | 888 | 888 | 888 |
| Overall R2 | 0.8413 | 0.8412 | 0.7564 | 0.7637 | 0.7588 | 0.7482 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

### 1.5.3. Comparing the lagging regions of North America and Europe

Are the drivers of innovation in North America's lagging regions the same as those at work in their European counterparts? The following section uses the empirical analysis to compare the factors that govern processes of innovation in the economically disadvantaged regions of North America and Europe.

Overall, the empirical analysis confirms the second hypothesis forwarded in *Section 1.2*: that innovation processes in North America's and Europe's lagging regions are far from identical and are governed by distinctly different combinations of factors. The few similarities between the territorial dynamics of innovation of the two contexts are *overshadowed* by several not-inconsequential differences.

In the economically disadvantaged regions of North America, processes of innovation are governed by five factors. First, lagging regions in North America display some ability to transform their relatively high levels of investment in higher education R&D activities (*Section 1.3, Figure 1.1, Panel 1B*) into innovative output – a process that is indicative of a system of university-industry linkages that is more mature in North America (e.g. Rothaermel et al., 2007) than in Europe. These regions are less able to capitalise on local investment in business enterprise R&D functions but are, however, reasonably adept at mobilising knowledge generated by firms in both neighbouring *and* more distant regions and translating it into measureable innovative dynamism. This capacity to do so is attributable, at least in part, to the relatively high levels of public R&D investment documented in *Section 1.3* (*Figure 1.1*, *Panels 1B* and *1C*) that directly enhance the 'absorptive capacities' of these regions (Cohen and Levinthal, 1990; Griffith et al., 2003; 2004; Vogel, 2015). A greater 'absorptive capacity' permits the internalisation and exploitation of knowledge generated beyond a region's borders.

Socioeconomic contextual conditions in North America's lagging regions also influence their respective innovative capacities. Provinces and states with a young and highly skilled population are more innovative. The innovativeness of the North America's economically disadvantaged regions is enhanced by the co-location of

individuals and economic actors – and the knowledge-related externalities associated with agglomeration – as well.

In short, innovation in the lagging regions of North America is a product, most immediately, of the application of basic knowledge generated via local higher education R&D investment *and* the mobilisation of more commercially applicable knowledge from elsewhere by economic actors operating in close physical proximity. These actors are able to draw upon and benefit from a skilled labour force that is continuously invigorated by the entry of younger and perhaps also more creative and dynamic individuals. The result is a set of less developed regions that are decidedly more innovative than their European counterparts.

Innovation in the lagging regions of Europe, on the other hand, is a product of a distinctly different set of influences. Most immediately, economically disadvantaged regions in Europe are capable of translating business enterprise R&D investment into measurable innovation. The challenge for these regions as it relates to R&D expenditure is therefore not necessarily one of exploitation, but rather one of underinvestment. That is, levels of business enterprise R&D investment in the less developed regions of Europe lag significantly behind not only those of both continents' more developed regions, but also those of their lagging counterparts in North America (*Section 1.3*, *Figure 1.1*, *Panel 1A*). This implies that any facility Europe's lagging regions have for the mobilisation of business R&D activities is largely wasted – or certainly under exploited – due to chronic underinvestment in these functions. The relative absence of dynamic firms capable of investing in R&D in the economically disadvantaged regions of Europe should therefore be seen as a serious handicap for the generation of innovation in these territories. This problem is compounded by a relative inability to mobilise public R&D expenditure, especially in contexts where business R&D is of an insufficient level.

Moreover, underinvestment in R&D activities is not confined to the private sector in the Europe's lagging regions – average levels of both higher education and government sector R&D expenditure in these regions are below those of their more developed European neighbours as well as those of both the lagging and non-lagging regions of North America (*Section 1.3*, *Figure 1.1*, *Panels 1B* and *1C*).

Underinvestment in R&D is, however, by no means the only factor curtailing innovation in Europe's lagging regions. In Europe, as in North America, access to a well-developed pool of human capital is conducive to innovation, as are the externalities associated with the co-location of individuals, firms and other actors. But, in contrast to North America's economically disadvantaged regions, lagging regions in Europe are less able to mobilise the skills of their young – the best educated age group. Persistently high levels of youth unemployment – youth unemployment in, for example, Greece, Spain and Italy stood at 45%, 39% and 31.6%, respectively, in 2014[17] – limit the 'absorptive capacity' and, in turn, innovative potential of Europe's lagging regions in ways which are not evident in North America. Certain industrial compositions may also serve as barriers to innovation in these regions – a phenomenon that was less visible in their economically disadvantaged counterparts in North America. The influence of their industrial compositions on innovativeness is, however, negligible when the level of business R&D is sufficiently high.

Europe's lagging regions have, against the odds, developed some capacity to exploit externally generated knowledge. They are capable of drawing upon the knowledge generated by the higher education R&D activities of their immediate neighbours and the public *and* private R&D activities occurring in more distant regions. Their capacity for the mobilisation of longer-distance higher education R&D spillovers does, however, appear to be highly contingent on levels of local business enterprise R&D investment and the 'absorptive capacity' they foster. It would seem, at least in some respects, that less developed regions in Europe draw more heavily upon their more distant neighbours – at least in terms of the scope of the knowledge they source – than their North American counterparts. That is to say, processes of innovation in Europe's lagging region are shaped, to some extent, not only by exposure to business enterprise R&D knowledge flows emanating from more distant regions as is the case in North America, but also by exposure to longer-distance government sector R&D knowledge flows, and perhaps also longer-distance higher education R&D knowledge flows, though the empirical evidence is less robust for the latter.

[17] Eurostat Employment and Unemployment (Labour Force Survey) Database

That Europe's lagging regions seem to benefit primarily from the R&D activities of firms and economic actors *in more distant locations* is likely a product not only of chronically low levels of all types of R&D investment in these regions (*Section 1.3*, *Figure 1.1*) that give rise to a need for externally generated knowledge, but also of the spatial distribution of lagging regions in Europe. That is, patterns of economic disadvantage in Europe are generally consistent with patterns of geographic peripherality, meaning that a lagging region in Europe is most immediately geographically proximate to other lagging regions. This stifles the extent to which they can rely on their closest neighbours as sources of knowledge. North America's less developed regions, despite their greater physical size, tend, by contrast, to be more physically proximate to sources of innovation, allowing those states and provinces with suitably deep pools of skills to benefit from spillovers emanating from proximate innovation cores. Pools of skilled and knowledgeable workers and a sufficient degree of physical proximity between economic actors do, however, seemingly permit many of Europe's lagging regions to absorb and mobilise knowledge that is being generated in their more geographically distant neighbours. This extra-local knowledge may be acting as a substitute for locally generated knowledge in contexts that struggle to create new economically useful knowledge endogenously and may even be the key to the cultivation of innovation in these types of regions (e.g. Tödtling et al., 2012; Fitjar and Rodríguez-Pose, 2011a,b; Grillitsch and Nilsson, 2015; Fitjar and Rodríguez-Pose, 2016).

Finally, the analysis reveals that, despite noticeable differences, lagging regions in North America and Europe behave, from an innovation perspective, more like their respective more developed counterparts than one another. Innovation in North America's less and more developed regions is fuelled by the presence of research universities and by skilled human capital and agglomeration. In Europe, skills and agglomeration are also central for innovation in both types of regions, as is investment in business R&D and exposure to long-distance business enterprise R&D knowledge flows. The R&D of European universities is not, however, associated with higher levels of innovation in its lagging regions or in its more economically developed ones. Moreover, and in contrast to North America, a young population represents more of a barrier than an asset for innovation. In this respect, it would seem that there is greater continuity between the dynamics of innovation at play in the differentially

developed regions that make up a broader economy, be it North America or Europe, then there is between those shaping processes of regional innovation in similarly developed areas spread across different geographic contexts.

## 1.6. Conclusions

This research compared and contrasted the socioeconomic factors that govern processes of innovation in the less developed regions of North America and Europe in an effort to provide systematic, macroeconomic insights that the literature thus far has yet to offer. An econometric investigation of a large sample of North American and European regions was conducted to formulate inferences relating to the factors that govern innovation in the contexts considered.

The analysis showed that the generation of innovative output in North America's lagging regions is most directly linked to regional investment in higher education R&D, the quality of local human capital, the co-location of economic actors and activities, and the youthfulness of the local population. Economically disadvantaged regions in North America also benefit from business enterprise R&D activities occurring in both their immediate and more distant neighbours. In Europe's lagging regions, on the other hand, regional innovative capacity is robustly associated with regional business enterprise R&D expenditure, the availability of sufficiently skilled human capital, an industrially-biased economic structure, and the agglomeration of economic activity. Exposure to interregional knowledge flows is, again, positively linked to regional patent intensity – these regions seem to benefit from long-distance business enterprise and public sector R&D knowledge flows, and from short-distance higher education R&D knowledge flows.

In sum, while there are some not inconsequential similarities between the structural and socioeconomic factors that shape processes of innovation in the economically disadvantaged regions of North America and Europe, there are, as hypothesised in *Section 1.2*, several points of divergence. Most notably, they differ in their respective capacities to transform different types of R&D activities into innovative output and, although they both benefit to a degree from extra-local

innovative activities, there is variation in both the types of knowledge flows they can capitalise upon.

The analysis points in the direction of several related policy implications all of which must be read and interpreted with an appropriate degree of caution in view of the limitations imposed by, among other factors, the availability of suitable data and the spatial units employed in the analysis. Most generally, the analysis provides evidence in support of contextually tailored innovation policies (e.g. Tödtling and Trippl, 2005; Navarro et al, 2009).

The analysis did expose a number of similarities between North America's and Europe's lagging regions that would justify commonalities between the contextually tailored policies that should be implemented in them. Lagging regions – be they in North America, Europe, or possibly elsewhere – that are characterised by larger endowments of skilled human capital and feature the operation of economic actors in close physical proximity are more capable of generating new knowledge and are decidedly more innovative than those that lag behind in terms of their human capital development and within which economic actors and activity are more dispersed and thus less likely to interact. The analysis also offers evidence to suggest that economically disadvantaged regions on either side of the Atlantic have at least some facility for the absorption and exploitation of extra-local knowledge and that this type of knowledge can catalyse innovative activity. It would therefore be reasonable to assert that innovation policies for lagging areas, irrespective of location, should prioritise labour up-skilling and human capital development more broadly. They should also incorporate the development of interregional connections and relationships – so-called "pipelines" (Bathelt et al., 2004) – as a means to import new knowledge to supplement local innovative activities, or perhaps more accurately, to compensate for a lack of them.

Policy-makers must, however, be aware that there will inevitably be certain policy 'levers' available in some economically disadvantaged contexts – and, for that matter, more economically advanced ones as well – that are not available in others. There is, for example, considerable cross-regional variation in the capacity to transform and capitalise upon different types of R&D. Similarly, not all interregional

knowledge flows and non-local connections operate in the same way or offer the same benefit for different lagging regions in different geographic contexts. Policy-makers need to recognise this latter phenomenon. They should, in turn, attempt, through the engagement of and consultations with local actors – a cornerstone, in fact, of bottom-up, territorial specific policy-making – to identify the types of extra-local connections and relationships – be they with actors in academia, the private sector or the public sphere – from which local innovators garner the greatest benefit. Resources should then be channelled accordingly.

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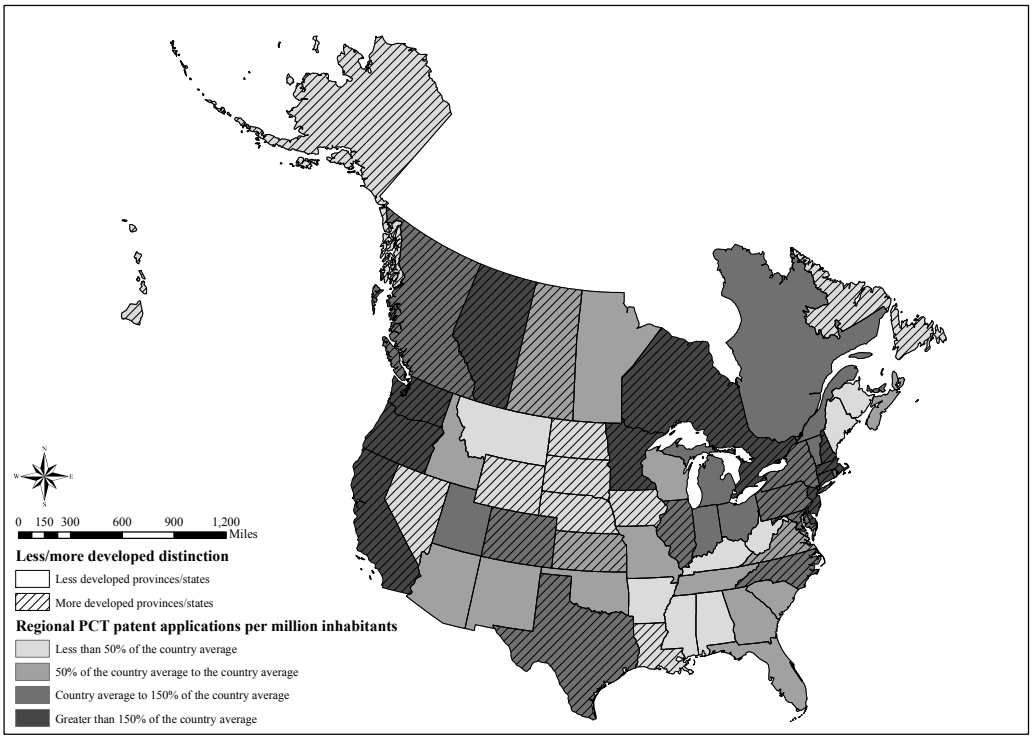
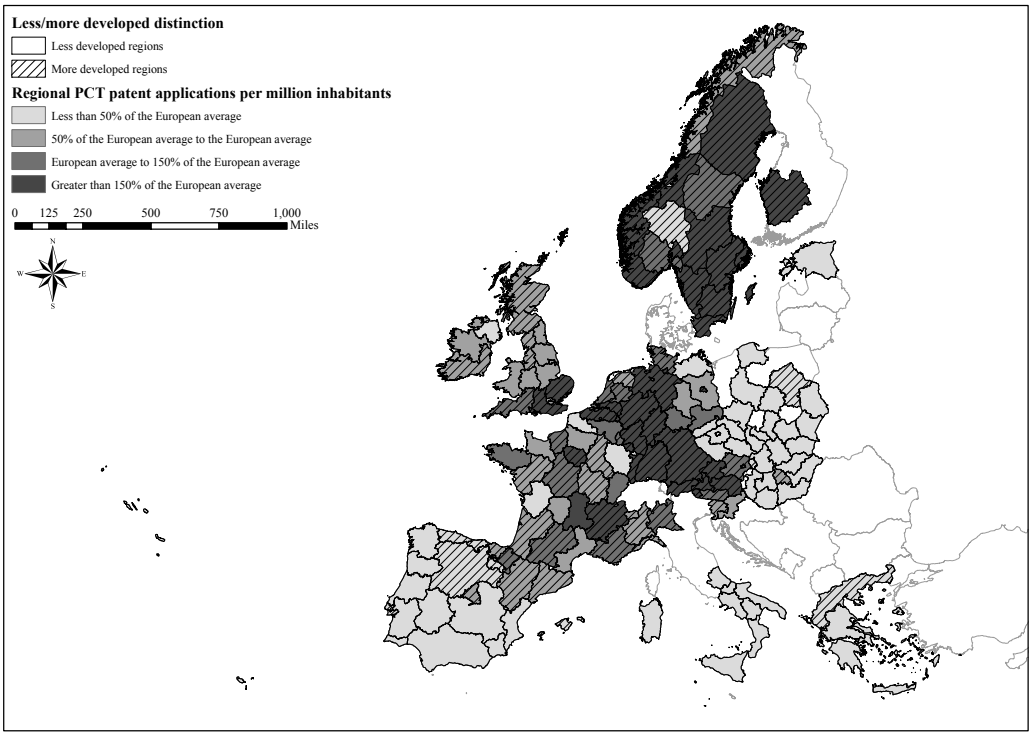
Appendix 1: Innovation in the less and more developed regions of North America and Europe, 2010



# Appendix 2. Europe's less developed regions

BE3: Wallonia
CZ02: Central Bohemian
CZ03: Southwest
CZ04: Northwest
CZ05: Northeast
CZ06: Southeast
CZ07: Central Moravia
CZ08: Moravia-Silesia
DE4: Brandenburg
DE8: Mecklenburg-
DED: Saxony
DEE: Saxony-Anhalt
DEG: Thuringia
EE00: Estonia
ES11: Galicia
ES42: Castile-La Mancha
ES43: Extremadura
ES52: Valencia
ES61: Andalusia
ES62: Murcia
FR22: Picardy
FR25: Lower Normandy
FR30: Nord-Pas-de-Calais
FR41: Lorraine
FR43: Franche-Comté
FR52: Brittany
FR53: Poitou-Charentes
FR63: Limousin
FR72: Auvergne
FR81: Languedoc-Roussillon
GR1: Northern Greece
GR2: Central Greece
GR4: Aegean Islands and Crete
HU21: Central Transdanubia
HU22: Western Transdanubia
HU23: Southern Transdanubia
HU31: Northern Hungary
HU32: Northern Great Plain
HU33: Southern Great Plain
IE01: Border, Midland and
ITF1: Abruzzo
ITF2: Molise
ITF3: Campania
ITF4: Apulia
ITF5: Basilicata
ITF6: Calabria
ITG1: Sicily
ITG2: Sardinia
PL11: Lodzkie
PL21: Lesser Poland
PL22: Silesia
PL31: Lublin Province
PL32: Podkarpacia
PL41: Greater Poland
PL51: Lower Silesia
PL63: Pomerania
PT11: North
PT15: Algarve
PT16: Central Portugal
PT18: Alentejo
PT20: Azores
SI01: Eastern Slovenia
SK02: West Slovakia
SK03: Central Slovakia
SK04: East Slovakia
UKC: North East England
UKE: Yorkshire and The
UKF: East Midlands
UKG: West Midlands
UKL: Wales
UKN: Northern Ireland

# Appendix 3. Europe's more developed regions

AT12: Lower Austria
AT13: Vienna
AT21: Carinthia
AT22: Styria
AT31: Upper Austria
AT32: Salzburg
AT33: Tyrol
BE1: Brussels Capital Region
BE2: Flemish Region
CZ01: Prague
DE1: Baden-Württemberg
DE2: Bavaria
DE3: Berlin
DE5: Bremen
DE6: Hamburg
DE7: Hesse
DE9: Lower Saxony
DEA: North Rhine-Westphalia
DEB: Rhineland-Palatinate
DEC: Saarland
DEF: Schleswig-Holstein
ES12: Asturias
ES13: Cantabria
ES21: Basque Country
ES22: Navarra
ES23: La Rioja
ES24: Aragon
ES30: Madrid
ES41: Castile and León
ES51: Catalonia
ES53: Balearic Islands
FI19: Western Finland
FR10: Ile de France
FR21: Champagne-Ardenne
FR23: Upper Normandy
FR24: Centre (FR)
FR26: Burgundy
FR42: Alsace
FR51: Pays de la Loire
FR61: Aquitaine
FR62: Midi-Pyrénées
FR71: Rhône-Alpes
FR82: Provence-Alpes-Côte
GR3: Athens
HU10: Central Hungary
IE02: Southern and Eastern
ITC1: Piedmont
ITC2: Aosta Valley
ITC3: Liguria
ITC4: Lombardy
LU00: Luxembourg
NL1: North Netherlands
NL2: East Netherlands
NL3: West Netherlands
NL4: South Netherlands
NO01: Oslo and Akershus
NO02: Hedmark and Oppland
NO03: South-Eastern Norway
NO04: Agder and Rogaland
NO05: Western Norway
NO06: Trøndelag
NO07: Northern Norway
PL12: Mazovia
PT17: Lisbon
PT30: Madeira
SE11: Stockholm
SE12: East Middle Sweden
SE21: Småland with Islands
SE22: South Sweden
SE23: West Sweden
SE31: North Middle Sweden
SE32: Central Norrland
SE33: Upper Norrland
SI02: Western Slovenia
SK01: Bratislava Region
UKD: North West England
UKH: East of England
UKI: Greater London
UKJ: South East England
UKK: South West England
UKM: Scotland

## Appendix 4. North America's less developed regions

CA11: Prince Edward Island
CA12: Nova Scotia
CA13: New Brunswick
CA24: Quebec
CA46: Manitoba
US01: Alabama
US04: Arizona
US05: Arkansas
US12: Florida
US13: Georgia
US16: Idaho
US18: Indiana
US21: Kentucky
US23: Maine
US26: Michigan
US28: Mississippi
US29: Missouri
US30: Montana
US35: New Mexico
US39: Ohio
US40: Oklahoma
US45: South Carolina
US47: Tennessee
US49: Utah
US50: Vermont
US54: West Virginia
US55: Wisconsin

## Appendix 5. North America's more developed regions

CA10: Newfoundland and
CA35: Ontario
CA47: Saskatchewan
CA48: Alberta
CA59: British Columbia
US02: Alaska
US06: California
US08: Colorado
US09: Connecticut
US10: Delaware
US11: District of Columbia
US15: Hawaii
US17: Illinois
US19: Iowa
US20: Kansas
US22: Louisiana
US24: Maryland
US25: Massachusetts
US27: Minnesota
US31: Nebraska
US32: Nevada
US33: New Hampshire
US34: New Jersey
US36: New York
US37: North Carolina
US38: North Dakota
US41: Oregon
US42: Pennsylvania
US44: Rhode Island
US46: South Dakota
US48: Texas
US51: Virginia
US53: Washington
US56: Wyoming

# Appendix 6. Variables used in the analysis

| **Variables (Europe)** | | **Source** |
|---|---|---|
| Innovative output | PCT patent applications per million inhabitants | *OECD Regional Database* |
| Regional R&D expenditure | Business enterprise R&D expenditure as % of GDP | *OECD Regional Database* |
| | Higher education R&D expenditure as % of GDP | *OECD Regional Database* |
| | Government sector R&D expenditure as % of GDP | *OECD Regional Database* |
| Availability and use of human capital | % of population aged 25-64 with a tertiary education | *Eurostat Regional Education Statistics* |
| | Unemployment rate | *OECD Regional Database* |
| Industrial composition | Employment in "industry, including energy" as % of regional employment | *OECD Regional Database* |
| Agglomeration of economic activity | Population density | *OECD Regional Database* |
| Demographics and development | % of population aged 15-24 | *OECD Regional Database* |
| | GDP per capita | *OECD Regional Database* |

*Note: Missing values for independent variables were interpolated linearly where possible. In the case of regional R&D expenditure, a regional R&D expenditure dataset prepared by Tobias Ketterer was used to replace missing values when reasonable linear interpolation was not possible. Missing values for the dependent variable (PCT patent applications) were not interpolated. Data availability constraints necessitated the use of statistics that correspond to the ISIC rev. 3 classification 'industry, including energy' for the years 2008-2008 and the use of statistics that correspond to the ISIC rev. 4 classification for 'industry, including energy' for the years 2009 and 2010.*

| **Variables (North America)** | | **Source** |
|---|---|---|
| Innovative output | PCT patent applications per million inhabitants | *OECD Regional Database* |
| Regional R&D expenditure | Business enterprise R&D expenditure as % of GDP | *OECD Regional Database* |
| | Higher education R&D expenditure as % of GDP | *OECD Regional Database* |
| | Government sector R&D expenditure as % of GDP | *OECD Regional Database* |
| Availability and use of human capital | % of labour force with a tertiary education | *OECD Regional Database* |
| | Unemployment rate | *OECD Regional Database* |
| Industrial composition | Employment in "industry, including energy" as % of regional employment | *OECD Regional Database* |
| Agglomeration of economic activity | Population density | *OECD Regional Database* |
| Demographics and development | % of population aged 15-24 | *OECD Regional Database* |
| | GDP per capita | *OECD Regional Database* |

# 2. INNOVATING IN LAGGING CITIES: A COMPARATIVE EXPLORATION OF THE DYNAMICS OF INNOVATION IN CHINESE CITIES

## 2.1. Introduction

Recent decades have seen China become an important participant in the global knowledge economy (OECD, 2009; Griffith and Miller, 2011; Fan, 2014; Woetzel et al., 2015; Rodríguez-Pose and Wilkie, 2016). Its economy is transforming from one based on low cost, low value added manufacturing activities to one increasingly reliant not only on the manufacturing of higher-value added, more sophisticated goods, but also on the generation of the knowledge and intellectual property that underpin it (Zhao and Yang, 2012; Leifner and Wei, 2014; Fu, 2015; McGilvray, 2016). Moreover, the importance of innovation in the Chinese context is unlikely to wane. China has been, and remains, one of the world's fastest growing economies. There are signs, however, that growth is beginning to slow as China completes its transition from a developing country to an emerging one (Gu et al., 2016; Eichengreen et al., 2017; World Bank, 2017). The extent to which this slowdown can be averted, and the economy's growth rates can be maintained will depend, in part, on its capacity to cultivate innovation and unlock the productivity gains associated with doing so (Fan, 2014; Woetzel et al., 2015; Fu, 2015; Gu et al., 2016; Lewin et al. 2016).

All of that said, there is considerable variation in the extent to which different territories – cities in particular – have participated in and benefitted from the expansion of the country's knowledge economy. Innovation in China is highly territorialised. The lion's share of the country's innovative activity is concentrated in its more economically developed regions and cities (e.g. Sun, 2000; Sun 2003; Yuan, 2005; Li, 2009; Crescenzi et al., 2012; Fan et al., 2012; Leifner and Wei, 2014; Fu, 2015; Rodríguez-Pose and Wilkie, 2016; Wang and Li, 2016). This geographic polarisation could prove problematic: innovation imbalances could entrench, if not exacerbate, already-pronounced disparities in wealth and economic performance between China's

more and less developed cities (Howells, 2005; Fu, 2015; Liu and Lawell, 2015; Zhou and Song, 2016).

These innovation imbalances can therefore not go unaddressed. There is a need for policy-makers to devise ways to bolster the innovative capacity of China's more developed, 'core' cities whilst also upgrading the innovative potential of its less developed ones. 'Spatially-targeted', contextually specific approaches, because of the way and extent to which processes of innovation are shaped by the specificities and characteristics of the territories in which they unfold (e.g. Crescenzi and Rodríguez-Pose, 2012), represent the only avenue for achieving both of these ends.

The development of a nuanced understanding of the factors that drive and shape processes of innovation in China's more and less developed cities is prerequisite to the design of innovation strategies for them (e.g. Tödtling and Trippl, 2005:1216). It is this understanding that the research aims to provide. It is guided by two research questions. The first relates to identifying the factors that govern processes of innovation in, on the one hand, China's more economically developed cities and, on the other, its less developed ones. The second question is a natural extension of the first. It asks whether – and if so, how – the 'dynamics of innovation' differ between the two types of cities.

The novelty of the chapter is derived from the comparative perspective it adopts and the territorial unit of analysis it employs. An explicit focus on processes of innovation in China's less developed cities is, so far as I am aware, unique to this research. Underdeveloped environments in China are *not* wholly incapable of generating innovative output. How they manage to do so, however, is not sufficiently understood; the presumption that they are distinctly 'un-innovative' coupled with a preoccupation with the success stories that are China's technological hubs has led to their neglect. This chapter represents an effort to fill this void and shed light on the mis-, or at least, insufficiently-understood processes of innovation that are unfolding in China's economic periphery. Moreover, preceding research of this nature has been conducted almost exclusively at the province-level (Li et al., 2016). My research eschews this provincial-level focus for an urban one that renders it able to capture the oft-overlooked internal heterogeneity by which Chinese provinces are characterised.

Accordingly, the inferences derived from the econometric analysis are more granular than those offered by existing literature.

The contributions of the chapter can therefore be summarised as follows: it offers insights into processes of innovation in China's more *and* less developed cities that previous research is yet to provide.[18] In doing so, the chapter exposes the policy 'levers' that need be pulled to stimulate innovation across the spectrum of Chinese cities and, in turn, provides policy-makers with a sense of how efforts to promote innovative activity in China's economically disadvantaged environments should differ from those undertaken in its more economically advanced ones.

The analysis, which focuses on a sample of 283 Chinese cities between 2003 and 2014 reveals that China's more developed cities feature innovation systems that are more complex, integrated and, ultimately, mature than those of their less developed counterparts. China's more developed cities mobilise knowledge inputs – the knowledge generated by local and extra-local R&D activities and human capital – with comparative efficiency. Their innovative capacities are underpinned by agglomeration externalities and their industrially-biased economic fabrics while those of their less developed counterparts rely merely on the ready availability of physical infrastructure. Moreover, the country's more developed cities appear to be reaping the innovative benefits of a range of knowledge resource-related synergies that are yet to materialise or mature in its less developed cities.

The remainder of the chapter is structured as follows: *Section 2.2* explores the geography of the Chinese knowledge economy before introducing the motivations for and the questions that guide the research. *Section 2.3* explores the heterogeneity of China's more and less developed cities via a taxonomic analysis of descriptive figures. *Section 2.4* outlines the methodology employed to answer the research questions. *Section 2.5* presents and offers a more comprehensive discussion of the results of the econometric analysis. *Section 2.6* concludes.

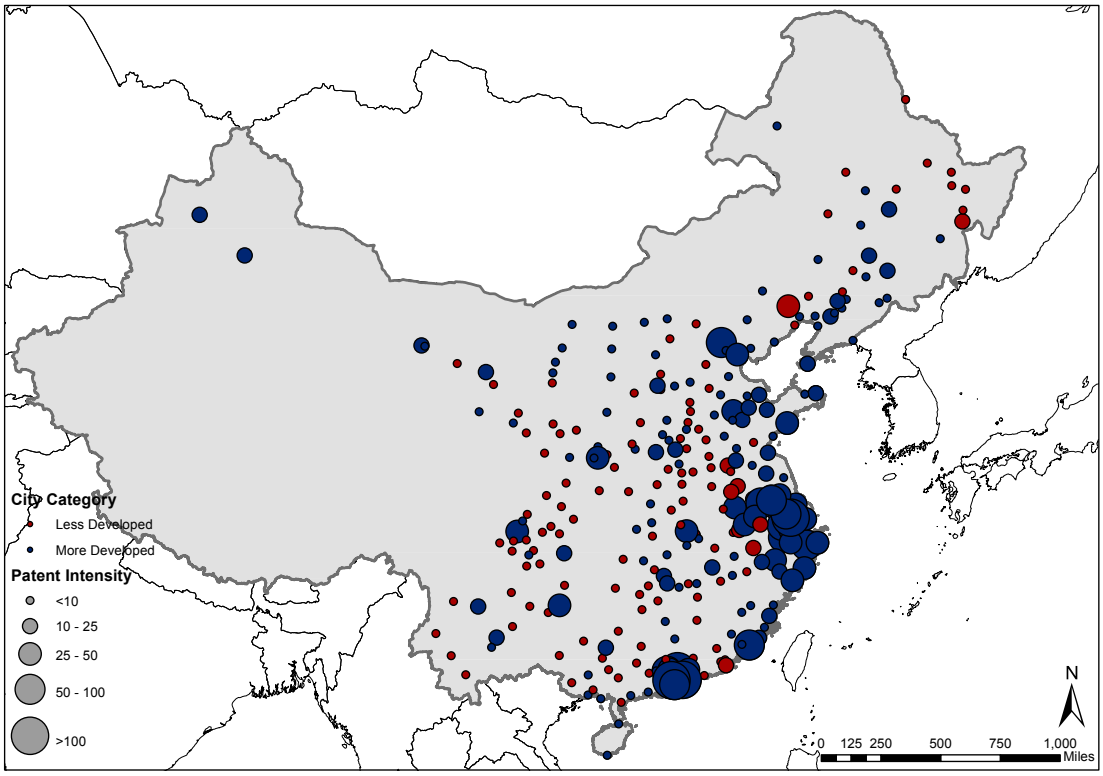
[18] Fu (2015:8), for example, observes that "comprehensive and systematic analyses of China's overall strategy, drivers and outcomes are rare with very few exceptions".

## 2.2. Innovation in Chinese cities

### 2.2.1. The territorialisation of innovation in China

The spatial distribution of innovation in China is far from equitable. The extent of this polarisation is captured by *Figure 2.1* which depicts the number of patent applications produced per capita by Chinese cities in 2014.[19] Two related inferences are drawn from *Figure 2.1*.

*Figure 2.1. Patent applications per 10,000 inhabitants, 2014*




**Author's elaboration**

First, there is considerable intra-national variation in the innovative capacities of Chinese cities. Different cities have participated to different extents in the country's rise to innovative prominence. A handful of Chinese cities, most of which are situated in the country's more economically developed eastern or coastal provinces, stand out as especially innovative. Shenzhen, Zhongshan, Dongguan and Suzhou – all of which

[19] The suitability of patent statistics as a proxy for innovation/innovative capacity is addressed in *Section 2.4.2.1.*

are located on the eastern seaboard – produced more than 120 patent applications per 10,000 inhabitants in 2014. In absolute terms, Beijing and Shanghai were responsible for over ten percent of the country's patent applications. At the other end of the spectrum, the interior cities of Zhoukou (0.45 patent applications per 10,000 inhabitants), Ulanqab (0.35) and Zhaotong (0.30), among others, struggle, in both absolute and relative terms, to keep pace with their more 'innovation prone' counterparts and produce innovative output.

The second inference relates to how China's innovative activities are spread across its more and less economically developed cities. *More developed cities are, for the purposes of the analysis, defined as those whose GDP per capita exceeds 75% of the national average. Less developed cities, on the other hand, are those whose GDP per capita falls below this threshold.* The development of this conceptualisation and the separation of more developed cities from their less developed counterparts, more generally, is a product of necessity; if the territorial dynamics of innovation at play in China's more and less economically developed cities, respectively, are to be probed and explicitly contrasted, the 283 cities by which the sample is composed must be categorised as such.[20] More and less economically developed cities are, in *Figure 2.1*, marked by blue and red dots, respectively.

China's less developed cities, while not devoid of innovative activity, are far less innovative than their more developed counterparts. In 2014, 47 of the 50 (and 87 of the 100) most innovative cities in China were classified as more economically developed. Six of these more developed cities – Beijing, Suzhou, Shanghai, Shenzhen, Chengdu and Hangzhou – produced over a quarter of China's total innovative output and, of the 19 cities that generated over half of the country's patent applications, all but one qualifies as more developed. Moreover, almost half of China's more economically developed cities registered more than 10 patent applications per 10,000 inhabitants in 2014. Less than a tenth of its less developed ones, on the other hand,

[20] Any effort to categorise cities as 'more' or 'less' economically developed will be subject to debate and scrutiny. It is for this reason that I have employed a conceptualisation of 'less developed' that is relied upon by authorities elsewhere in the world and is one that enjoys some semblance of more widespread acceptance; "Less Developed Regions" in the European Union are also understood as those whose GDP per capita falls below 75% of the EU average.

managed to do so and only one, Chaoyang, located in the province of Liaoning and proximate to its capital, produced more than 20.

The implications of this polarisation and of the innovation averseness of China's less economically developed cities are not insignificant. There are two of particular note. First, the socioeconomic divide between China's more and less developed cities will continue to widen if the innovative capacities of its less developed ones are not upgraded and innovation remains a 'developed city phenomenon'. Innovation is a driver of economic growth and development (e.g. Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1994). The territorialisation of innovative activity, in China or otherwise, is therefore tantamount to the territorialisation of potential for economic growth (Howells, 2005). China's already more economically developed cities are, because of their more robust innovative capacities (*Figure 2.1*), also better positioned for the pursuit and achievement of competiveness, economic growth and dynamism than their less developed counterparts. Spatial inequalities, that are both detrimental to, and inhibitors of, economic growth and dynamism (e.g. Cingano, 2014; Ostry et al., 2014) and catalysts for social discontent, tensions and unrest, will become more and more pronounced as China's more developed cities leverage this innovative potential and outperform their lagging peers.

The second relates to the necessity of boosting the innovative capacities of China's less innovative, less economically developed cities for the achievement of more widespread economic growth. Consensus is beginning to form around the notion that "China needs to evolve…to an innovation leader to sustain GDP growth in the coming decade as other drivers of growth…decline" (Woetzel et al., 2015:ii). Established technological hubs have and will undoubtedly continue to contribute to this drive. Their innovative efforts thus far, as considerable as they have been, have not, however, proven sufficient to arrest the now decade-long decline in the country's growth rate – *more innovation, and the boost to productivity it provides, is needed*. The latent innovation potential of the country's less economically developed cities will have to be tapped to generate knowledge and innovations at a rate and with a frequency that is sufficient to halt this stagnation and reignite economic growth.

Policy-makers are not, it would seem, short incentive to pursue initiatives to upgrade the innovative capacities of China's less developed cities. Shoring up the innovative capacities of its lagging cities is necessary if pervasive spatial dipartites in economic performance are to be addressed, if the gulf between the country's more and less developed cities is to be reduced and if a return to more robust economic growth is to be achieved. The design of the policies and strategies that will be relied upon to do so is predicated on the development of a robust understanding of the factors that shape the innovative capacities of these less developed cities.

*Herein lies the motivation for and relevance of this research.*

### 2.2.2. Innovating in the 'core' and the 'periphery': Do China's less economically developed cities differ from their more developed counterparts?

The spatial patterns revealed in the previous section are consistent with expectation. Innovative activity the world over has a well-documented tendency to concentrate in larger, more economically developed cities and regions (e.g. Feldman and Audretsch, 1999; Bettencourt et al., 2007b; Carlino et al., 2007; Mitra, 2007; Crescenzi et al., 2007; 2012; Liu and Sun, 2009; Fan et al., 2012; Buzzard and Carlino, 2013; Breau et al., 2014; Wang and Li, 2016).

The innovativeness of more developed cities is explicable by several factors. Skilled workers, entrepreneurs and a diversity of firms and public organisations come together in more economically developed cities that tend to be well-endowed with the sorts of infrastructure and resources upon which the aforementioned actors rely (Herman and Ausubel, 1988; Feldman and Florida, 1994; Glaeser, 1999; Acs, 2002; Florida, 2002; Ewers, 2007; Glaeser and Resseger, 2010; Acs et al., 2011; Bosman and Sternberg, 2014; Brinkman, 2014). The concentration and relative abundance of these public and private entities yields a similar concertation of R&D activities and investment that affords these places a facility for the generation of the knowledge and ideas without which innovation is not possible (e.g. Grilliches, 1979; Audretsch and Feldman, 2004). Similarly, the ready availability of skills and human capital renders them capable of transforming this knowledge into more applied innovation (e.g. Griffith et al., 2004; Crescenzi, 2005). Moreover, and perhaps most importantly (e.g.

Storper and Venables, 2004), the co-location of all manner of economic actors lays both the physical and the institutional foundation for the emergence of efficiency enhancing "agglomeration economies" (Duranton and Puga, 2004; Rosenthal and Strange, 2004; Glaeser, 2010) and, more specifically, for the sharing and exchange of knowledge and the other interactive processes that are readily associated with the genesis, diffusion and application of innovation (Gertler, 2003; Bathelt et al., 2004; Storper and Venables, 2004; Rasiah, 2011).

Less economically developed cities, on the other hand, suffer from contextual deficiencies that hamper their innovative potential (e.g. Rodríguez-Pose, 2001). The most fundamental of these relates to the general weakness of their "economic fabrics". The industrial profiles of less developed cities are often dominated by more traditional, technologically unsophisticated sectors where the potential for innovation is scarce. Accordingly, economic actors operating in these environments have little incentive and/or opportunity to invest in R&D or engage in knowledge-intensive activities more generally. This, in turn, curtails the innovative potential the economy as a whole. Further limits are imposed by a characteristic scarcity of human, physical and financial capital that undermines both the generation and application of knowledge in these territories. The socioeconomic deficiencies by which less developed cities are faced are also, in many cases, compounded by geographic ones; many less developed cities are situated beyond the spatial limits of knowledge spillovers emanating from more innovative territories and are thus deprived of an exploitable, and in some cases needed, source of knowledge (e.g. Moreno et al., 2005; Sonn and Storper, 2008; Rodríguez-Pose and Crescenzi, 2008).

These generalisations hold true for the Chinese context. China's more developed cities direct more resources to R&D functions than their less developed counterparts. Their more robust financial commitments to the generation of "new economic knowledge" (Audretsch and Feldman, 2004:2716) are anticipated to lend them a greater capacity to do so. This indispensable 'input' (e.g. Grilliches, 1979; Audretsch and Feldman, 2004) to processes of innovation is, accordingly, more abundant in China's more developed cities than it is in its less developed ones. Skilled human capital is, like the aforementioned 'new economic knowledge', more readily available in these cities as well. Their facility for the mobilisation and productive

application of this knowledge in innovative processes is, in turn, expected to be greater. China's more developed cities are also, on balance, more densely populated than their less developed neighbours. This density of economic actors and activity is prerequisite for, and conducive to, the diffusion, sharing and exchange of knowledge, ideas and innovation, and the emergence of other innovation-enhancing, agglomeration-induced externalities.

Conversely, China's less developed cities suffer from more than a comparative underinvestment in R&D and a relative dearth of human capital, both of which impair their capacity to generate and absorb knowledge; their underlying economic fabrics, in which manufacturing activity features less prominently, are not especially amenable to innovative activity. They are also, as is characteristic of less developed cities, both more sparsely populated and more geographically isolated; while many of China's more developed cities are clustered on the country's east coast, its less developed ones are scattered across the country and without immediately proximate neighbours (*Figure 2.1*). The scope for the realisation of benefit from local *and* extra-local knowledge spillovers is therefore likely more limited.

That China's more economically developed cities host a disproportionate amount of the country's innovative activity is, in that respect, what prevailing theories would predict. *China's less developed cities are not, however, wholly incapable of generating innovation*. As much as innovation in China is a 'developed city phenomenon', it is nonetheless occurring, albeit with less intensity and frequency, in the country's less developed cities (*Figure 2.1*).

That said, it cannot be assumed that the factors and forces behind the innovativeness of China's more developed, innovation-prone cities are identical to those which shape processes of innovation in its less developed ones. Innovative processes, as Crescenzi and Rodríguez-Pose (2012:529) note, "display very differentiated territorial processes in different contexts" in accordance with territories' socioeconomic, institutional and political factors, characteristics, features and attributes. That is, not only are territories that, for example, direct different amounts of resources to R&D, are differentially endowed with human capital or host different types of firms, sectors and industries anticipated to display different innovative

capacities, it is thought that they will actually *generate* innovation in different ways. Contextual similarities between China's more and less developed cities are, as alluded to above and as *Section 2.3* explores and expounds on, few. *It is therefore unlikely that innovative processes in China's less economically developed cities will resemble those unfolding in their more developed counterparts.*

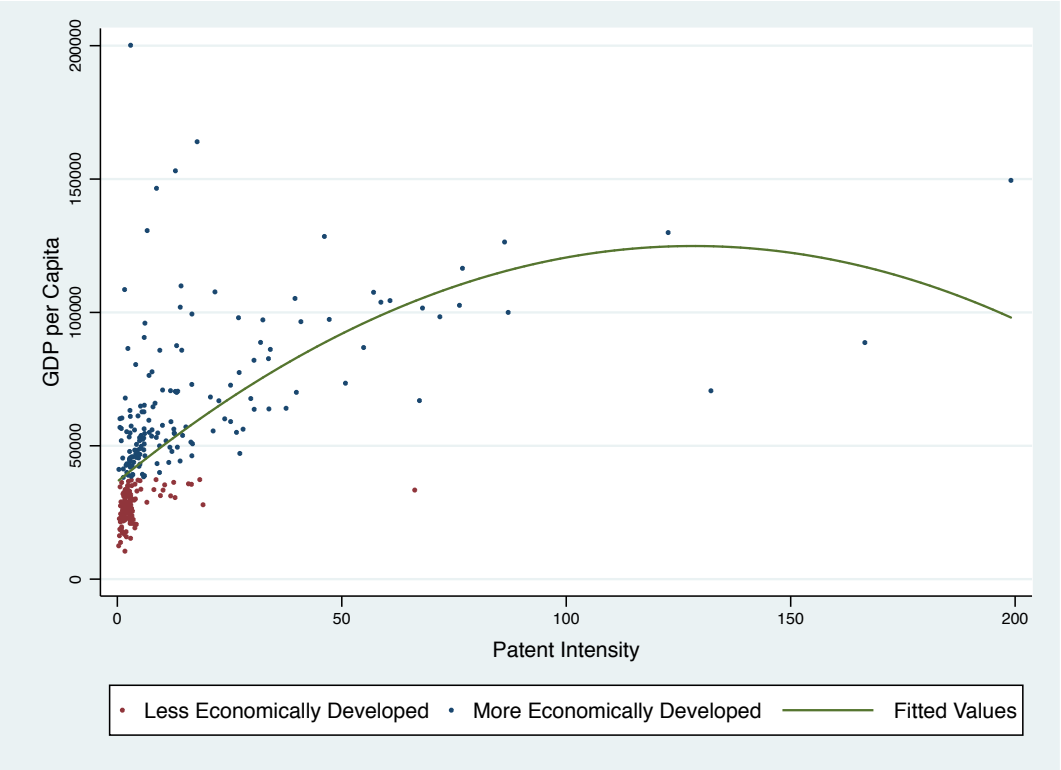
It is from this hypothesis that the chapter's research questions are derived. The overarching aim of the chapter is to contrast the innovative processes hosted by China's more economically advanced cities with those occurring in their less economically developed neighbours with a view to discern how they differ. Two more specific questions guide the analysis: (a) what are the socioeconomic and structural factors that govern processes of innovation in, on the one hand, China's more economically developed cities and, on the other, their less dynamic, developed counterparts? And (b) how do these factors differ between the two types of cities?

## 2.3. Descriptive statistics

Prior to proceeding with the econometric analysis, I consider the heterogeneity of Chinese cities and assess how the country's more economically developed cities differ from their less developed counterparts. The presentation and taxonomic analysis of the descriptive statistics and figures that follows also facilitates the establishment of a cursory understanding of the links between the innovative capacity of China's more and less developed cities and a series of socioeconomic factors and territorial characteristics.

*Figure 2.2* plots patent intensity against GDP per capita. It visualises the key difference between the two types of cities: *China's more developed cities are more innovative than their less developed counterparts*.

*Figure 2.2. Patent applications per 10,000 inhabitants and GDP per capita, 2014*



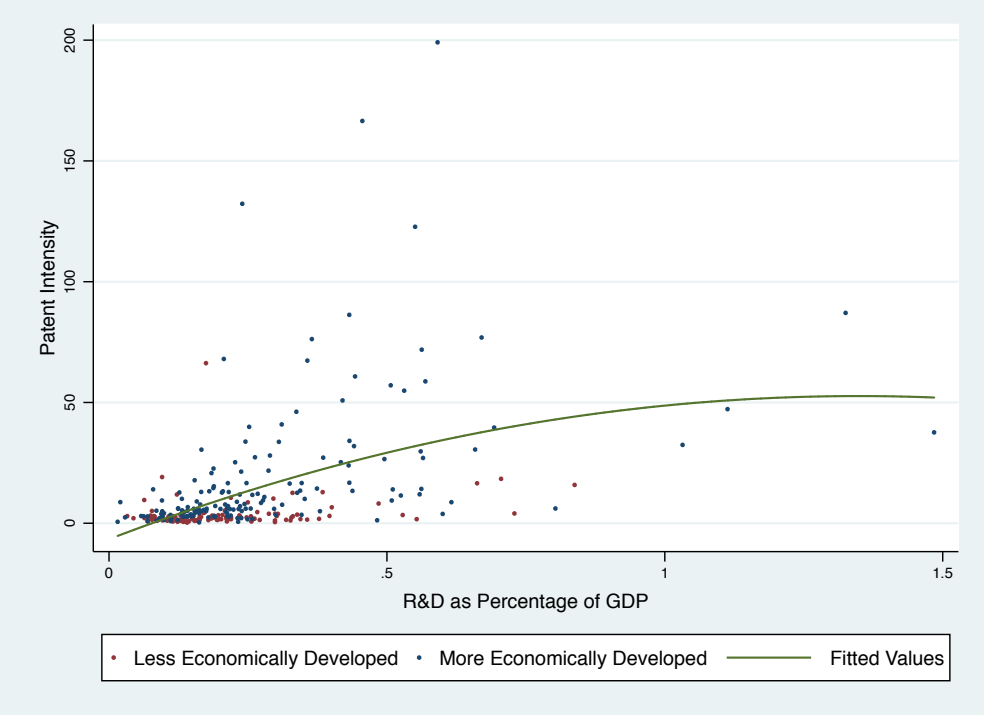

**Author's elaboration**

There is some variation in the innovative capacities of China's more economically developed cities. This variation is itself reflective of the intra-national variation in urban innovative capacities flagged in *Section 2.2*. Less developed cities, on the other hand, are similarly 'innovation averse' and there are next to no 'outliers'. The virtual absence of outliers is indicative of the difficulties less developed cities face cultivating higher-value added, knowledge-intensive activities.

*Figures 2.3* through 2.*8* adopt a slightly different perspective. They do, however, yield similar conclusions.

*Figure 2.3* depicts R&D expenditure as a percentage of GDP against innovative capacity, proxied by patent intensity. Two key inferences emerge. The first is that China's more developed cities channel more resources to knowledge generating activities than their less developed counterparts.

*Figure 2.3. R&D expenditure as a percentage of GDP and patent intensity, 2014*




**Author's elaboration**

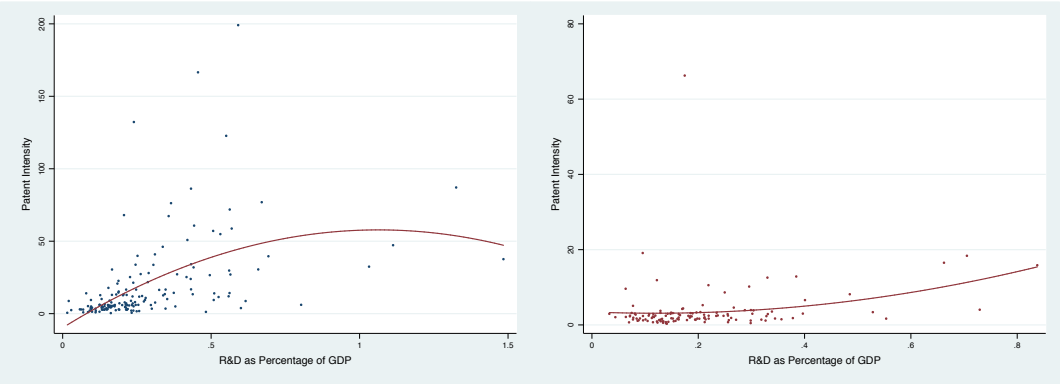
Second, *Figure 2.3* reveals a positive relationship between R&D expenditure and patent intensity. Chinese cities that invest more in knowledge generating functions are, as anticipated by linear models of innovation (e.g. Grilliches, 1979; Godin, 2006; Balconi et al., 2010), more innovative than those that opt not, or are unable, to do so. Deeper analysis, however, reveals that this positive relationship is driven by the country's more developed cities that both invest more in R&D *and* transform it into innovative output more efficiently than their less dynamic counterparts (*Figures 2.4A* and 2.*4B*).

Additional inferences are drawn from the curvature of the trend-lines depicted in *Figures 2.4A* and *B*. The concave trend-line that captures the relationship between R&D expenditure and patenting for China's more developed cities implies that R&D investment in these cities may be subject to diminishing returns (*Figure 2.4A*). *Conversely*, the convex trend-line featured in *Figure 2.4B* suggests that R&D investments in less developed cities may be subject a threshold effect; there appears to be a level below which increases in R&D expenditure yield minimal, if any, returns in less developed environments. Once, however, the threshold is exceeded, there may be increasing returns to be realised from investments in the generation of new knowledge.

These observations, and the former in particular, are consistent with Schumpeterian perspectives on innovation that posit that a critical mass of R&D expenditure must be reached before returns to the investments are realised (e.g. Rodríguez-Pose, 1999; 2001).

*Figure 2.4. R&D expenditure as a percentage of GDP and patent intensity in China's more and less developed cities, 2014*

*A. More developed cities* *B. Less developed cities*

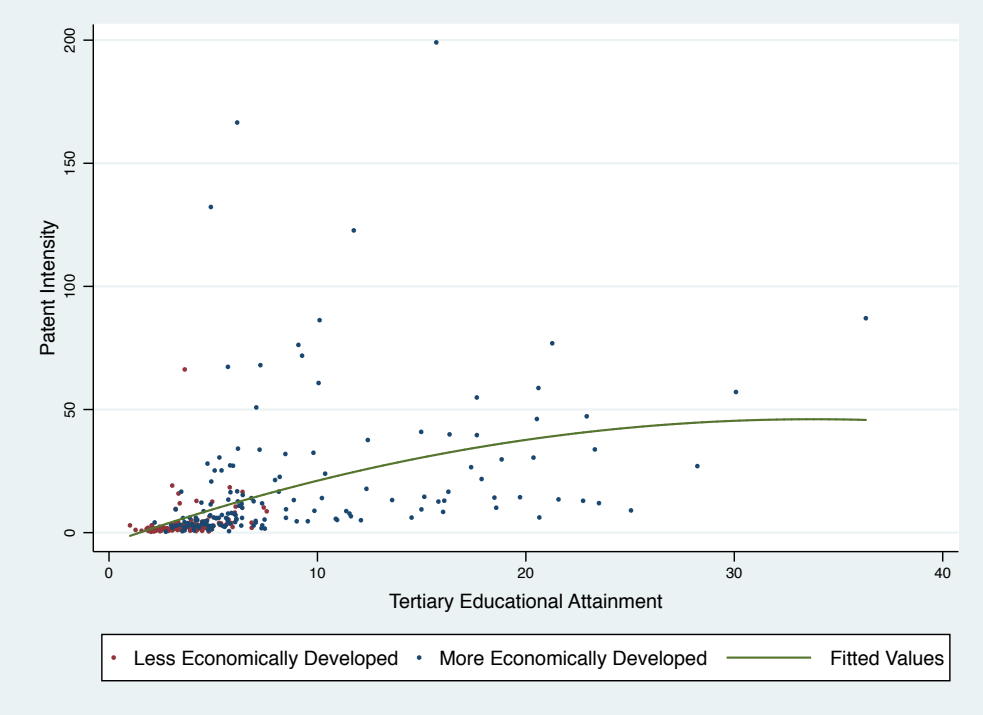



**Author's elaboration**

Similar conclusions are reached about the relationship between the availability of human capital in, and the innovative capacity of Chinese cities. *Figure 2.5* reveals a positive correlation between tertiary educational attainment and patent intensity.

Once again, however, the positive relationship is a function of the strength of the relationship in the country's more developed cities where skilled human capital is more abundant (*Figure 2.6A*). There *is* evidence of a positive relationship between skills endowments and patenting propensity in China's less dynamic regions. It is, however, made apparent by *Figures 2.6A* and *B* that China's more developed cities mobilise their deeper pools of human capital with greater efficiency than their less developed counterparts.

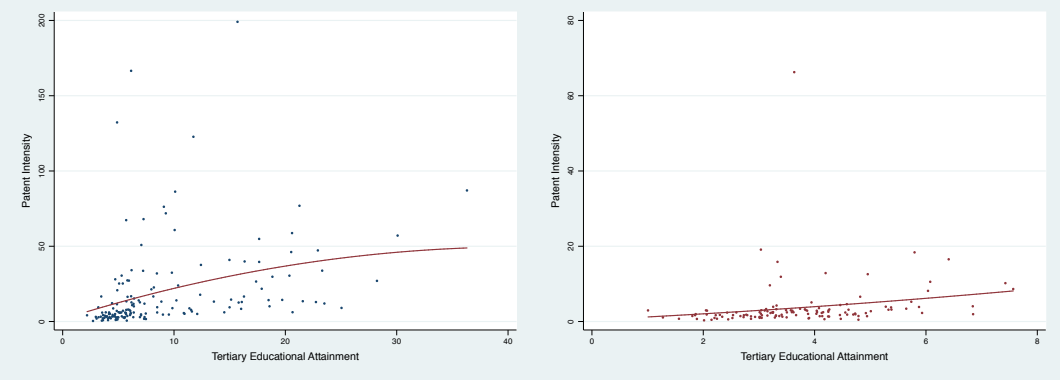
*Figure 2.5. Tertiary educational attainment and patent intensity, 2014*




**Author's elaboration**

*Figure 2.6. Tertiary education attainment and patent intensity in China's more and less developed cities, 2014*

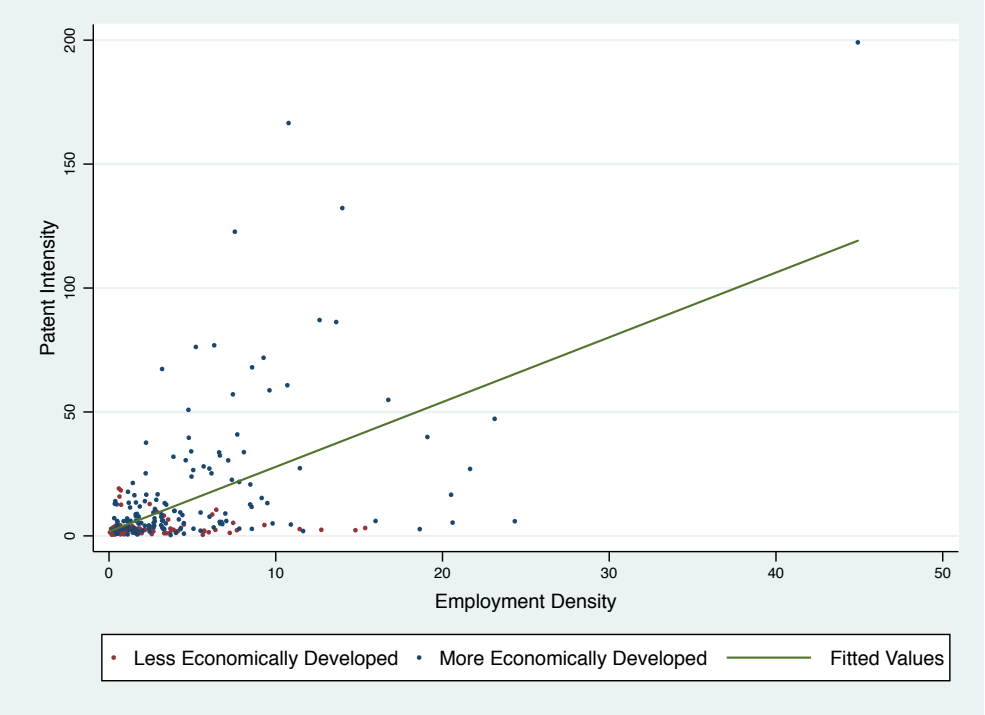
*A. More developed cities* *B. Less developed cities*




**Author's elaboration**

*Figures 2.7* and *2.8*, which plot patent intensity against employment density and employment in manufacturing activities, respectively, fulfil two related purposes.

*Figure 2.7. Employment density and patent intensity, 2014*




**Author's elaboration**

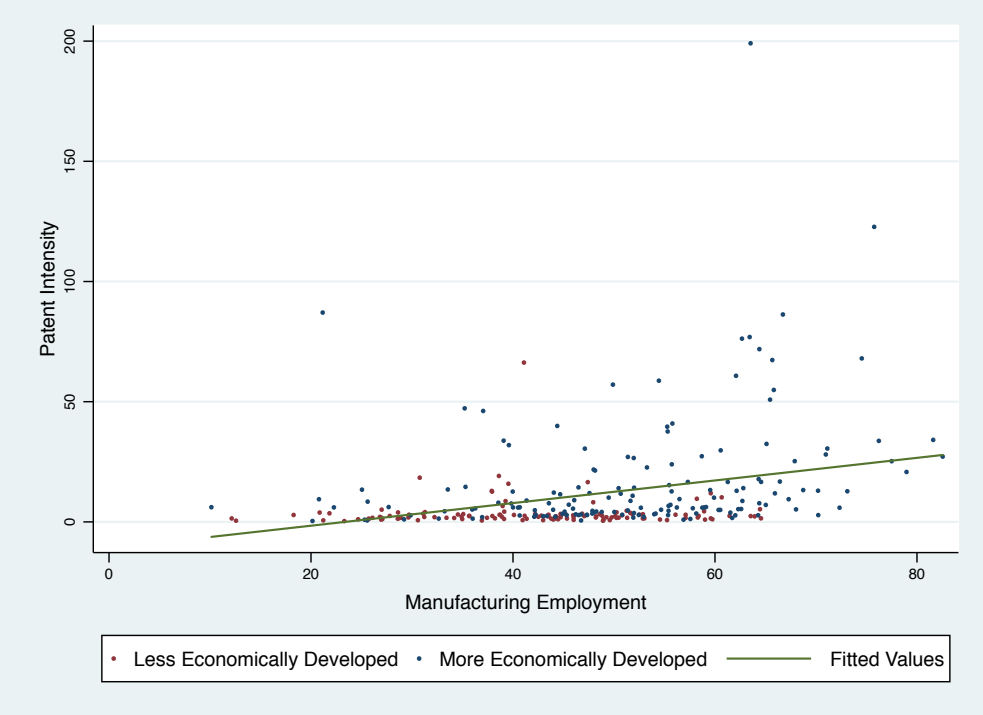
First, they provide further evidence of the heterogeneity of China's more and less developed cities; manufacturing activities are more, albeit marginally, prevalent and account for a greater share of employment (*Figure 2.8*) in China's more economically developed cities that are also more densely populated (*Figure 2.7*).

*Figures 2.7* and *2.8* also suggest that processes of innovation in Chinese cities are shaped by more than just the availability of 'knowledge inputs'. There is evidence that agglomeration may be conducive to innovation in Chinese cities; patent intensity is positively correlated with employment density across the sample of cities. Similarly, higher levels of employment in manufacturing are associated with the generation of innovative output signalling that a city's innovative capacity is not free from influence by its economic fabric or industrial structure.

Taken together, *Figures 2.2* through *2.8* confirm that China's more economically developed cities differ from their less developed counterparts in several fundamental and not inconsequential ways. China's more developed cities invest more in R&D than their less developed counterparts (*Figures 2.3* and *2.4*). They are also endowed with skilled labour forces whose respective capacities for the identification,

internalisation and exploitation of knowledge are greater than those of their less developed neighbours (*Figures 2.5* and *2.6*). Economic actors and activity are situated in closer physical proximity in China's more developed cities as well (*Figure 2.7*) which creates scope for the emergence of innovation-inducing externalities that are less likely to materialise in China's less densely populated, less developed cities. Finally, the economic fabrics by which China's more developed cities are underpinned are, because of relative prevalence of manufacturing activities, marginally more conducive to knowledge-intensive, innovative activity (*Figure 2.8*).

*Figure 2.8. Manufacturing employment and patent intensity, 2014*




**Author's elaboration**

These observations provide an indicative sense of why, as *Figures 2.1* and *2.2* reveal, China's more developed cities are more innovative than their less developed counterparts. The econometric exercise that follows facilitates the testing of these theorisations and the formulation of more robust conclusions in this direction. What remains wholly unaddressed, however, is whether these differences manifest themselves in *the way* these cities generate innovation. The prevailing theoretical discourse suggests they should. Innovation is a contextually-contingent process (e.g. Doloreux and Parto, 2005; Crescenzi and Rodríguez-Pose, 2012); processes of innovation unfold in ways that reflect the socioeconomic, political and institutional

uniqueness of the territories in which they transpire, and the opportunities and challenges that contextual conditions present and impose (e.g. Edquist and Chaminade, 2006). It is therefore appropriate, given the observed heterogeneity of China's more and less developed cities, to propose that innovative processes in its less economically developed cities are unlikely to resemble those unfolding in their more developed counterparts.

## 2.4. Methodology

### 2.4.1. The model

A 'modified knowledge production function' (e.g. Ó hUallacháin and Leslie, 2007; Crescenzi et al., 2007; 2012) within which innovative capacity is a function of: investment in R&D; exposure to knowledge spillovers emanating from neighbouring cities; the availability of skilled human capital and a vector of structural factors is employed to model the innovative capacity of China's more and less developed cities.

The model is specified as follows:

$$y_{i,t} = \beta_1 R\&D_{i,t} + \beta_2 WR\&D_{i,t} + \beta_3 HumanK_{i,t} + Structural_{i,t}'\delta + \phi_t + \lambda_{i+} \varepsilon_{i,t}$$

Where:

| | |
|---|---|
| *y* | represents innovative performance proxied by patent intensity; |
| *R&D* | represents local investment in R&D; |
| *WR&D* | is a spatially-lagged variable that reflects the average R&D expenditure of neighbouring cities; |
| *HumanK* | represents the availability of skilled human capital; |
| *Structural* | is a vector of structural factors; |
| *i,t* | represent city and time, respectively |

### 2.4.2. The variables

#### *2.4.2.1. The dependent variable*

The dependent variable is patent applications per 10,000 inhabitants. Patent statistics capture and quantify the development and introduction of applied innovations and technological developments. It is for this reason that researchers undertaking econometric analyses of this nature rely on patent intensity as a proxy for innovative capacity. Patent intensity is by no means a perfect measure of a territory's innovative capacity. Its limitations are, however, well understood[21] and, importantly, do not impair one's capacity to draw the sorts of inferences the research sets out to provide.

#### *2.4.2.2. The independent variables*

*Knowledge inputs*

Innovation involves the application of knowledge; "new economic knowledge" is the key 'input' to processes the 'outputs' of which are more tangible, applied and commercially viable innovations (Audretsch and Feldman, 2004:2716). This knowledge is generated by, embodied in, and drawn from a diversity of activities and sources. I consider three:

R&D activities are undertaken by public and private actors alike with the aim of generating basic, economically useful knowledge.[22] Their importance as a source of this knowledge and an influence on a territory's innovative capacity can therefore

[21] Nagaoka et al. (2010) contemplate the validity and suitability of patent statistics as "innovation indicators". Pavitt (1988) and Desrochers (1998), among others, discuss the limitations and shortcomings of patent applications as a proxy for innovative capacity. The most prominent criticism levelled against the use of patent applications as a proxy for innovation is that patent statistics – for reasons relating to the (i) patentability (or lack thereof) of certain inventions and innovations, and (ii) variability in the propensities of different firms, sectors and industries to apply for patents – do not capture all of the innovations introduced by, and in turn, the innovative capacity of an economy and are, in that respect, somewhat biased (e.g. Desrochers, 1998). The case for their employment is presented by Trajtenberg (1990:183) who asserts that patent statistics are "the only observable manifestation of inventive activity with a well-grounded claim for universality".

[22] The OECD (2002:30) conceptualizes R&D as "work undertaken on a systemic basis in order to increase the stock of knowledge […] and the use of this stock of knowledge to devise new applications." Similarly, Arora et al. (2017) consider "why firms invest in R&D". It is proposed that R&D functions generate scientific knowledge that then feeds into processes of innovation.

not be overstated. Audretsch and Feldman (2004:2716), for example, observe that "the greatest source generating new economic knowledge is generally considered to be R&D". Accordingly, R&D expenditure, expressed as a percentage of GDP, is included in the model to capture extent to which cities are engaging in these functions and generating the essential knowledge that spurs innovation.

Economically useful knowledge is also generated by and embodied in human capital (e.g. Lucas, 1988; Dachs, 2009; Rupietta and Backes-Gellner, 2017). This is not, however, the only avenue through which educated workers contribute to innovative processes. Skilled workforces *facilitate* the identification, absorption and mobilisation of knowledge, locally generated or otherwise (e.g. Griffith et al., 2004; Dachs, 2009). The second 'knowledge input' considered is therefore tertiary educational attainment. The inclusion of this variable permits the formulation of inferences relating to the extent to which the depth of a city's pool of skilled workers shapes its innovative capacity, both directly (i.e. as an input) and indirectly (i.e. as a facilitator of the absorption of other sources of knowledge).

Finally, territories are, through various mechanisms and channels, exposed to knowledge that is generated beyond their borders (Audretsch and Feldman, 2004; Feldman and Kogler, 2010). This extra-locally sourced knowledge is an important input to innovative processes (e.g. Bathelt et al., 2004; Sonn and Storper, 2008; Rodríguez-Pose and Crescenzi, 2008; Grillitsch and Nilsson, 2015). To neglect these knowledge flows would be to overlook a potentially powerful catalyst for innovation. A spatially-lagged R&D variable is included in the analysis to explore if, and how, a city's innovative potential is conditioned by its exposure to intercity R&D knowledge flows.

*Structural factors*

Innovative processes are shaped by a multitude of other territorial characteristics, features and attributes (Doloreux and Parto, 2005; Edquist and Chaminade, 2006; Buesa et al., 2010; Crescenzi and Rodríguez-Pose, 2012). The relationships between a set of preeminent structural influences and factors and the

innovative capacities of Chinese cities are probed via the inclusion of five additional variables:

1. Externalities associated with the agglomeration of economic actors and activities are a catalyst for innovation (e.g. Carlino and Kerr, 2014). The importance of these externalities, and of co-location more generally, to the generation of innovative output is often examined in empirical analyses via the inclusion of measures of density (Ke, 2010). Employment density (e.g. Carlino et al., 2007) is employed here to assess the link between agglomeration and innovation.

2. Territories' innovative capacities are not free from influence by their demographic compositions (e.g. Frosch and Tivig, 2007; Poot, 2008); younger populations, in particular, are anticipated to be more innovative (e.g. Crescenzi et al., 2007). Following Crescenzi et al., (2007; 2012), the percentage of the population aged 15-24 is incorporated into the analysis to control for the youthfulness of a city's population.

3. A city's propensity to patent has been linked to the size of the population it is home to as well (e.g. Bettencourt et al., 2007a,b). Population size is, accordingly, added to the model to explore whether a having a larger population is supportive of, or detrimental to, a city's innovative potential.

4. Cities, as Capello et al., (2012:152) note, may also realise "benefit from a favourable industrial mix [that supports] innovation". I explore the extent to which a city's innovative capacity is a function of its economic fabric, and more specifically, of the types of activities it hosts, via the inclusion of employment in manufacturing as a percentage of total employment.

5. Finally, a well-developed stock of physical infrastructure may be a boon to innovative capacity (e.g. Agrawal et al., 2017). An infrastructure density variable is, therefore, included to assess how an urban environment's innovative potential is affected by the ready availability (or lack thereof) of physical infrastructure.

## 2.5. Results and analysis

The model is estimated using a panel data regression approach with time and city fixed-effects. Robust standard errors are clustered by city. The analysis considers a sample of 283 Chinese cities between 2003 and 2014. The cities included in the sample are listed in *Appendices 1* and *2*. The estimation results are presented in *Tables 2.1* through *2.5*. *Table 2.1* summarises the results of the first, most basic iteration of the model. *Tables 2.2* and *2.3* summarise iterations of the model to which a series of interaction terms are added. *Tables 2.4* and *2.5* present the results of a set of estimations that include the spatially-lagged R&D variable.

The interaction terms included in *Tables 2.2* through *2.5* facilitate the formulation of more nuanced inferences relating to the extent to which the socioeconomic and structural factors captured by the model (i.e. employment density, demographic composition, etc.) directly affect and shape a city's capacity to mobilise both the knowledge generated by the R&D activities they host and that which they are exposed to via intercity knowledge flows and transform it into applied innovation. Simply stated, they reveal the *indirect* effect of these factors and influences on the innovative capacity of China's more and less developed cities, respectively. The 'knowledge-related synergies' they expose provide an indicative sense, as I will address, of how integrated and evolved the innovation systems hosted by the two types of cities are.

The full sample specifications (*Table 2.1, Specifications 1-4*) provide a baseline against which the results for the more developed and less developed cities can be implicitly compared. They are, in that that respect, the most suitable point of departure.

*Table 2.1. Full sample, more and less developed cities estimations, without interaction terms*

| | All cities | | | | More developed cities | | | | Less developed cities | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| R&D expenditure (% of GDP) | 1.666*** | 1.263** | 1.082** | 1.086** | 7.903*** | 6.773*** | 5.889*** | 5.722*** | 0.230 | 0.334** | 0.330** | 0.326** |
| | (0.539) | (0.588) | (0.510) | (0.492) | (2.380) | (2.523) | (2.167) | (2.066) | (0.209) | (0.139) | (0.139) | (0.134) |
| Tertiary educational attainment | 3.210*** | 3.079*** | 3.165*** | 3.137*** | 2.369*** | 2.493*** | 2.752*** | 2.694*** | 0.873* | 0.943** | 0.906** | 0.885** |
| | (0.547) | (0.510) | (0.498) | (0.499) | (0.594) | (0.549) | (0.547) | (0.552) | (0.487) | (0.437) | (0.438) | (0.432) |
| Employment density | | 0.995** | 0.874* | 0.868* | | 1.175** | 1.029** | 1.029** | | -0.0194 | -0.0239 | -0.0386 |
| | | (0.435) | (0.451) | (0.453) | | (0.460) | (0.489) | (0.490) | | (0.0285) | (0.0295) | (0.0382) |
| Share of the population aged 15-24 | | -1.262 | -1.058 | -0.761 | | -2.076 | -1.807 | -1.230 | | -0.0810 | -0.0827 | -0.0722 |
| | | (0.869) | (0.830) | (0.735) | | (1.440) | (1.431) | (1.330) | | (0.0795) | (0.0778) | (0.0784) |
| Population | | -0.0220 | -0.0205 | -0.0145 | | -0.0192 | -0.0183 | -0.0148 | | -0.0163** | -0.0158** | -0.0162** |
| | | (0.0251) | (0.0256) | (0.0201) | | (0.0298) | (0.0309) | (0.0258) | | (0.00641) | (0.00633) | (0.00638) |
| Employment in industry/ manufacturing | | | 0.0899** | 0.105* | | | 0.150** | 0.182** | | | -0.00114 | -0.00143 |
| | | | (0.0450) | (0.0543) | | | (0.0687) | (0.0817) | | | (0.0142) | (0.0140) |
| Infrastructure density | | | | -0.0955 | | | | -0.150 | | | | 0.0568** |
| | | | | (0.152) | | | | (0.161) | | | | (0.0278) |
| Constant | -11.69*** | 15.47 | 8.437 | 1.189 | -19.95*** | 18.35 | 7.474 | -3.372 | -1.688 | 6.131* | 6.063 | 5.974 |
| | (2.512) | (18.24) | (16.71) | (12.55) | (4.810) | (25.83) | (25.12) | (21.26) | (1.056) | (3.669) | (3.670) | (3.688) |
| City fixed-effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,385 | 3,309 | 3,278 | 3,268 | 1,897 | 1,860 | 1,837 | 1,828 | 1,488 | 1,449 | 1,441 | 1,440 |
| R-squared | 0.742 | 0.765 | 0.765 | 0.757 | 0.743 | 0.771 | 0.770 | 0.762 | 0.643 | 0.673 | 0.673 | 0.678 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The first four specifications included in *Table 2.1* imply that processes of innovation in the 283 Chinese cities that compose the sample are shaped by four of the factors captured by the model. R&D expenditure is found to be positively and statistically significantly associated with patent generation in all four of the specifications (*Table 2.1, Specifications 1-4*). The innovative capacities of these cities appear to be mediated by the depth of their skilled labour forces as well. The coefficients of the tertiary educational attainment variable are positive and strongly significant across *Specifications 1-4*. Positive relationships also emerge between patent intensity and both the agglomeration of economic activity – captured by the inclusion of the employment density variable – (*Table 2.1, Specifications 2-4*) and employment in manufacturing (*Table 2.1, Specifications 3, 4*). There is, on the other hand, no evidence to suggest that the innovative performance of these cities is linked to the youthfulness or size of their respective populations (*Table 2.1, Specifications 2-4*) or the state of their infrastructure endowments (*Table 2.1, Specification 4*).

There is, however, reason to believe that the full sample specifications do not tell the whole story. Theory suggests, as alluded to in *Section 2.2* and at the end of *Section 2.3*, that the socioeconomic heterogeneity of China's more and less developed cities, respectively, will influence *how*, and, in turn, be reflected in the *way*, the two types of cities generate innovative output. The testing of this underlying hypothesis is facilitated by the disaggregation of the sample into more and less developed cities.

A more nuanced story does, in fact, emerge when China's more economically developed cities are separated from their less developed counterparts.

Processes of innovation in China's more developed cities are shaped by five factors. First, China's more developed cities succeed in transforming R&D into innovation. The positive and significant relationship between R&D expenditure and patent generation unearthed by the analysis implies that China's more developed cities are realising considerable benefit, in the form of tangible innovative outputs and technological progress, from the sizable financial commitments they make to the cultivation of knowledge (*Table 2.1, Specifications 5-8*). A similar inference is formed about the link between exposure to extra-locally generated knowledge flows and innovative performance. The direction and statistical significance of the coefficient for

the spatially-lagged R&D variable across all specifications of the model indicates that China's more developed cities have a robust facility for the translation of R&D knowledge flows emanating from neighbouring cities into innovative output (*Table 2.4, Specifications 1-5*). These cities' facilities for the mobilisation and exploitation of both local and extra-local R&D are attributable, at least in part, to their relatively highly skilled workforces that function not only as facilitators of the absorption, internalisation and exploitation of knowledge (e.g. Griffith et al., 2004; Vinding, 2006), but also are themselves evidently catalysts for innovation. That is, a positive, statistically significant relationship between tertiary education attainment and patenting suggest that the innovative capacities of these more developed cities are directly enhanced by the ready availability of skilled labour (*Table 2.1, Specifications 5-8*). The positive and significant relationship between employment density and patent intensity that emerges from the analysis provides evidence to support the assertion that externalities associated with the agglomeration of economic activity are a boon to the innovative capacity of China's more economically developed cities as well (*Table 2.1, Specifications 6-8*). Finally, the innovative capacities of China's more developed cities are also a function of the prevalence of manufacturing activities in them; employment in manufacturing is positively and significantly linked to patent generation (*Table 2.1, Specifications 7, 8*).

Stated simply, the innovativeness of China's more developed cities is explicable by a marked facility for the application of basic knowledge and a supportive structural and socioeconomic context. That is, China's more developed cities exploit locally and extra-locally generated knowledge with a considerable degree of efficiency. The former is made readily available by the well-funded R&D efforts they undertake. They are amply exposed to the latter in large part because of the extent of the clustering of China's more economically developed cities on the country's east coast (*Figure 2.1*). This ready availability of knowledge is matched by a comparable availability of skills. Their skilled human capital, much of which is employed in *more* innovation-prone manufacturing activities, works in close physical proximity to translate knowledge into applied innovation. All of this gives rise to innovative capacities that exceed those of China's less developed cities.

*Table 2.2. More developed cities estimations, with interaction terms*

| | More developed cities | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| R&D expenditure (% of GDP) | 8.404*** | 6.498*** | 8.521*** | 8.083*** |
| | (2.379) | (2.173) | (2.940) | (2.696) |
| Tertiary educational attainment | 2.476*** | 2.601*** | 2.579*** | 2.656*** |
| | (0.468) | (0.545) | (0.547) | (0.528) |
| Employment density | 0.983** | 0.945** | 0.986** | 1.073** |
| | (0.474) | (0.459) | (0.487) | (0.476) |
| Share of the population aged 15-24 | -1.156 | -1.070 | -1.204 | -1.337 |
| | (1.301) | (1.289) | (1.318) | (1.252) |
| Population | -0.0222 | -0.0161 | -0.0173 | -0.0217 |
| | (0.0235) | (0.0251) | (0.0247) | (0.0251) |
| Employment in industry/manufacturing | 0.164** | 0.176** | 0.171** | 0.174** |
| | (0.0806) | (0.0832) | (0.0816) | (0.0788) |
| Infrastructure density | -0.177 | -0.149 | -0.165 | -0.309 |
| | (0.160) | (0.161) | (0.158) | (0.198) |
| **R&D expenditure x Tertiary educational attainment** | **1.110*** ** | | | |
| | **(0.297)** | | | |
| **R&D expenditure x Employment density** | | **0.574**** | | |
| | | **(0.262)** | | |
| **R&D expenditure x Employment in industry/manufacturing** | | | **0.197**** | |
| | | | **(0.0830)** | |
| **R&D expenditure x infrastructure density** | | | | **0.436**** |
| | | | | **(0.205)** |
| Constant | 21.53 | 18.54 | 18.70 | 24.43 |
| | (21.65) | (22.52) | (22.65) | (21.52) |
| City fixed-effects | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes |
| Observations | 1,828 | 1,828 | 1,828 | 1,828 |
| R-squared | 0.771 | 0.765 | 0.766 | 0.767 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The innovative capacities of China's less developed cities are, similarly, a function of five of the factors contemplated by the analysis. First, China's less developed cities have an unexpected facility for the translation of knowledge generated *both* within *and* beyond their borders into innovative output. Lower levels of investment in R&D – that could conceivably, in many cases, fail to exceed the threshold below which returns to this expenditure are unlikely to materialise –, shallower pools of skilled human capital and weaker economic fabrics are chief among the factors that *should* render them less receptive to and less able to absorb and apply

the knowledge they generate or are exposed to. Yet, the positive and statistically significant relationship between R&D expenditure and patent intensity implies that investments in R&D *do not* represent a waste of scarce financial resources in China's less developed cities (*Table 2.1, Specification 10-12*).[23] Likewise, the positive coefficient of the spatially-lagged R&D variable indicates that these cities can and do leverage the knowledge they are exposed to via intercity knowledge spillovers to generate innovation (*Table 2.5, Specification 1-5*).

Skills support innovation in these environments as well; a significant relationship is observed between tertiary education attainment and patent generation (*Table 2.1, Specification 9-12*). Unlike their more developed peers, neither employment density nor employment in manufacturing are robustly associated with the innovative capacities of China's less developed cities. Rather it is the availability of physical infrastructure that conditions their innovative capacities (*Table 2.1, Specification 12*). The implications of the positive and statistically significant relationship between infrastructure density and patent intensity are two-fold: first, infrastructural deficiencies are a barrier to achieving innovation in these cities. Second, there is benefit to be realised from appropriate investments in the upgrading of the infrastructure endowments of China's less developed cities. Finally, the analysis provides an indication that population size cannot be overlooked in the context of China's less economically developed cities. That is, the negative and significant coefficients of the population size variable in the less developed specifications suggest that overcrowding in these generally populous cities has an adverse effect on their innovative potential (*Table 2.1, Specifications 10-12*).

[23] It should also be highlighted that the significance of the relationship between R&D expenditure and patent intensity does not hold for China's less developed cities when the spatially-lagged R&D variable is introduced (*Table 2.5*), with the implication being *if sufficiently exposed to it*, less developed cities rely more on the extra-locally generated knowledge emanating from their neighbours and less on domestic R&D efforts to cultivate innovation.

*Table 2.3. Less developed cities estimations, with interaction terms*

| | **Less developed cities** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| R&D expenditure (% of GDP) | 1.981** | 0.409* | 0.345 | 1.356** |
| | (0.947) | (0.228) | (0.259) | (0.552) |
| Tertiary educational attainment | 0.939** | 0.888** | 0.885** | 0.913** |
| | (0.463) | (0.433) | (0.431) | (0.424) |
| Employment density | -0.0409 | -0.0452 | -0.0385 | -0.0382 |
| | (0.0416) | (0.0356) | (0.0384) | (0.0412) |
| Share of the population aged 15-24 | -0.0796 | -0.0712 | -0.0723 | -0.101 |
| | (0.0796) | (0.0788) | (0.0784) | (0.0800) |
| Population | -0.0170** | -0.0160** | -0.0162** | -0.0157** |
| | (0.00652) | (0.00639) | (0.00640) | (0.00613) |
| Employment in industry/manufacturing | -0.00637 | -0.00166 | -0.00159 | -0.00430 |
| | (0.0135) | (0.0140) | (0.0143) | (0.0134) |
| Infrastructure density | 0.0555** | 0.0578** | 0.0568** | 0.0699** |
| | (0.0269) | (0.0282) | (0.0276) | (0.0285) |
| **R&D expenditure x Tertiary educational attainment** | **0.441**** | | | |
| | **(0.223)** | | | |
| **R&D expenditure x Employment density** | | **0.0191** | | |
| | | **(0.0242)** | | |
| **R&D expenditure x Employment in industry/manufacturing** | | | **0.000767** | |
| | | | **(0.00586)** | |
| **R&D expenditure x infrastructure density** | | | | **0.128**** |
| | | | | **(0.0550)** |
| Constant | 10.93*** | 10.49*** | 10.68*** | 10.65*** |
| | (3.257) | (3.293) | (3.335) | (3.163) |
| City fixed-effects | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes |
| Observations | 1,440 | 1,440 | 1,440 | 1,440 |
| R-squared | 0.686 | 0.678 | 0.678 | 0.688 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

Innovative processes in China's less developed cities do, in some respects, confound expectation. Notably, these cities are able to translate knowledge and knowledge resources into innovation. The issue it would therefore seem is not necessarily one of ability but rather of availability. China's less developed cities invest less in R&D activities than their more developed neighbours; locally generated knowledge is therefore less ubiquitously available. These cities tend to be more physically isolated as well, which limits their exposure to innovation-inducing knowledge spillovers. As a result, whatever capacity these cities have for the

mobilisation and productive application of knowledge goes un- or certainly underexploited. The same can be said of skills. The skilled labour with which these cities are endowed does support innovative processes in, and enhance the respective innovative capacities of, these less developed areas. Skilled labourers are, however, few and far between in these cities.

*Table 2.4. More developed cities estimations, with interaction terms and the spatially-lagged R&D variable*

| | **More developed cities** | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| R&D expenditure (% of GDP) | 3.424** | 4.981** | 3.921** | 4.269** | 3.648** |
| | (1.710) | (1.940) | (1.790) | (2.118) | (1.735) |
| Spatially-lagged R&D expenditure | 33.37*** | 29.55*** | 35.15*** | 32.50*** | 33.56*** |
| | (7.451) | (6.998) | (7.824) | (7.199) | (7.533) |
| Tertiary educational attainment | 2.769*** | 2.990*** | 2.780*** | 2.738*** | 2.782*** |
| | (0.516) | (0.535) | (0.514) | (0.516) | (0.516) |
| Employment density | 1.018** | 1.004** | 1.012** | 1.012** | 1.031** |
| | (0.474) | (0.467) | (0.474) | (0.477) | (0.481) |
| Share of the population aged 15-24 | -1.270 | -1.278 | -1.258 | -1.264 | -1.310 |
| | (1.295) | (1.280) | (1.289) | (1.299) | (1.297) |
| Population | -0.0133 | -0.0146 | -0.0125 | -0.0141 | -0.0141 |
| | (0.0259) | (0.0258) | (0.0262) | (0.0257) | (0.0258) |
| Employment in industry/manufacturing | 0.120 | 0.117 | 0.115 | 0.116 | 0.119 |
| | (0.0797) | (0.0805) | (0.0809) | (0.0801) | (0.0795) |
| Infrastructure density | -0.196 | -0.231 | -0.227 | -0.195 | -0.236 |
| | (0.156) | (0.160) | (0.169) | (0.157) | (0.191) |
| **Spatially-lagged R&D expenditure x Tertiary educational attainment** | | **0.570*** (0.170)** | | | |
| **Spatially-lagged R&D expenditure x Employment density** | | | **0.338** (0.155)** | | |
| **Spatially-lagged R&D expenditure x Employment in indu/manu** | | | | **0.0519 (0.0389)** | |
| **Spatially-lagged R&D expenditure x Infrastructure density** | | | | | **0.0582 (0.0399)** |
| Constant | -32.59 | -27.09 | -37.03 | -32.49 | -32.15 |
| | (28.51) | (28.08) | (29.50) | (28.49) | (28.57) |
| City fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,828 | 1,828 | 1,828 | 1,828 | 1,828 |
| R-squared | 0.770 | 0.773 | 0.771 | 0.770 | 0.770 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The facility these cities have for the mobilisation of knowledge inputs and human capital provides a sense of why these underdeveloped environments are not wholly un-innovative. The scarcity of these inputs however, also *begins* to explain why these cities lag so far behind their more developed counterparts in terms of innovation. Further limits to the innovative capacities of these cities are imposed by infrastructural deficiencies by which less developed environments are characteristically plagued and by large populations that the analysis suggests are impediments to innovation.

At first glance, the factors shaping processes of innovation in China's more developed cities do not seem *wholly* dissimilar to those at play in its less developed ones. A closer look, however, suggests that China's more developed cities differ from their less developed counterparts in two critical, related respects.

First, while both types of cities have at least some facility for the mobilisation of different types of 'knowledge inputs' – knowledge resources generated by local and extra-local R&D activities and their skilled workforces –, China's more developed cities do so considerably more efficiently. The size and statistical significance of the coefficients of the R&D expenditure, spatially-lagged R&D expenditure and tertiary educational attainment variables in the more developed city specifications (*Table 2.1, Specifications 5-8; Table 2.4, Specifications 1-5*) exceed those of the coefficients that appear in the less developed city iterations (*Table 2.1, Specifications 9-12; Table 2.5, Specifications 1-5*). The implication of this is that China's more economically developed cities are realising returns from (i) the R&D activities they host, (ii) the knowledge spillovers to which they are exposed and (iii) the human capital they are home to that massively outstrip those available in their less developed neighbours. So, not only are these cities investing more in R&D activities; more exposed to intercity knowledge flows and better endowed with skilled human capital than their less developed counterparts, they are putting the outputs of these investments, these spillovers and these skills to work with a comparatively advanced degree of efficiency and realising comparatively large returns from them. This renders the innovation gap between China's more and less developed cities that much more understandable.

*Table 2.5. Less developed cities estimations, with interaction terms and the spatially-lagged R&D variable*

| | **Less developed cities** | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| R&D expenditure (% of GDP) | 0.136 | 0.192 | 0.170 | 0.137 | 0.199 |
| | (0.129) | (0.145) | (0.140) | (0.165) | (0.136) |
| Spatially-lagged R&D expenditure | 3.390*** | 4.327*** | 3.591*** | 3.389*** | 4.450*** |
| | (1.279) | (1.612) | (1.331) | (1.282) | (1.458) |
| Tertiary educational attainment | 0.833* | 0.867* | 0.836* | 0.833* | 0.856** |
| | (0.423) | (0.447) | (0.424) | (0.424) | (0.427) |
| Employment density | -0.0323 | -0.0322 | -0.0460 | -0.0323 | -0.0330 |
| | (0.0390) | (0.0410) | (0.0348) | (0.0391) | (0.0433) |
| Share of the population aged 15-24 | -0.0646 | -0.0672 | -0.0626 | -0.0646 | -0.0734 |
| | (0.0771) | (0.0771) | (0.0772) | (0.0774) | (0.0766) |
| Population | -0.0174*** | -0.0181*** | -0.0172*** | -0.0174*** | -0.0178*** |
| | (0.00659) | (0.00673) | (0.00654) | (0.00659) | (0.00660) |
| Employment in industry/manufacturing | -0.00268 | -0.00474 | -0.00307 | -0.00270 | -0.00411 |
| | (0.0138) | (0.0137) | (0.0138) | (0.0141) | (0.0136) |
| Infrastructure density | 0.0517** | 0.0508** | 0.0528** | 0.0517** | 0.0547** |
| | (0.0260) | (0.0256) | (0.0261) | (0.0258) | (0.0254) |
| **Spatially-lagged R&D expenditure x Tertiary educational attainment** | | **0.242*** | | | |
| | | **(0.141)** | | | |
| **Spatially-lagged R&D expenditure x Employment density** | | | **0.0263*** | | |
| | | | **(0.0154)** | | |
| **Spatially-lagged R&D expenditure x Employment in indu/manu** | | | | **0.000143** | |
| | | | | **(0.00534)** | |
| **Spatially-lagged R&D expenditure x Infrastructure density** | | | | | **0.0870**** |
| | | | | | **(0.0344)** |
| Constant | 5.297** | 5.355** | 4.782* | 5.298** | 4.599* |
| | (2.629) | (2.613) | (2.637) | (2.629) | (2.543) |
| City fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,440 | 1,440 | 1,440 | 1,440 | 1,440 |
| R-squared | 0.682 | 0.683 | 0.682 | 0.682 | 0.684 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The second point of divergence between the two types of cities is discerned from the interaction terms that feature in *Tables 2.2* through *2.5*. There is considerably more scope for the emergence of 'knowledge-related synergies' in China's more developed cities. The various iterations of the model, and, more specifically, the positive and statistically significant coefficients of the R&D- and spatially-lagged

R&D-interaction terms, respectively, provide evidence to suggest that the skilled workforces and physical infrastructure with which China's more developed cities are endowed (*Table 2.2, Specification 1, 4*; *Table 2.4, Specification 2*); the industrially-biased economic fabrics by which they are characterised (*Table 2.2, Specification 3*) and the agglomeration externalities (*Table 2.2, Specification 2*; *Table 2.4, Specification 3*) from which they benefit *directly enhance* their capacity to translate knowledge and/or knowledge spillovers into tangible innovative output. These synergies are fewer and further between in China's less developed cities.[24] Moreover, the coefficients of the significant interaction terms indicate that when they materialise, these synergistic relationships are considerably weaker in less developed cities than they are in their more developed counterparts.

All of this points in the direction of a singular, more general inference. The empirical analysis implies that China's more and less developed cities are not necessarily leveraging *completely* different sets of factors, resources or characteristics to cultivate innovation. Differences do exist, but more and less developed cities are both relying on similar 'knowledge inputs' to generate innovation. *Where China's more and less developed cities differ most profoundly is in the complexity of the processes of innovation they host and the maturity of the innovation systems they are home to.*

Processes of innovation in China's less developed cities conform closely to linear conceptualisations of innovation (e.g. Maclaurin, 1953; Grilliches, 1979). The analysis suggests that increases in R&D investment, exposure to knowledge flows or efforts to upgrade human capital will yield innovation. There is, however, comparatively little to suggest that the processes by which these knowledge inputs are translated into innovative outputs are profoundly affected or mediated by features, attributes or characteristics of the environments in which they transpire. Their innovative capacities are, for example, unconnected to their industrial compositions and the extent to which actors and activity are co-located. Weaker contextual

[24] There is cursory evidence to suggest: (1) that, *if* they are endowed with them, adequately developed stocks of human capital and physical infrastructure may grant these less developed cities a marginally greater facility for the exploitation of the R&D investment (*Table 2.3, Specifications 1, 4*); and (2) that human capital, physical infrastructure and agglomeration externalities, *again when* they are available or arise in less developed environments, can aid, albeit minimally, in the absorption and mobilisation of intercity knowledge flows (*Table 2.5, Specifications 2, 3, 5*)

conditions, like those by which China's less developed cities are characterised (*Section 2.3*), are anticipated to be more than just unsupportive of innovation. They can actually *compromise* a territory's innovative potential (Rodríguez-Pose, 1999). Moreover, it does not appear that the innovation systems these cities host have matured or become integrated to a point where all elements of the innovation system work synergistically to maximise the efficiency with which knowledge inputs are mobilised; 'knowledge-related synergies' are considerably scarcer and weaker in less developed cities than they are in their more developed neighbours. Simply stated, 'outside', contextual influence on the processes by which knowledge inputs are translated into outputs is minimal – exactly as is envisioned by linear models. The result is that returns to knowledge and knowledge resources in China's less developed cities are modest and potentially limited, especially when compared to those being realised in more developed territories.

The exact opposite is true for China's more developed cities. Knowledge inputs are, in these cities, transformed into innovation via a process that is considerably more multidimensional and, because of the array of influences to which it is evidently subject, complex. Their innovative potential is, for one, directly affected by much more than the availably of knowledge inputs in ways anticipated not by linear models of innovation, but rather by more recent conceptualisations of innovative processes that stress their dynamic and, especially, contextually-contingent nature (e.g. Edquist and Chaminade, 2006). There is evidence to suggest, as literature has anticipated, that both externalities associated with the agglomeration of economic activity enhance their innovative capacities as do their industrially-biased economic fabrics (Storper and Venables, 2004; Glaeser, 2010). More revealing of the maturity and complexity of these innovation systems, however, is the abundance of knowledge-related synergies from which they benefit. The innovation systems of China's more developed cities have evolved to such an extent that territorial characteristics and attributes – that themselves impel innovation – interact and work in mutually-reinforcing ways to facilitate the maximisation of returns from inputs to innovative processes. The ultimate reflection of this, and of the maturity of these cities' innovation systems more generally, is the comparatively robust efficiency with which they mobilise and productively apply knowledge, and, relatedly, the returns they manage to realise from knowledge inputs that dwarf those available in China's less developed cities.

*In short, their innovative processes are more complex, and their innovation systems, more evolved, integrated and mature, than those hosted by their less developed counterparts*.

## 2.6. Conclusions

The preceding research sought to unpack processes of innovation in China's more and less developed cities, respectively, with a view to identify and understand the differences between the sets of factors that drive and shape them in these heterogeneous environments. A comparative econometric analysis of 283 cities was employed to form policy relevant insights and inferences that previous empirical research is yet to provide.

The analysis revealed that China's more advanced cities, on the one hand, mobilise and productively exploit R&D, knowledge spillovers and human capital with a comparatively high degree of efficiency. Processes of interaction, collaboration and a host of other proximity-related externalities, borne out of the agglomeration of economic actors and activity in them, are profoundly supportive of the innovative activities they host. These innovative processes unfold on more industrially-biased economic fabrics – functions of the types of economic actors, activities and sectors by which they are composed – that are themselves conducive to innovation. Innovation enhancing 'knowledge-related synergies' were also found to be abundant; factors, features and territorial characteristics that are anticipated to, by themselves, support innovative activity, are working in mutually reinforcing ways to ensure that knowledge resources, locally generated or otherwise, are mobilised and productively exploited as efficiently as possible.

A different story emerged for China's less developed cities. While knowledge inputs do not go unexploited in these environments, they are translated into innovative outputs *relatively* inefficiently. Their innovative potential is detached from the broadly-defined types of economic activities they engage in and they are unable to reap the innovative benefits of, and the externalities associated with, co-location and

density. If anything, their generally large populations serve as barriers to innovative processes. Moreover, it is only the most basic of public investments – those in physical infrastructure – that are anticipated to yield returns in the form of innovative output suggesting that these cities may be suffering from fundamental deficiencies the shoring up of which is likely prerequisite to the establishment of any measureable innovative capacity. Finally, the 'knowledge-related synergies' that are abundant in China's more developed environments are both fewer and further between and, when they emerge, relatively weak in these cities.

All of this suggests that the innovation processes, and by extension, systems hosted by China's more developed cities are more complex, integrated and mature than those that have and are emerging in the country's less developed cities where processes of innovation seem to unfold in a manner that is more consistent with basic, linear conceptualisations of innovation.

It is from this overarching conclusion that the chapter's preeminent policy implication is derived. Policy-makers responsible for the promotion of innovation in, and, in turn, the growth of China's less developed cities will need to walk a tightrope of sorts. That is, there is an obvious need to, on the one hand, capitalise on the facility these cities have for the mobilisation and application of knowledge and knowledge inputs. This will involve the pursuit of more traditional innovation policies – of the sort rooted in the aforementioned linear models – based, for example, on the prioritisation of R&D and basic knowledge generation or, even more rudimentarily, infrastructure expansion. Such policies would, however, represent 'quicker-fixes' designed not with the longer-term performance or sustainability of the innovation systems in mind, but rather to cultivate innovative output, promote growth and stem the emergence of spatial inequalities in the immediate, shorter-term. Measures to impel the maturation of the innovation system *as a whole* will likely be necessary to achieve the former. These might include efforts to promote the integration of a system's constituent components and intra-system connectivity more generally, or interventions to upgrade the socioeconomic and structural environments within which these systems exist and, more specifically, address the deficiencies by which they are burdened.

Policy-makers responsible for China's more developed cities, on the other hand, face an *arguably* less daunting task. Further increasing the availability of knowledge inputs and/or expanding the innovation system via the attraction of economic actors and activity will undoubtedly be integral to the maintenance and expansion of their innovative capacities here as well. What is more important, however, is ensuring that these inputs and actors complement, and are integrated into, what are already mature innovation systems. Simply stated, special attention should be paid to the maintenance of the synergistic dynamics – and the cultivation of new ones – that underpin these reasonably evolved innovation systems.

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# Appendix 1. China's less developed cities

| | | | | | |
|---|---|---|---|---|---|
| Handan | Shuangyashan | Ji'an | Huanggang | Qinzhou | Ziyang |
| Xingtai | Yichun | Yichun | Suizhou | Guigang | Liupanshui |
| Baoding | Jiamusi | Fuzhou | Hengyang | Yulin | Zunyi |
| Zhangjiakou | Qitaihe | Shangrao | Shaoyang | Baise | Anshun |
| Hengshui | Heihe | Linyi | Zhangjiajie | Hezhou | Qujing |
| Datong | Suihua | Heze | Yiyang | Hechi | Baoshan |
| Jinzhong | Bengbu | Kaifeng | Yongzhou | Laibiri | Zhaotong |
| Yuncheng | Huainan | Pingdingshan | Huaihua | Chongziio | Lijiang |
| Xinzhou | Huaibei | Anyang | Loudi | Luzhou | Pu'er |
| Linfen | Anqing | Xinxiang | Shantou | Mianyang | Lincang |
| Luliang | Huangshan | Puyang | Zhanjiang | Guangyuan | Weinan |
| Fuxin | Chuzhou | Luohe | Meizhou | Suining | Hanzhong |
| Tiding | Fuyang | Nanyang | Shanwei | Neijiang | Ankang |
| Chaoyang | Suzhou | Shangqiu | Heyuan | Leshan | Shangluo |
| Huludao | Lu'an | Xinyang | Qingyuan | Nanchong | Baiyin |
| Siping | Bozhou | Zhoukou | Chaozhou | Meishan | Tianshui |
| Baicheng | Chizhou | Zhumadian | Jieyang | Yibin | Wuwei |
| Qiqihar | Xuancheng | Shiyan | Yunfu | Guang'an | Zhangye |
| Jixi | Jiujiang | Xiaogan | Guilin | Dazhou | Pingliang |
| Hegang | Ganzhou | Jingzhou | Wuzhou | Ya'an | Qingyang |
| Bazhong | Dingxi | Wuzhong | Guyuan | | |

# Appendix 2. China's more developed cities

| | | | | | |
|---|---|---|---|---|---|
| Beijing | Changzhou | Weifang | Sanya | Harbin | Dandong |
| Tianjin | Suzhou | Jinin | Chongqing | Daqing | Jinzhou |
| Shijiazhuang | Nantong | Taian | Chengdu | Mudanjiang | Yingkou |
| Tangshan | Lianyungang | Weihai | Zigong | Shanghai | Liaoyang |
| Qinhuangdao | Huai'an | Rizhao | Panzhihua | Nanjing | Panjin |
| Chengde | Yancheng | Laiwu | Deyang | Wuxi | Changchun |
| Cangzhou | Yangzhou | Dezhou | Guiyang | Xuzhou | Putian |
| Langfang | Zhenjiang | Liaocheng | Kunming | Yingtan | Sanming |
| Taiyuan | Taizhou | Binzhou | Yuxi | Jinan | Quanzhou |
| Yangquan | Suqian | Zhengzhou | Xi'an | Qingdao | Zhangzhou |
| Changzhi | Hangzhou | Luoyang | Tongchuan | Zibo | Nanping |
| Jincheng | Ningbo | Hebi | Baoji | Zaozhuang | Longyan |
| Shuozhou | Wenzhou | Jiaozuo | Xianyang | Dongying | Chenzhou |
| Hohhot | Jiaxing | Xuchang | Yan'an | Yantai | Guangzhou |
| Baotou | Huzhou | Sanmenxia | Yulin | Dongguan | Shaoguan |
| Wuhai | Shaoxing | Wuhan | Lanzhou | Zhongshan | Shenzhen |
| Chifeng | Jinhua | Huangshi | Jiayuguan | Nanning | Zhuhai |
| Tongliao | Quzhou | Yichang | Jinchang | Liuzhou | Foshan |
| Erdos | Zhoushan | Xiangyang | Jiuquan | Beihai | Baishan |
| Hulunbuir | Taizhou | Ezhou | Xining | Fangchenggang | Songyuan |
| Bayannur | Lishui | Jingmen | Yinchuan | Haikou | Ningde |
| Ulanqab | Hefei | Xianning | Shizuishan | Xinyu | Nanchang |
| Shenyang | Wuhu | Changsha | Urumqi | Jiangmen | Jingdezhen |
| Dalian | Maanshan | Zhuzhou | Karamay | Maoming | Pingxiang |
| Anshan | Tongling | Xiangtan | Jilin | Zhaoqing | |
| Fushun | Fuzhou | Yueyang | Liaoyuan | Huizhou | |
| Benxi | Xiamen | Changde | Tonghua | Yangjiang | |

# Appendix 3. Variables used in the analysis

| **Variables** | | **Source** |
|---|---|---|
| Innovative output | Number of patent applications per 10,000 inhabitants | *SIPO (State Intellectual Property Office of the P.R.C)* |
| R&D expenditure | Local investment in R&D as % of GDP | *China City Statistical Yearbook* |
| Availability of human capital | Workers with a college-level or higher degree as a share of total employment (aged 25-64 years) | *China Population Census Data* |
| Industrial composition | Employment in manufacturing as % of employment | *China City Statistical Yearbook* |
| Agglomeration of economic activity | Population density (number of persons per square kilometre) | *China City Statistical Yearbook* |
| Demographics | % of population aged 15-24<br>Population size (population at year end) | *China Population Census Data* |
| Infrastructure density | Per capita area of paved roads in urban areas (meters squared per person) | *China City Statistical Yearbook* |

*Note: Missing values for variables were linearly interpolated/extrapolated where appropriate.*

# 3. INNOVATION AND ECONOMIC GROWTH IN THE EUROPEAN PERIPHERY: COMPARING EUROPE'S LAGGING REGIONS

## 3.1. Introduction

The relationship between knowledge, innovation and economic performance is increasingly well understood: innovation and knowledge-intensive activities are often cited drivers of economic growth, dynamism and more broadly-defined development (e.g. Solow, 1957; Romer, 1990; Aghion and Howitt, 1992; Grossman and Helpman, 1994). Improved economic performance is not, however, an inevitable outcome of investment in or the generation of knowledge and innovation. Sterlacchini (2008:1098), for example, notes "a significant relationship at a regional level between knowledge and economic growth cannot be taken for granted". Knowledge-intensive activity is transformed into economic change via a complex process that is subject to influence by an array of factors and forces the exact relevance of which vary from context to context (e.g. Maurseth and Verspagen, 1999; Rodríguez-Pose, 2001; Rodríguez-Pose and Villareal Peralta, 2015). It is therefore anticipated not only that this process will transpire in different ways in different environments, but more importantly, that certain territories will – owing to their unique features, conditions and characteristics – have different facilities for the mobilisation of knowledge and innovation and for their translation into economic growth and dynamism (Crescenzi, 2005; Capello and Lenzi, 2014). Less economically developed environments, in particular, are thought to be among the least capable of capitalising on knowledge and innovative activity (Rodríguez-Pose, 1999). This does not, however, mean that all economically disadvantaged regions are characterised by the *same* facility – or lack thereof – for its mobilisation.

The overarching aim of this research is to explore the extent to which different types of economically disadvantaged regions are capable of transforming *both* the knowledge-intensive, innovative activities they host and those to which they are exposed into economic growth and dynamism, given their unique socioeconomic and institutional characteristics. More specifically, it relies on a comparison of two types of lagging regions in Europe – 'low-income' and 'low-growth' regions – to address

two related research questions: (a) Are low-growth and low-income regions equally capable of transforming knowledge *and* innovation into economic growth? And (b) are processes of economic growth in low-income and low-growth regions, respectively, governed by the same, more broadly-defined set of socioeconomic and institutional forces?

In doing so, this research builds on the body of literature that examines the determinants of regional economic performance in Europe (e.g. Crescenzi, 2005; Sterlacchini, 2008; Rodríguez-Pose and Crescenzi, 2008; Crescenzi and Rodríguez-Pose, 2012; Paci and Marrocu, 2013; Capello and Lenzi, 2014; Crespro-Cuaresma et al., 2014; Crescenzi et al., 2016; Ketterer and Rodríguez-Pose, 2016). The comparative perspective it adopts facilitates both the formulation of inferences pertaining to the triadic relationship between knowledge, innovation and growth in a subset of Europe's most economically disadvantaged regions as well as an assessment of how, and the extent to which, their socioeconomic and institutional heterogeneity is manifested in it. The contributions of this chapter are not, however, confined to the academic realm – because the research focuses on a subset of regions that have been prioritised by the European Commission, any conclusions drawn can be applied to the development of the innovation and growth policies that are sure to follow for these regions.

The analysis suggests, most generally, that Europe's low-income and low-growth regions display markedly different facilities for the mobilisation of different types of knowledge and innovation. Low-income regions are able to translate locally generated innovations into economic dynamism. Their low-growth counterparts, on the other hand, while unable to capitalise on local innovative efforts, are capable of converting the knowledge and innovation that is generated in and flows out of their European neighbours into growth. The differences between the two types of lagging regions do not, however, stop there. The dynamism of Europe's low-income regions is, for example, more readily linked to 'structural' factors and influences. The economic performance of its low-growth ones is, conversely, mediated by the availability of suitably skilled human capital, by externalities associated with agglomeration and by their physical proximity to markets and the activities they host. The efficiency and functioning of regional institutions emerges as a preeminent determinant of the economic performance of both types of lagging regions.

The remainder of the chapter proceeds as follows: *Section 3.2* outlines the theoretical underpinning of and motivations for the research. *Section 3.3* presents the sample of regions with which it is concerned. *Section 3.4* relies on a series of descriptive statistics to expose and assess the heterogeneity of Europe's low-income and low-growth regions. *Section 3.5* introduces the econometric model and outlines the variables included in the analysis. The results of the analysis, and a substantive interpretation of them, are provided in *Section 3.6*. *Section 3.7* concludes.

## 3.2. Knowledge, innovation and growth in lagging regions

Knowledge, technological change and innovation are fundamentally important to the achievement of economic growth. Innovation and knowledge-intensive activity spur increases in productivity that, in turn, catalyse and support growth, dynamism and development (e.g. Solow, 1957; Rosenberg, 1972; Romer, 1990; Aghion and Howitt, 1992; Bresnahan and Trajtenberg, 1995; Grossman and Helpman, 1994; Cooke and Leydesdorff, 2006). Consequently, the most technologically sophisticated territories tend to be both more economically advanced and more favourably positioned for the continued pursuit of competitiveness and dynamism. Lower-levels of technological sophistication, on the other hand, often coincide with weaker economic performances and comparably lower levels of socioeconomic development (Maurseth and Verspagen, 1999; Howells, 2005). Implicit in these statements is an inference that is found at the heart of development policies pursued across the globe in recent years: it is anticipated that increasing a region's knowledge endowment and, in turn, its innovative capacity will inevitably yield proportional improvements in economic performance. This latter inference rests, however, on an assumption that *may not* be defensible – namely that all regions are similarly capable of *mobilising* knowledge and innovative activity and *transforming* it into economic growth.

A number of authors have suggested that the extent to which a region is capable of translating innovative efforts into growth is mediated by its unique attributes, features and characteristics (e.g. Rodríguez-Pose, 1999; Crescenzi, 2005; Rodríguez-Pose and Crescenzi, 2008; Conte et al., 2009; Capello and Lenzi, 2014). Capello and Lenzi (2014:190), in fact, note that there is "a wide consensus [in the literature] on the

importance of some territorial preconditions to create knowledge and innovation and to turn them into growth".

Prior to proceeding, it should be clarified that while knowledge and innovation are intrinsically related, they are not one in the same, nor is the way in which they relate to economic performance. The relationship between them is one of complementarity. Knowledge is an *input* to innovative processes. Innovation, on the other hand, is a consequence of the mobilisation and application of knowledge and is, in that respect, the *output* of innovative processes.[25]

The link between innovation and economic performance is more direct than that between knowledge and growth. Knowledge, including that which is generated via R&D, must be mobilised, combined and cross-fertilised to yield the more tangible, applied innovations that impel economic growth (e.g. Fagerberg, 2003). The process by which knowledge is converted into innovation is affected by a multitude of territorially-specific socioeconomic and institutional influences (Edquist and Chaminade, 2006; Crescenzi and Rodríguez-Pose, 2012). The availability of human capital and skills (Romer, 1990; Glaeser, 1999; Andersson et al., 2005; Lee et al., 2010; Pater and Lewandowska, 2015); the maturity and character of the local economic fabric (Rodríguez-Pose, 1999; 2001; Capello et al., 2012); the local circulation and exchange of knowledge facilitated, in part, by physical co-location (Duranton and Puga, 2004; Storper and Venables, 2004); a territory's exposure to and ability to exploit inter-territorial spillovers (Moreno et al., 2005; Rodríguez-Pose and Crescenzi, 2008; Grillitsch and Nilsson, 2015; Fitjar and Rodríguez-Pose, 2016); the maturity of its informal institutional constructs and arrangements (Morgan, 1997; Cooke and Morgan, 1998); and the efficiency of its formal institutions (Rodríguez-Pose and Di Cataldo, 2015) are among the factors and influences that are thought to shape a region's facility for the application of knowledge and, ultimately, its innovative capacity.

[25] Griliches' (1979) 'knowledge production function' offers the clearest conceptualization of this relationship. In said function, innovative output is understood to be a function of a variety of inputs, one of which is "technological knowledge, determined in part by current and past research and development expenditures" (p. 95). Capello and Lenzi (2014:187) also distinguish knowledge from innovation asserting that "both knowledge and innovation are crucial, albeit different, drivers of economic growth".

The set of factors that conditions a region's capacity to *generate* innovation is not dissimilar to that which is anticipated to determine its facility for *mobilising* it. That said, three factors stand out as especially relevant to the relationship between innovation and economic performance.

The first is the economic structure of a region. The relevance of regional economic structure to the mobilisation of innovation is derived from the fact that a region's demand for knowledge and innovation, and the number of channels it offers for their application, is a function of the characteristics of the economic actors its hosts, including their size and the industry in which they operate as well as the competitive context in which they exist. Rodríguez-Pose (2001), in fact, posits that a region's capacity to mobilise its innovative efforts may be most directly influenced, at least in the European context, by its economic structure. More specifically, he asserts that "the absence of a dense network of companies, the predominance of small and very small enterprises, lack of competition and the lack of entrepreneurship, curtail the capacity of [an] economic environment to transform innovation into economic activity" (Rodríguez-Pose, 2001:292).

The second is the availability of skills and the composition of the regional workforce. Demand for knowledge and innovation is not sufficient, in and of itself, to ensure that either will be applied in a growth-enhancing way. Regions must also have the "capability" to do so (Crescenzi, 2005:483). This capability is shaped by the availability of skills. Skilled human capital 'screens' different types and sources of knowledge and innovation and determines how to channel them in appropriate and productive ways.

The final, albeit less tangible, factor relates to density and maturity of the institutions – both formal and informal – that shape behaviours and mediate interactions in a region. Capello and Lenzi (2014:188) reiterate the importance of both "interaction, synergy and cooperation" and of various types of inter-actor engagements to the genesis of innovation before extrapolating this relevance to the relationship between knowledge, innovation and economic growth. Informal institutions, as the underpinnings of trust and 'social capital', serve as regulators of these relations (Putnam, 1993; Fukuyama, 2000; Rodríguez-Pose and Storper, 2006; Rodríguez-Pose,

2013). Formal institutions, on the other hand, provide the more tangible framework within which they occur (e.g. North, 1990). Well-developed institutions are therefore thought to support, and may even be prerequisites for, the process by which knowledge and innovation are transformed into economic growth. Conversely, the absence of suitably mature institutional infrastructures could inhibit such a transformation.

Bearing all of this in mind, it becomes inevitable that different types of regions have different facilities for the mobilisation of knowledge and innovation. More specifically, lagging regions will not only be less innovative than their more economically developed counterparts, they are also likely to be less able to translate their innovative efforts into economic growth and dynamism. Lagging regions tend to be marked by lower levels of investment in the generation of new knowledge and, consequently, by minimal innovative capacities; by weaker economic fabrics; and by insufficiently deep pools of skilled human capital, as well as by poorer functioning and less efficient institutions (e.g. Rodríguez-Pose, 2001; Rodríguez-Pose and Di Cataldo, 2015).

The underinvestment in R&D that is characteristic of Europe's lagging regions – and of low-income ones (*Section 3.3*) in particular – curtails their capacity to generate the types of knowledge that serve not only as catalysts for innovation but also as facilitators of its productive application. The inadequacy of these regions' financial commitments to knowledge generation constrains their ability to absorb and exploit knowledge spillovers emanating from neighbouring areas as well. Similar consequences may be attributed to the skills shortages that are readily apparent in Europe's lesser-developed areas. Likewise, the weaker economic fabrics that characterise Europe's lagging regions – products of the types of firms, industries and activities they host – render them both less receptive to existing knowledge and innovation and less able to introduce it themselves. Moreover, the inefficiency of these regions' formal institutions and the underdevelopment of their informal ones increase uncertainly with the effect of discouraging both investment in and the more general pursuit of technological progress, whilst also limiting the interactions and other interactive processes that underpin the performance and mobilisation of knowledge-intensive activities.

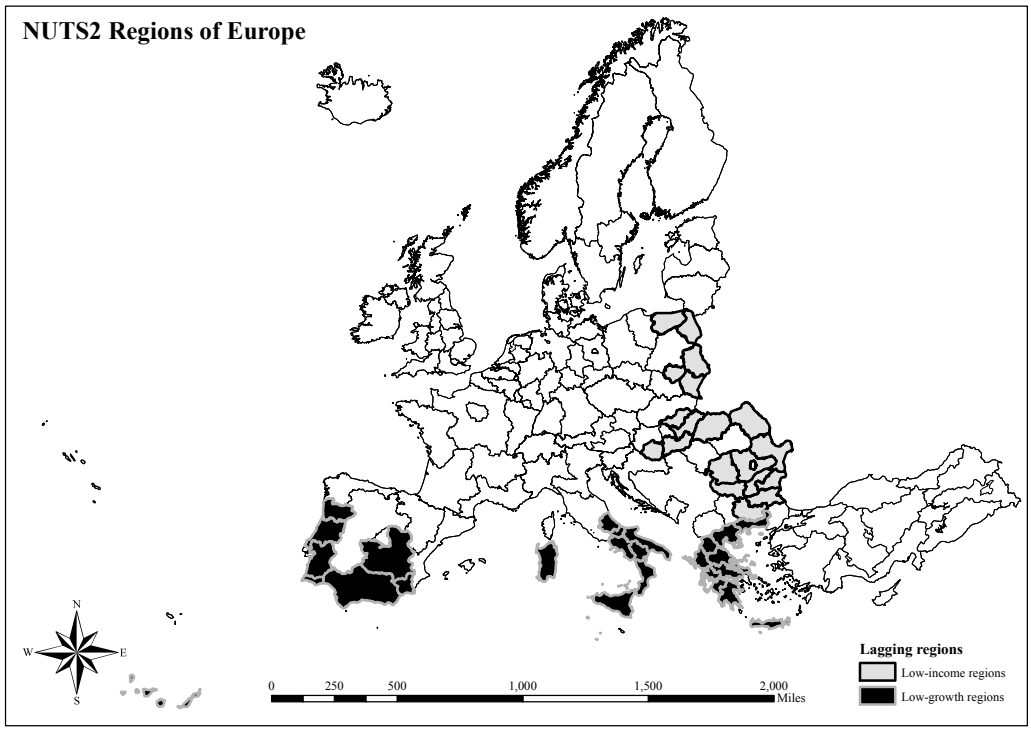
In short, one, or some combination of the aforementioned deficiencies will, according to the prevailing discourse, impair the capacity of Europe's lagging regions to realise economic benefit from whatever knowledge they have generated and innovations they have cultivated. Lagging regions are, however, heterogeneous entities. They may very well share broad similarities that are both cause and consequence of their classification as 'lagging'. Any similarities are, however, likely matched by equally important socioeconomic and institutional differences. This implies that while it is perhaps reasonable to expect that Europe's economically disadvantaged regions will, on balance, be less able to mobilise innovative efforts than their more economically developed counterparts, one cannot presume that *all* lagging regions will be similarly capable – or incapable – of doing so, and that the triadic relationship between knowledge, innovation and growth will manifest itself in the same away across them.

*It is this hypothesis that motivates the research.*

## 3.3. Europe's lagging regions: The 'low-growth/low-income' distinction

How different are the European Union's lagging regions? The European Commission, since its *6th Cohesion Report* (2014), distinguishes between 'low-income' and 'low-growth' regions. This distinction was motivated principally by the realisation that the development challenges faced by lagging regions are profoundly different and, moreover, that suitability differentiated policy responses will be needed to overcome them.

*Figure 3.1. The geography of Europe's lagging regions*




**Author's elaboration**

Assignment to one of the two categories of lagging regions is based, mainly, on a set of GDP-oriented criteria. The low-income regions category is composed of all European regions "*with a GDP per head in PPS below 50% of the EU average in 2013*" (DG Regio, 2015:1). Low-growth regions, on the other hand, are "*less developed and transition regions that did not converge to the EU average between the years 2000 and 2013 in Member States with a GDP per head in PPS below the EU average in 2013*" (DG Regio, 2015:1).

19 of Europe's 276 NUTS2 regions are classified as low-income. These regions are spread across four of the countries that make up Europe's eastern periphery - Bulgaria (5 regions), Hungary (4), Poland (5) and Romania (5). Europe's 28 low-growth regions are scattered across the continent's southern periphery; 11 are situated in Greece, five in Spain, eight in Italy and four in Portugal.

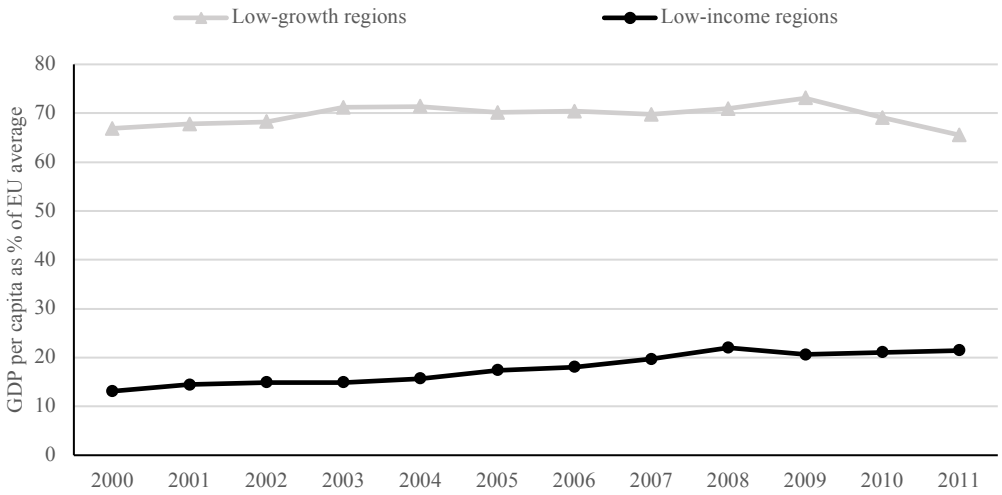
## 3.4. Assessing the heterogeneity of Europe's low-income and low-growth regions

There are two questions that must be addressed prior to proceeding with the econometric analysis: (i) how do Europe's low-income regions differ from their low-growth counterparts; and (ii) are the differences that emerge pronounced enough to justify the employment of the aforementioned distinction be it for analytical or policy-making purposes?

### 3.4.1. Comparing the economic performance and growth trajectories of Europe's low-income and low-growth regions

A suitable starting point for this taxonomic exercise is a comparison of the economic growth trajectories of the two types of lagging regions.

*Figure 3.2. Average GDP per capita of Europe's low-income and low-growth regions, relative to EU average, 2000-2011*



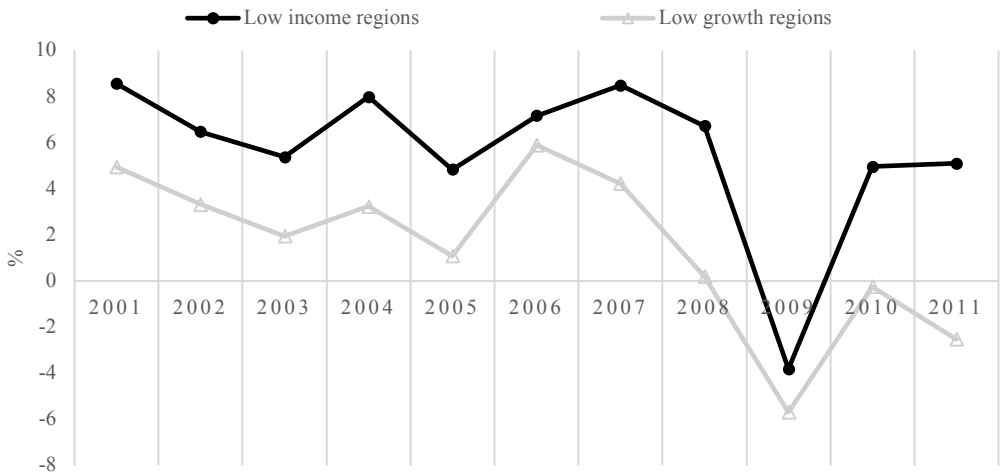

**Author's elaboration**

*Figure 3.2* depicts the average GDP per capita of Europe's low-income and low-growth regions relative to the EU average. While Europe's low-growth regions are more economically developed than their low-income counterparts, the average GDP per capita of both types of regions fell below the European average throughout the period of analysis. Interestingly, the gap between the two types of regions did

narrow towards the end of the timeframe. This convergence has, however, been modest and the gulf between them remains sizeable.

The aforementioned inferences are supplemented by those revealed by *Figure 3.3* which summarises the average annual change in GDP per capita (as a percentage of the previous year's GDP per capita) for low-growth and low-income regions, respectively. Prior to 2008, the GDP per capita of both types of regions were, on average, increasing annually. In 2008, however, the average annual change in GDP per capita for low-growth regions dropped close to zero and, in 2009, this figure turned negative for both types of lagging regions. It was then that a not inconsequential divergence occurred. In 2010, growth resumed in low-income regions – the average annual change in GDP per capita for low-income regions re-entered positive territory. The same cannot be said for low-growth regions. The average annual change in GDP per capita for low-growth regions stayed negative in 2010 and 2011.

*Figure 3.3. Average annual change in regional GDP per capita, 2000-2011*




**Author's elaboration**

Taken together, the gap between the average GDP per capita of Europe's low-income and low-growth regions (*Figure 3.2*) and the divergence in their growth trajectories (*Figure 3.3*) confirm that the economic fortunes of, and the challenges faced by, these two types of regions are distinctly different in spite of their shared status as 'lagging'. That is, the challenge with which low-income regions are faced is not necessarily related to catalysing growth, but rather to ensuring that that which is already occurring is socioeconomically and temporally sustainable, and that their GDP

per capita continue to converge to those of other European regions. For low-growth regions, on the other hand, the challenge centres on the reversal of economic stagnation and the re-ignition of growth.

Herein lies the motivation for employing the European Commission's taxonomy of lagging regions. The European Union's low-income and low-growth regions exemplify the heterogeneity of economically disadvantaged areas; the two types of regions are on markedly different development trajectories and, as a consequence, are facing different barriers, obstacles and challenges. This renders them the perfect subsample of lagging regions for an exploration of this nature. Moreover, because the European Union has declared the development of these regions a priority, they are likely to be the focus of an array of policies and strategies designed to mitigate and rectify the aforementioned challenges. By focusing on these two types of regions with the explicit aim of understanding the differences between them, this research will yield inferences and insights that are immediately relevant to policy-makers. More specifically, its conclusions can be used to inform the design of the contextually tailored innovation and development policies are likely to be pursued in these regions.

The analysis is guided by two specific research questions: First, and most importantly, are low-growth and low-income regions equally capable of transforming locally and extra-locally generated knowledge and innovation into economic growth? Second, and more generally, are processes of economic growth in low-income and low-growth regions, respectively, governed by the same set of more broadly-defined socioeconomic and institutional forces?

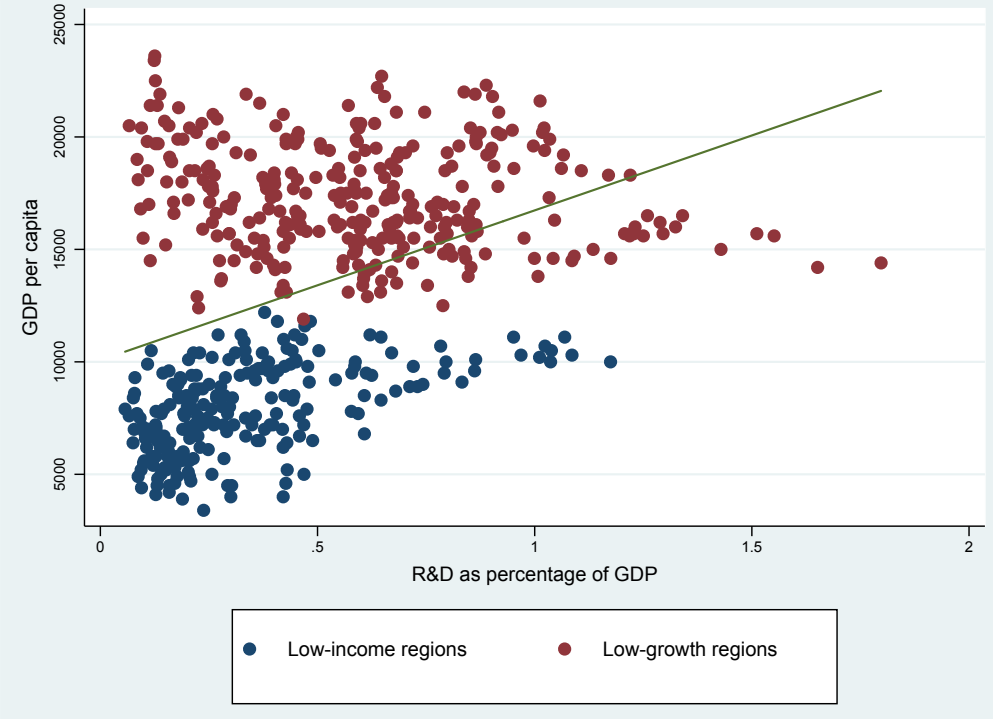
### 3.4.2. Exploring the socioeconomic and institutional fabrics of Europe's lagging regions

While their divergent economic fortunes may represent the most pronounced difference between Europe's low-income and low-growth regions, the consideration of a series of socioeconomic and institutional indicators reveals that the differences between them are not confined to their contrasting growth trajectories.

The examination of two barometers of regional innovative capacity – R&D expenditure as a percentage of GDP and patent applications to the European Patent

Office – confirms that the heterogeneity of low-income and low-growth regions is reflected in their financial commitments to the generation of new knowledge and their capacity to introduce applied, more tangible innovations.

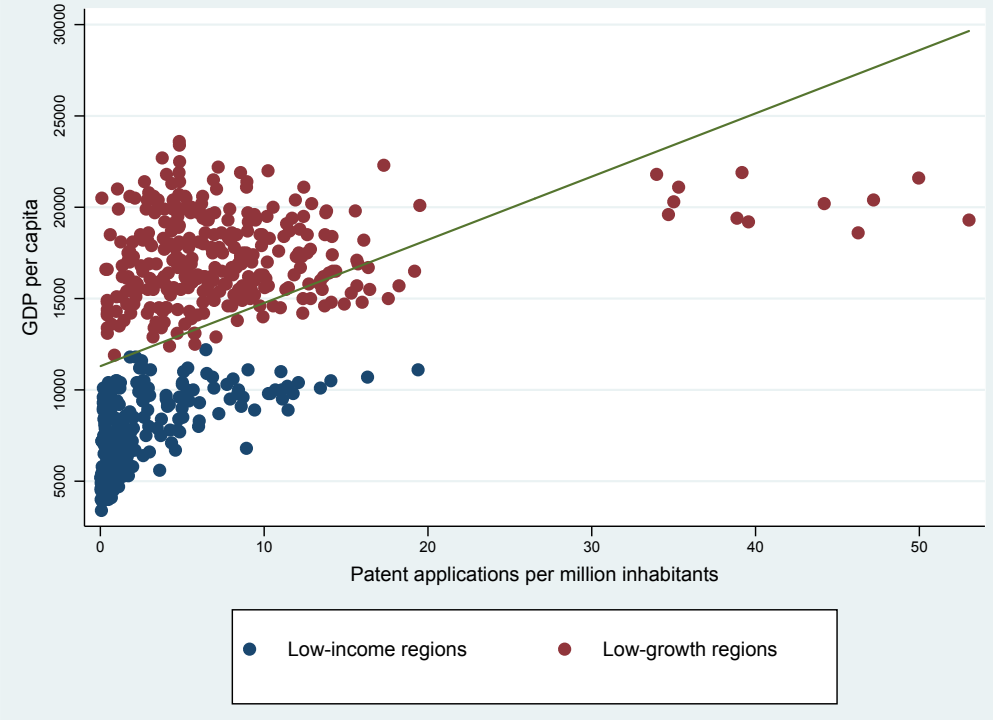
*Figure 3.4. R&D expenditure as a percentage of GDP*




**Author's elaboration**

Europe's low-growth regions are, on balance, more innovative – in terms of both inputs (R&D) and outputs (patent applications) – than their low-income counterparts (*Figures 3.4* and *3.5*). Regional R&D expenditure as a percentage of GDP relative to GDP per capita is summarised by *Figure 3.4*. *Figure 3.5* depicts regional patenting propensity, again with reference to GDP per head. Taken together, the figures provide an indication that even among Europe's most economically disadvantaged regions, higher levels of economic development are associated with greater investment in knowledge generating functions and better developed innovative capacities.

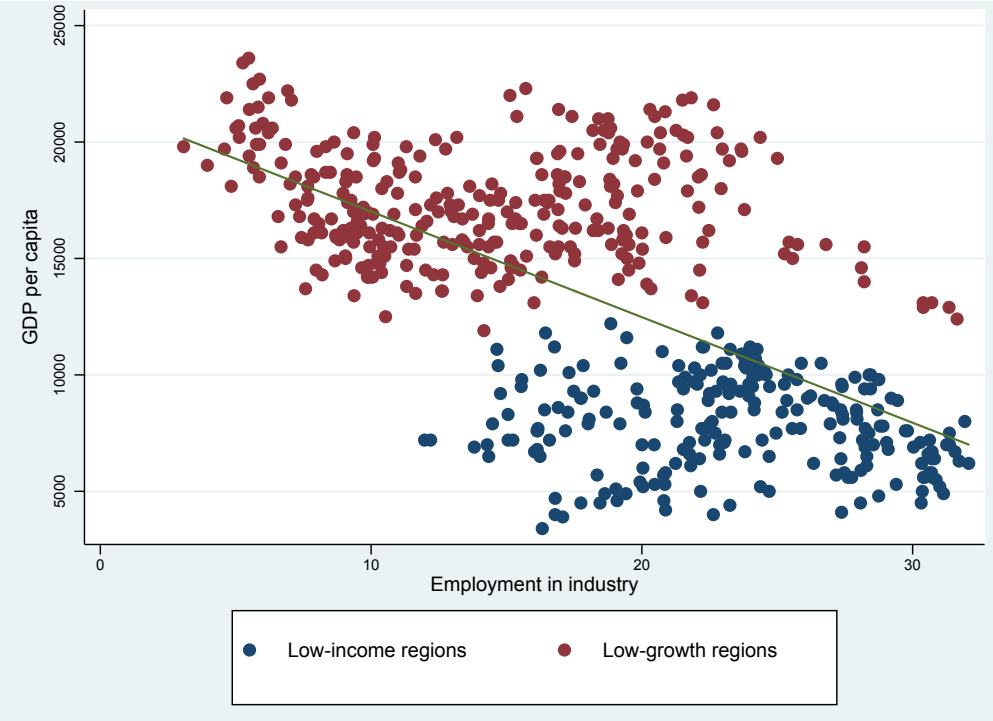
*Figure 3.5. Patent applications to the EPO per million inhabitants*




**Author's elaboration**

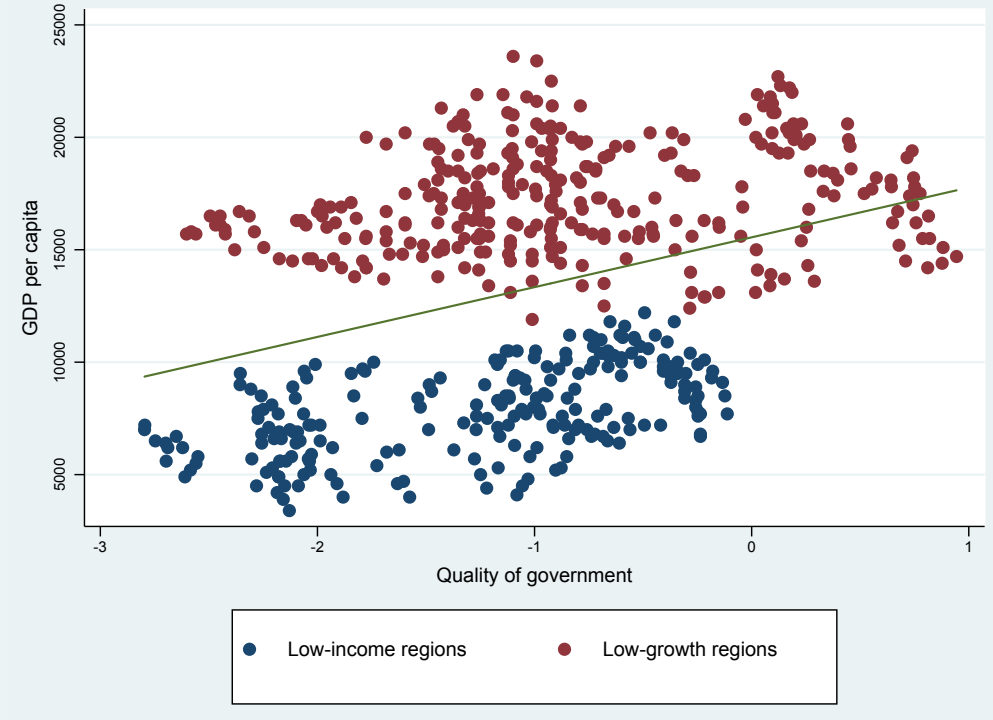
Further evidence of the heterogeneity of these lagging regions is found in a cursory comparison of their sectoral compositions. The negative correlation between GDP per capita and industrial employment revealed in *Figure 3.6* indicates that a greater share of workers is employed in 'industrial activities' in Europe's low-income regions than in their low-growth counterparts. Lower levels of industrial employment in Europe's low-growth regions are not indicative, in this case, of a less mature economic structure, but rather are part and parcel with the more robust service sectors these regions play host too. The service sector in Europe's low-income regions is relatively underdeveloped (50.66% of total employment in 2011) while agricultural- and natural resource-based activities (20.01%) and manufacturing (19.34%) account for a large share of total employment. In low-growth regions, an overwhelming majority of workers are employed in the service sector (65.93%).

*Figure 3.6. Employment in industry*




**Author's elaboration**

*Figure 3.7. Quality of government*

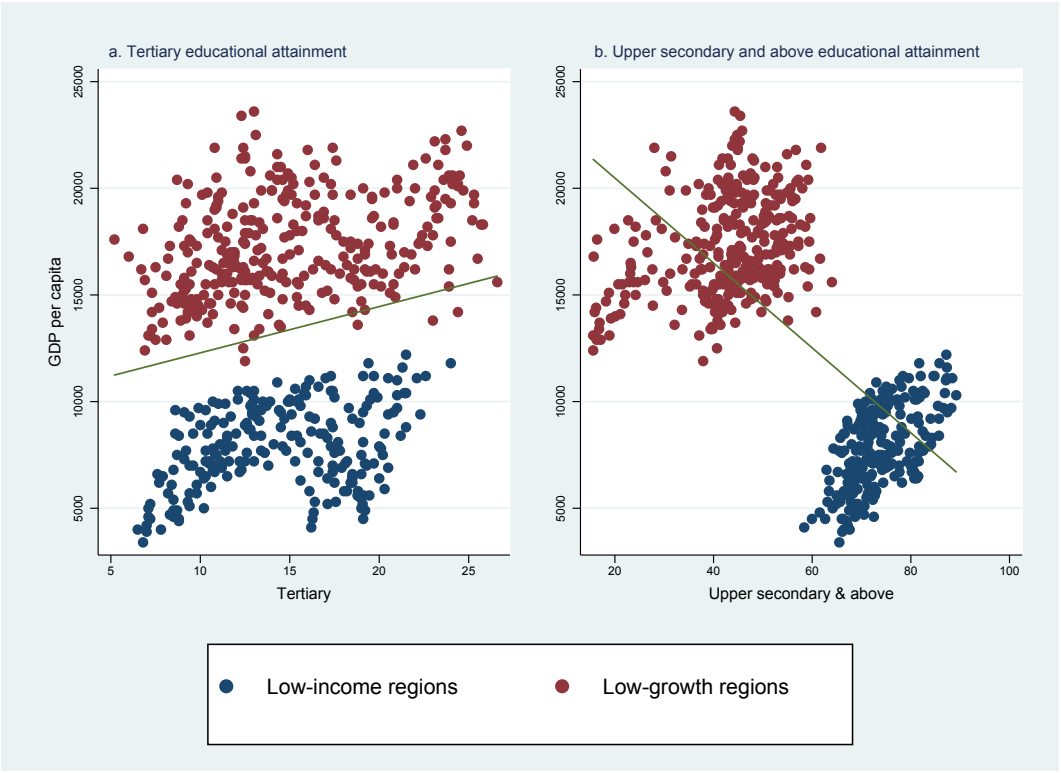



**Author's elaboration**

Another point of divergence between Europe's low-income and low-growth regions relates to the efficiency and functioning of their formal institutions. *Figure*

*3.7*, which plots quality of government against GDP per capita, indicates that Europe's low-growth regions feature, on balance, more mature, favourable institutional environments than their low-income counterparts. It should be noted that the gulf between the institutional qualities of the two types of lagging regions is less pronounced than say that which exists between their respective innovative capacities (*Figures 3.4* and *3.5*). That said, *Figure 3.7* leaves little doubt that there are differences between the quality of institutions in Europe's low-growth and low-income regions, respectively.

*Figure 3.8. Educational attainment*




**Author's elaboration**

Interestingly, neither low-income nor low-growth regions suffer from a debilitating shortage of highly skilled workers. Europe's lagging regions are endowed with comparable stocks of workers with a tertiary education (*Figure 3.8a*). This is perhaps the most marked similarly between them. In 2011, for example, an average of 17.5% and 18.2% of workers in low-income and low-growth regions, respectively, had completed a tertiary education. Low-income regions do, however, benefit from more robustly developed stocks of 'semi-skilled' labour (*Figure 3.8b*). In 2011, an average of 60.25% of working-age individuals in low-income regions had completed either an

upper secondary degree or some form of non-tertiary, post-secondary education. In low-growth regions, this figure was 31.29%.

### 3.4.3. Putting it all together

Low-income regions are marked most immediately by the rate and resilience of the growth they have achieved in recent years. They are endowed with reasonably highly skilled workforces but feature sectoral profiles in which less technologically sophisticated activities are prevalent and suffer from especially weak innovative capacities that are reflected in both their financial commitments to R&D and propensities to introduce patents. The latter two observations coupled with that that the institutions underpinning economic activity in Europe's low-income regions are of a lesser quality than those of their low-growth counterparts raise concerns about the extent to which these regions will be capable of translating knowledge and innovation into economic growth; it is anticipated that they will, on balance, struggle to do so.

The economic performance of Europe's low-growth regions throughout the period of analysis, and the slowdown and stagnation from which they suffered in the latter part of the 2000s, is what sets them apart from their low-income neighbours. This is not, however, the only point of divergence. Low-growth regions, while not especially innovative by European standards, invest more in the generation of knowledge and are certainly more innovative than their low-income counterparts. Their services-oriented sectoral profiles are also anticipated to be more conducive to knowledge-intensive activity than those of Europe's low-income regions. Their institutions are more – albeit marginally – effective, efficient and developed than those of their low-income peers as well. Finally, while highly skilled labour is not in overly short supply in Europe's low-growth regions, they do suffer from a dearth of the semi-skilled labour that is more abundant in the continent's low-income areas.

These observations, when taken together, give rise to a hypothesis about the relationship between innovative activity and economic growth in low-growth regions that is the opposite to that which was formulated for low-income ones. More specifically, low-growth regions benefit from reasonably mature pools of highly skilled workers that should afford them some capacity to internalise and exploit

knowledge and innovation; from economic structures that, relative to those of their low-income counterparts, seem more receptive to technologically sophisticated activities; and from institutions that, again relative to those of their low-income cousins, are more amenable to all manner of economic activity. It is therefore anticipated that low-growth regions will display some facility for the conversion of knowledge and innovation, locally generated or otherwise, into economic growth.

## 3.5. Methodology

### 3.5.1. The model

The research questions are explored using a basic econometric model within which a region's economic performance is a function of its investment in R&D; its innovative capacity; its exposure to 'spillovers'; its human capital endowment; its economic structure; the quality and efficiency of its institutions; and a vector of structural factors.

The model is specified as follows:

$$\begin{aligned}\Delta lnGDPpc_{i,t} = {} & \beta_1 R\&D_{i,t} + \beta_2 WR\&D_{i,t} + \beta_3 Patents_{i,t} + \beta_4 WPatents_{i,t} \\ & + \varphi_1 HumanK_{i,t} + \varphi_2 EconStructure_{i,t} + \varphi_3 Institutions_{i,t} + X_{i,t}'\theta \\ & + \delta_1 lnGDPpc_{i,t-1} + \phi_t + \lambda_i + \varepsilon_{i,t}\end{aligned}$$

Where:

| | |
|---|---|
| *ΔlnGDPpc* | represents economic growth proxied by annual changes in GDP per capita; |
| *R&D* | represents regional R&D expenditure; |
| *WR&D* | represents the average R&D expenditure of neighbouring regions; |
| *Patents* | represents regional innovative capacity; |
| *WPatents* | Represents the average regional innovative capacity of neighbouring regions; |
| *HumanK* | represents the availability of skilled human capital[26]; |
| *EconStructure* | represents the proportion of workers employed in industrial activities; |
| *Institutions* | is a measure of the quality of regional institutions; |
| *X* | is a vector of other structural variables; |
| $lnGDPpc_{t-1}$ | represents the level of regional GDP per capita in time period *t-1*; |
| *i,t* | represent region and time, respectively |

### 3.5.2. The variables

#### *3.5.2.1. The dependent variable*

The dependent variable is a measure of regional economic performance: the annual change of the logarithmic transformation of regional GDP per capita. The 'dynamic' nature of the dependent variable necessitates the inclusion of a lagged dependent variable on the right-hand side of the equation. Accordingly, regional GDP per capita in time period '*t – 1*' is included.

[26] The proxies for the availability of skilled human capital have been logarithmically transformed to address an issue of multicollinearity stemming from the inclusion of the Quality of Government index.

*3.5.2.2. Measures of knowledge and innovation*

Six related independent variables are included to assess the extent to which Europe's low-income and low-growth regions are capable of translating knowledge and innovation from different sources in economic dynamism:

First is regional R&D expenditure expressed as a percentage of GDP. R&D expenditure is employed as a proxy for investment in the generation of economically useful knowledge. The inclusion of this variable permits the formulation of inferences relating to the extent to which Europe's lagging regions are capable of translating locally generated knowledge into economic performance.

The second independent variable of interest is a proxy for regional innovativeness: patent applications to the European Patent Office per million inhabitants. Patent statistics are by no means a perfect proxy for regional innovative capacity.[27] That said, they are a reliable and consistent measure of the introduction of commercially viable, applied innovation. Regional patent intensity is therefore included to assess the relationship between the generation of more tangible, applied innovation and economic growth.

The remainder of the independent variables of interest are spatially-lagged ones. Regions can draw upon knowledge and innovations generated elsewhere to bolster their own innovative capacity (e.g. Bathelt et al., 2004; Feldman and Kogler, 2010). Exposure to externally generated knowledge and innovation may, in fact, be especially important for economically disadvantaged regions. An emerging body of empirical literature has provided evidence to suggest that exposure to externally generated knowledge and innovation can compensate for a lack of local knowledge and innovative dynamism (e.g. Fitjar and Rodríguez-Pose, 2011; 2016; Tödtling et al., 2012; Grillitsch and Nilsson, 2015). Suffice to say, the relationship between exposure to extra-local innovative activities and economic growth cannot be overlooked. *Table*

[27] The limitations of patent applications are well understood (e.g. Desrochers, 1998). The fact that many innovations are, for any number of reasons, are not patentable or are not patented has led many to assert that patent statistics paint an overly simplistic and perhaps biased picture of regional innovativeness. That said, patent statistics remain something of a standard proxy for research of this nature in large part because they are, as noted by Trajtenberg (1990:183), "the only observable manifestation of inventive activity with a well-grounded claim for universality".

*3.1* outlines the four spatially-lagged variables developed with the specific intention of capturing this relationship.

*Table 3.1. Spatially-lagged measures of knowledge and innovation*

| ***Variable:*** | ***Proxy for:*** |
|---|---|
| **Spatially-lagged R&D (1st-order contiguity)** | Exposure to the knowledge flows/spillovers emanating from a region's immediate neighbours |
| **Spatially-lagged R&D (inverse distance)** | Exposure to the knowledge flows/spillovers emanating from across Europe |
| **Spatially-lagged patent intensity (1st-order contiguity)** | Exposure to innovation occurring in and the innovation flows/spillovers emanating from a region's immediate neighbours |
| **Spatially-lagged patent intensity (inverse distance)** | Exposure to innovation occurring in and the innovation flows/spillovers emanating from across Europe |

The inclusion of these spatially-lagged variables adds an important dimension to the analysis; it ensures that the scope of the research is not confined simply to the extent to which Europe's low-income and low-growth regions are able to translate their own knowledge resources and innovations into economic growth. With these spatially-lagged variables, I can assess the way in which the economic performance of Europe's lagging regions is affected by processes transpiring beyond their immediate borders and, more specifically, by the innovative efforts of their European neighbours.

*3.5.2.3. Socioeconomic and institutional variables*

As indicated in *Section 3.2*, there are a multitude of structural, socioeconomic and institutional factors, characteristics and conditions that mediate the translation of innovative efforts into economic dynamism. A series of variables are incorporated into the analysis to control for these influences and explore their relevance in the geographic contexts with which this research is concerned.

*Section 3.2* posited that there are three factors that that stand out as especially relevant to the relationship between knowledge, innovation and economic performance: (i) the availability of skills; (ii) the industrial composition of a region's

economy and (iii) the functioning of their institutions. These fundamental factors are explored in the analysis via the inclusion of five variables.

Two measures educational attainment[28] – (1) tertiary educational attainment and (2) upper secondary and post-secondary non-tertiary educational attainment – are employed to probe the link between the availability of human capital and regional economic performance. Regional unemployment rates are included alongside the educational attainment variables to capture the relationship between the "productive employment" (Crescenzi et al., 2007:684) of that human capital and economic dynamism. The influence of industrial compositions and the structure of a region's economy is explored via the inclusion of an employment in industry as a percentage of total employment variable. Finally, the importance of the quality of regions' institutions is examined via the incorporation of the Quality of Government index to the model.

A handful of other variables are included to control for relevant structural influences. The importance of agglomeration – and of the knowledge-related externalities with which it is associated – to the achievement of economic growth is assessed via the inclusion of regional population density. A spatially-lagged GDP variable is employed, as is customary in comparable literature (e.g. Blonigen et al., 2007), as a measure of market accessibility. It is incorporated into the analysis to determine whether geographic peripherality serves as a boon or a barrier to growth and dynamism. Finally, the percentage of the population aged 15-24 is included to control for regions' respective demographic structures.

## 3.6. Results and analysis

The model is estimated using a panel data approach with time and region fixed-effects. Robust standard errors are employed. The explanatory variables of interest – the measures of knowledge and innovation (*Section 3.5.2.*2) – are fitted with two-year

[28] The inclusion of two related measures of educational attainment is motivated by the desire to capture the role played by different types of human capital. Tertiary educational attainment is a proxy for the availability of highly skilled human capital while upper secondary and post-secondary non-tertiary educational attainment is indicative of the availability of semi-skilled labour.

lags to reflect the assumption that the transformation of knowledge and innovation into economic growth is *not* instantaneous, and also to minimise issues of simultaneity. The analysis focuses on Europe's low-income and low-growth regions for the period between 2000 and 2011. A list of the regions considered in the analysis is provided in *Appendix 1*.

The section is structured as follows: *Section 3.6.1* summarises a set of specifications that consider low-income and low-growth regions together under the umbrella of 'lagging regions'. *Sections 3.6.2* and *3.6.3* separate low-income from low-growth regions and provide simple summaries of the estimation results. *Section 3.6.4* compares the two types of regions and provides a substantive interpretation of results.[29]

### 3.6.1. Lagging regions

Before exploring the growth dynamics of Europe's low-growth and low-income regions independently, the two types of lagging regions are considered together to ascertain insights that will serve as points of reference for the comparative analysis that follows in *Section 3.6.4*.

*Table 3.2* summarises the estimation results for Europe's lagging regions.[30]

[29] This research is exploratory in nature. I am therefore concerned, most immediately, with the direction and significance of the coefficients.

[30] The regional GDP per capita in 't-1' variable is included out of necessity (*Section 3.5*) and will therefore not be addressed in detail. That its coefficient is negative and significant across all specifications of the model for lagging, low-income and low-growth regions alike does, however, provide evidence of convergence among lagging (*Table 3.2*, *Specifications 1-10*), low-income (*Table 3.3*, *Specifications 1-10*) and low-growth (*Table 3 4*, *Specifications 1-10*) regions, respectively.

*Table 3.2. Europe's lagging regions*

| | All | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| PCT patents applications per million inhabitants | 0.000327 | 0.000261 | 0.000298 | 0.000248 | 0.000310 |
| | (0.000724) | (0.000703) | (0.000712) | (0.000698) | (0.000724) |
| R&D expenditure | 0.0133 | 0.0103 | 0.0109 | 0.00927 | 0.0127 |
| | (0.0225) | (0.0178) | (0.0214) | (0.0174) | (0.0232) |
| Spatially-lagged R&D (1st order contiguity) | | | 0.0178 | 0.00880 | |
| | | | (0.0186) | (0.0127) | |
| Spatially-lagged R&D (inverse distance) | | | | | 0.0378 |
| | | | | | (0.131) |
| Spatially-lagged patent applications (1st order contiguity) | | | | | |
| Spatially-lagged patent applications (inverse distance) | | | | | |
| Tertiary educational attainment | -0.0132 | | -0.0153 | | -0.0139 |
| | (0.0176) | | (0.0180) | | (0.0179) |
| Upper secondary and NON-tertiary educational attainment | | 0.0554* | | 0.0517* | |
| | | (0.0324) | | (0.0303) | |
| Unemployment rate | -0.00303*** | -0.00325*** | -0.00310*** | -0.00327*** | -0.00307*** |
| | (0.000674) | (0.000701) | (0.000678) | (0.000708) | (0.000701) |
| Percentage of the population aged 15-24 | 0.00553 | 0.00695 | 0.00529 | 0.00677 | 0.00539 |
| | (0.00656) | (0.00604) | (0.00652) | (0.00603) | (0.00665) |
| Employment in industry | 0.000978 | 0.00105 | 0.00104 | 0.00110 | 0.000984 |
| | (0.00176) | (0.00182) | (0.00173) | (0.00181) | (0.00176) |
| Population density | 0.00166** | 0.00184** | 0.00176** | 0.00189** | 0.00166** |
| | (0.000744) | (0.000717) | (0.000778) | (0.000751) | (0.000752) |
| Market access | 0.0422*** | 0.0453*** | 0.0428*** | 0.0454*** | 0.0422*** |
| | (0.00890) | (0.00963) | (0.00890) | (0.00960) | (0.00880) |
| Quality of government | 0.0704*** | 0.0709*** | 0.0692*** | 0.0701*** | 0.0699*** |
| | (0.0140) | (0.0136) | (0.0140) | (0.0135) | (0.0141) |
| GDP per capita (t-1) | -0.231*** | -0.225*** | -0.230*** | -0.224*** | -0.230*** |
| | (0.0242) | (0.0248) | (0.0241) | (0.0247) | (0.0237) |
| Constant | 1.691*** | 1.347*** | 1.665*** | 1.346*** | 1.643*** |
| | (0.248) | (0.221) | (0.241) | (0.222) | (0.269) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 450 | 450 | 450 | 450 | 450 |
| R-squared | 0.601 | 0.604 | 0.602 | 0.604 | 0.601 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

*Table 3.2. (Continued)*

| | All | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| PCT patents applications per million inhabitants | 0.000283<br>(0.000711) | 0.000286<br>(0.000727) | 0.000223<br>(0.000706) | 0.000229<br>(0.000706) | 0.000167<br>(0.000689) |
| R&D expenditure | 0.0109<br>(0.0189) | 0.0125<br>(0.0222) | 0.00971<br>(0.0176) | 0.0123<br>(0.0221) | 0.00946<br>(0.0170) |
| Spatially-lagged R&D (1st order contiguity) | | | | | |
| Spatially-lagged R&D (inverse distance) | -0.0590<br>(0.115) | | | | |
| Spatially-lagged patent applications (1st order contiguity) | | 0.000985*<br>(0.000514) | 0.000879*<br>(0.000474) | | |
| Spatially-lagged patent applications (inverse distance) | | | | 0.00477*<br>(0.00249) | 0.00415*<br>(0.00227) |
| Tertiary educational attainment | | -0.0150<br>(0.0174) | | -0.0199<br>(0.0181) | |
| Upper secondary and NON-tertiary educational attainment | 0.0617*<br>(0.0341) | | 0.0529<br>(0.0323) | | 0.0550*<br>(0.0313) |
| Unemployment rate | -0.00321***<br>(0.000721) | -0.00302***<br>(0.000665) | -0.00323***<br>(0.000695) | -0.00292***<br>(0.000675) | -0.00315***<br>(0.000703) |
| Percentage of the population aged 15-24 | 0.00728<br>(0.00601) | 0.00642<br>(0.00654) | 0.00771<br>(0.00607) | 0.00595<br>(0.00628) | 0.00742<br>(0.00581) |
| Employment in industry | 0.00101<br>(0.00182) | 0.00106<br>(0.00176) | 0.00115<br>(0.00183) | 0.00112<br>(0.00171) | 0.00125<br>(0.00179) |
| Population density | 0.00186***<br>(0.000689) | 0.00170**<br>(0.000749) | 0.00187**<br>(0.000726) | 0.00135*<br>(0.000753) | 0.00159**<br>(0.000729) |
| Market access | 0.0459***<br>(0.00945) | 0.0402***<br>(0.00874) | 0.0433***<br>(0.00949) | 0.0353***<br>(0.0100) | 0.0390***<br>(0.0106) |
| Quality of government | 0.0721***<br>(0.0135) | 0.0713***<br>(0.0140) | 0.0715***<br>(0.0137) | 0.0735***<br>(0.0136) | 0.0729***<br>(0.0134) |
| GDP per capita (t-1) | -0.226***<br>(0.0249) | -0.226***<br>(0.0243) | -0.220***<br>(0.0250) | -0.225***<br>(0.0239) | -0.218***<br>(0.0250) |
| Constant | 1.398***<br>(0.260) | 1.650***<br>(0.248) | 1.313***<br>(0.224) | 1.395***<br>(0.297) | 1.059***<br>(0.277) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 450 | 450 | 450 | 450 | 450 |
| R-squared | 0.604 | 0.603 | 0.606 | 0.604 | 0.606 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The most suitable point of departure for the analysis is an examination of the relationships between regional economic performance and the six measures of knowledge and innovation. Neither regional investment in R&D nor patent intensity are found to be significantly related to the economic performance of Europe's lagging regions. This implies that these regions are, on balance, incapable of converting any knowledge they generate or innovations they cultivate into economic growth (*Specifications 1-10*).

There is, however, evidence to suggest that these regions *may* have some facility for the mobilisation of innovation spillovers emanating from both the their immediate and more distant European neighbours; the coefficients of both spatially-lagged patenting variables are statistically significant (*Specifications 7-10*). This facility is not, as evidenced by the absence of significant relationships between economic growth and the spatially-lagged R&D variables, matched by a comparable one for the absorption and exploitation of R&D spillovers (*Specifications 3-6*).

The inference drawn from the emergence of a positive relationship between regional economic performance and exposure to innovation spillovers – and from the insignificance of the coefficients of the other variables of interest – is that the economic performance of Europe's lagging regions seems to be mediated more by innovative activities transpiring *beyond* their borders than by those occurring within them. A logical extension of this inference is that the strategic efforts these regions have undertaken to catalyse and support innovative activity are yet to yield returns in the form of growth.

The results also provide an indication of the way in which the economic performance of Europe's lagging regions is governed by other socioeconomic, institutional and structural influences. The quality of these regions' institutions is, for one, revealed as a preeminent determinant of their dynamism. The coefficient of the quality of government variable is positive and strongly significant across all specifications (*Specifications 1-10*). Positive and significant relationships between the economic performance of Europe's lagging regions and their physical proximity to other regions and the markets they host (*Specifications 1-10*); the availability of semi-skilled human capital (*Specifications 2, 4, 6, 10*); and the agglomeration of economic

activity (*Specifications 1-10*) emerge as well. There is also evidence of a significant association between a lagging region's capacity to mobilise its human capital, proxied by the unemployment rate, and its economic performance (*Specifications 1-10*).

The dynamism of these regions does not, on the other hand, appear to be influenced by the structure of their respective economies or by the availability of highly skilled human capital; the coefficients of the tertiary educational attainment and industrial employment variables are statistically insignificant across all specifications of the model (*Specifications 1-10*).

Taken together the specifications summarised in *Table 3.2* would *seem* to shed a great deal of light on the factors that condition the economic dynamism of Europe's lagging regions. The question that remains to be addressed, however, relates to whether the aggregation of low-income and low-growth regions is masking fundamental differences between the factors, forces and features that drive and shape processes of economic growth and change in them. There is good reason to think that it may. The differences between Europe's low-income and low-growth regions are numerous and manifest themselves across a number of axes (*Section 3.4*). The body of literature within which this research is situated (*Section 3.2*) suggests that it is unlikely that regions as heterogeneous as these are drawing on and mobilising the same resources, or are facing the same obstacles and impediments, in their pursuit of economic growth.

### 3.6.2. Low-income regions

*Table 3.3* summarises the estimation results for Europe's low-income regions.

Once again, I begin the analysis, this time of Europe's low-income regions, with the six variables of primary interest (*Section 3.5.2.2*). Regional R&D expenditure, as a proxy for investment in the generation and subsequent availability of knowledge, is not significantly linked to their economic dynamism (*Specifications 1-10*). There is, however, evidence of a positive and statistically significant relationship between regional patent intensity and economic growth (*Specifications 1, 3, 5, 7, 9, 10*). It should be highlighted that the coefficients of the patent intensity variable are only

significant in model specifications that control for tertiary educational attainment.[31] This suggests that the process by which innovation is translated into economic performance in Europe's low-income regions could be undermined by an absence of suitability skilled human capital.

Similarly, the coefficients of the spatially-lagged measures of knowledge and innovation imply that the economic performance of Europe's low-income regions is not free from external influence. That is, while exposure to shorter-distance knowledge and innovation spillovers is unrelated to their economic dynamism (*Specifications 3, 4, 7, 8*), the results suggest that the economic performance of these territories is negatively and significantly associated with exposure to longer-distance knowledge and innovation flows alike (*Specifications 5, 6, 9, 10*).

The results also indicate that the economic performance of Europe's low-income regions is mediated, more generally, by their economic structures, their demographic compositions, externalities associated with the agglomeration of economic activity and by the quality, functioning and efficiency of their institutions. Employment in industry is positively and significantly related to economic growth across all specifications of the model, as are the quality of government, the population density, and the percentage of the population aged 15-24 variables (*Specifications 1-10*).

Market accessibility, educational attainment and levels of unemployment are, on the other hand, not robustly linked to the economic performance of these regions (*Specifications 1-10*).

[31] *Specification 10 is the only outlier.*

*Table 3.3. Europe's low-income regions*

| | **Low-income regions** | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| PCT patents applications per million inhabitants | 0.00178* | 0.00143 | 0.00175* | 0.00141 | 0.00201* |
| | (0.000847) | (0.000890) | (0.000907) | (0.000940) | (0.000963) |
| R&D expenditure | 0.00822 | 0.00558 | 0.0129 | 0.00837 | 0.00911 |
| | (0.0248) | (0.0250) | (0.0261) | (0.0254) | (0.0247) |
| Spatially-lagged R&D (1st order contiguity) | | | -0.0270 | -0.0163 | |
| | | | (0.0643) | (0.0665) | |
| Spatially-lagged R&D (inverse distance) | | | | | -0.555** |
| | | | | | (0.215) |
| Spatially-lagged patent applications (1st order contiguity) | | | | | |
| Spatially-lagged patent applications (inverse distance) | | | | | |
| Tertiary educational attainment | -0.0285 | | -0.0295 | | -0.0298 |
| | (0.0401) | | (0.0406) | | (0.0405) |
| Upper secondary and NON-tertiary educational attainment | | -0.0940 | | -0.0908 | |
| | | (0.114) | | (0.120) | |
| Unemployment rate | 0.000691 | 0.000711 | 0.000691 | 0.000709 | 0.00107 |
| | (0.000954) | (0.000905) | (0.000960) | (0.000909) | (0.000935) |
| Percentage of the population aged 15-24 | 0.0278*** | 0.0218** | 0.0288*** | 0.0225** | 0.0275*** |
| | (0.00912) | (0.00935) | (0.00966) | (0.0105) | (0.00891) |
| Employment in industry | 0.00568*** | 0.00585*** | 0.00559*** | 0.00580*** | 0.00544*** |
| | (0.00162) | (0.00165) | (0.00171) | (0.00173) | (0.00161) |
| Population density | 0.00996*** | 0.00625** | 0.0103*** | 0.00647* | 0.00998*** |
| | (0.00317) | (0.00280) | (0.00333) | (0.00314) | (0.00303) |
| Market access | -0.0173 | -0.0254 | -0.0169 | -0.0251 | -0.00752 |
| | (0.0231) | (0.0247) | (0.0233) | (0.0252) | (0.0203) |
| Quality of government | 0.112*** | 0.0998*** | 0.114*** | 0.101*** | 0.107*** |
| | (0.0289) | (0.0268) | (0.0307) | (0.0294) | (0.0289) |
| GDP per capita (t-1) | -0.265*** | -0.272*** | -0.263*** | -0.271*** | -0.252*** |
| | (0.0504) | (0.0651) | (0.0497) | (0.0663) | (0.0467) |
| Constant | 1.349* | 2.165 | 1.303* | 2.115 | 1.776** |
| | (0.666) | (1.296) | (0.670) | (1.377) | (0.754) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 190 | 190 | 190 | 190 | 190 |
| R-squared | 0.663 | 0.664 | 0.664 | 0.664 | 0.669 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

*Table 3.3. (Continued)*

| | Low-income regions | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| PCT patents applications per million inhabitants | 0.00165<br>(0.00104) | 0.00175*<br>(0.000866) | 0.00142<br>(0.000910) | 0.00246*<br>(0.00124) | 0.00235*<br>(0.00130) |
| R&D expenditure | 0.00638<br>(0.0247) | 0.00614<br>(0.0245) | 0.00496<br>(0.0225) | 0.0235<br>(0.0258) | 0.0253<br>(0.0255) |
| Spatially-lagged R&D (1st order contiguity) | | | | | |
| Spatially-lagged R&D (inverse distance) | -0.527**<br>(0.210) | | | | |
| Spatially-lagged patent applications (1st order contiguity) | | 0.000851<br>(0.00357) | 0.000226<br>(0.00395) | | |
| Spatially-lagged patent applications (inverse distance) | | | | -0.0145*<br>(0.00733) | -0.0170*<br>(0.00831) |
| Tertiary educational attainment | | -0.0317<br>(0.0335) | | -0.00404<br>(0.0254) | |
| Upper secondary and NON-tertiary educational attainment | -0.0815<br>(0.112) | | -0.0939<br>(0.113) | | -0.177*<br>(0.0970) |
| Unemployment rate | 0.00106<br>(0.000897) | 0.000642<br>(0.00106) | 0.000697<br>(0.00102) | 0.00107<br>(0.00103) | 0.00123<br>(0.00104) |
| Percentage of the population aged 15-24 | 0.0220**<br>(0.00915) | 0.0285***<br>(0.00942) | 0.0220**<br>(0.00953) | 0.0286***<br>(0.00853) | 0.0214**<br>(0.00826) |
| Employment in industry | 0.00563***<br>(0.00163) | 0.00557***<br>(0.00166) | 0.00583***<br>(0.00170) | 0.00579***<br>(0.00172) | 0.00587***<br>(0.00180) |
| Population density | 0.00645**<br>(0.00262) | 0.00993***<br>(0.00322) | 0.00619*<br>(0.00325) | 0.0127***<br>(0.00386) | 0.00954**<br>(0.00351) |
| Market access | -0.0156<br>(0.0221) | -0.0186<br>(0.0269) | -0.0258<br>(0.0304) | -0.00927<br>(0.0207) | -0.0167<br>(0.0217) |
| Quality of government | 0.0955***<br>(0.0265) | 0.112***<br>(0.0298) | 0.0995***<br>(0.0283) | 0.126***<br>(0.0311) | 0.114***<br>(0.0279) |
| GDP per capita (t-1) | -0.258***<br>(0.0621) | -0.261***<br>(0.0463) | -0.271***<br>(0.0575) | -0.334***<br>(0.0396) | -0.362***<br>(0.0517) |
| Constant | 2.481*<br>(1.330) | 1.321**<br>(0.616) | 2.159<br>(1.254) | 2.601***<br>(0.570) | 4.145***<br>(1.102) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 190 | 190 | 190 | 190 | 190 |
| R-squared | 0.669 | 0.664 | 0.664 | 0.678 | 0.684 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

### 3.6.3. Low-growth regions

*Table 3.4* summarises the estimation results for Europe's low-growth regions.

The analysis of Europe's low-growth regions begins, yet again, with an examination of the extent to which these regions are capable of translating the knowledge-intensive and innovative activities they host, and are exposed to, into economic growth. Neither patent intensity nor regional investment in R&D is statistically significantly related to their economic dynamism (*Specifications 1-10*). Their economic performance is, however, affected by the knowledge-intensive and innovative activities occurring beyond their borders. The analysis reveals positive and significant relationships between regional economic performance and exposure to short- and long-distance knowledge and innovation flows alike (*Specifications 3-5, 7-10*). Interestingly, the statistical significance of these relationships is greater in specifications that control for levels of tertiary educational attainment (*Specifications 1, 3, 5, 7, 9*).

The availability of skills is also found to be a preeminent determinant of the economic performance of Europe's low-growth regions. The coefficients of the upper secondary and post-secondary non-tertiary educational attainment variable are positive and significant in all specifications of the model in which they are included (*Specifications 2, 4, 6, 8, 10*). It is perhaps not surprising then that the results reveal a significant relationship between levels of unemployment – as a proxy for a region's capacity to mobilise its human capital – and economic dynamism (*Specifications 1-10*). The coefficients of the tertiary educational attainment variable are not, however, statistically significant (*Specifications 1, 3, 5, 7, 9*). Significant relationships also emerge between the economic performance of Europe's low growth regions and both the population density and market access variables (*Specifications 1-10*). Evidence to suggest that their dynamism is conditioned by the quality and functioning of the institutions that underpin them is found as well (*Specifications 1-10*).

*Table 3.4. Europe's low-growth regions*

| | Low-growth regions | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| PCT patents applications per million inhabitants | 7.37e-05 | -9.80e-05 | 1.91e-06 | -0.000129 | -2.93e-05 |
| | (0.000792) | (0.000765) | (0.000761) | (0.000756) | (0.000767) |
| R&D expenditure | 0.0124 | 0.00267 | 0.00703 | 0.000135 | 0.00761 |
| | (0.0299) | (0.0177) | (0.0256) | (0.0157) | (0.0256) |
| Spatially-lagged R&D (1st order contiguity) | | | 0.0444* | 0.0259* | |
| | | | (0.0227) | (0.0131) | |
| Spatially-lagged R&D (inverse distance) | | | | | 0.388*** |
| | | | | | (0.138) |
| Spatially-lagged patent applications (1st order contiguity) | | | | | |
| Spatially-lagged patent applications (inverse distance) | | | | | |
| Tertiary educational attainment | 0.0284 | | 0.0255 | | 0.0169 |
| | (0.0281) | | (0.0276) | | (0.0278) |
| Upper secondary and NON-tertiary educational attainment | | 0.167*** | | 0.157*** | |
| | | (0.0395) | | (0.0357) | |
| Unemployment rate | -0.00424*** | -0.00468*** | -0.00448*** | -0.00480*** | -0.00420*** |
| | (0.000657) | (0.000650) | (0.000683) | (0.000681) | (0.000659) |
| Percentage of the population aged 15-24 | -0.00753 | -0.00360 | -0.00766 | -0.00391 | -0.00563 |
| | (0.00993) | (0.00879) | (0.00961) | (0.00893) | (0.00954) |
| Employment in industry | -0.000486 | -0.000688 | -0.000519 | -0.000695 | -0.000452 |
| | (0.00255) | (0.00197) | (0.00237) | (0.00196) | (0.00235) |
| Population density | 0.00310*** | 0.00312*** | 0.00342*** | 0.00330*** | 0.00294*** |
| | (0.000823) | (0.000673) | (0.000871) | (0.000748) | (0.000838) |
| Market access | 0.0711*** | 0.0743*** | 0.0667*** | 0.0715*** | 0.0617*** |
| | (0.0120) | (0.0116) | (0.0119) | (0.0117) | (0.0114) |
| Quality of government | 0.0750*** | 0.0654*** | 0.0645*** | 0.0599*** | 0.0466*** |
| | (0.0169) | (0.0135) | (0.0148) | (0.0131) | (0.0158) |
| GDP per capita (t-1) | -0.345*** | -0.414*** | -0.358*** | -0.417*** | -0.368*** |
| | (0.0372) | (0.0489) | (0.0371) | (0.0515) | (0.0346) |
| Constant | 2.593*** | 2.729*** | 2.704*** | 2.785*** | 2.433*** |
| | (0.377) | (0.446) | (0.369) | (0.460) | (0.342) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 260 | 260 | 260 | 260 | 260 |
| R-squared | 0.693 | 0.725 | 0.701 | 0.727 | 0.705 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

*Table 3.4. (Continued)*

| | Low-growth regions | | | | |
|---|---|---|---|---|---|
| | (6) | (7) | (8) | (9) | (10) |
| PCT patents applications per million inhabitants | -0.000129<br>(0.000759) | 9.32e-05<br>(0.000804) | -8.16e-05<br>(0.000774) | 0.000118<br>(0.000817) | -5.50e-05<br>(0.000780) |
| R&D expenditure | 0.00132<br>(0.0166) | 0.0114<br>(0.0293) | 0.00231<br>(0.0177) | 0.0105<br>(0.0282) | 0.00198<br>(0.0171) |
| Spatially-lagged R&D (1st order contiguity) | | | | | |
| Spatially-lagged R&D (inverse distance) | 0.197<br>(0.127) | | | | |
| Spatially-lagged patent applications (1st order contiguity) | | 0.00130**<br>(0.000593) | 0.000882*<br>(0.000506) | | |
| Spatially-lagged patent applications (inverse distance) | | | | 0.0107**<br>(0.00441) | 0.00736*<br>(0.00420) |
| Tertiary educational attainment | | 0.0310<br>(0.0280) | | 0.0232<br>(0.0270) | |
| Upper secondary and NON-tertiary educational attainment | 0.149***<br>(0.0394) | | 0.162***<br>(0.0397) | | 0.157***<br>(0.0390) |
| Unemployment rate | -0.00462***<br>(0.000629) | -0.00423***<br>(0.000628) | -0.00467***<br>(0.000641) | -0.00408***<br>(0.000591) | -0.00455***<br>(0.000589) |
| Percentage of the population aged 15-24 | -0.00302<br>(0.00895) | -0.00706<br>(0.00968) | -0.00345<br>(0.00874) | -0.00808<br>(0.00920) | -0.00419<br>(0.00861) |
| Employment in industry | -0.000618<br>(0.00199) | -0.000293<br>(0.00249) | -0.000579<br>(0.00200) | -0.000582<br>(0.00240) | -0.000721<br>(0.00204) |
| Population density | 0.00306***<br>(0.000679) | 0.00319***<br>(0.000817) | 0.00316***<br>(0.000672) | 0.00242***<br>(0.000835) | 0.00267***<br>(0.000654) |
| Market access | 0.0692***<br>(0.0121) | 0.0671***<br>(0.0110) | 0.0714***<br>(0.0109) | 0.0510***<br>(0.0120) | 0.0603***<br>(0.0104) |
| Quality of government | 0.0518***<br>(0.0137) | 0.0754***<br>(0.0169) | 0.0662***<br>(0.0137) | 0.0862***<br>(0.0176) | 0.0735***<br>(0.0143) |
| GDP per capita (t-1) | -0.418***<br>(0.0490) | -0.347***<br>(0.0372) | -0.413***<br>(0.0492) | -0.367***<br>(0.0383) | -0.425***<br>(0.0524) |
| Constant | 2.621***<br>(0.468) | 2.611***<br>(0.363) | 2.748***<br>(0.439) | 2.282***<br>(0.359) | 2.499***<br>(0.427) |
| Region fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Time fixed-effects | Yes | Yes | Yes | Yes | Yes |
| Observations | 260 | 260 | 260 | 260 | 260 |
| R-squared | 0.728 | 0.698 | 0.727 | 0.702 | 0.729 |

**Robust standard errors in parentheses**

***** p<0.01, ** p<0.05, * p<0.1**

The economic performance of these regions is not, on the other hand, significantly connected to their industrial compositions or demographic profiles (*Specifications 1-10*).

### 3.6.4. Comparing Europe's low-income and low-growth regions

When considered together, the economic performance of Europe's low-income and low-growth regions appears to be influenced less by the intensity of their respective innovative efforts and more by five institutionally-, socioeconomically- and structurally-related factors. Europe's lagging regions seem to benefit, first, from being physically proximate to other markets and the activities and firms they host. The co-location of economic actors and activities and, more specifically, the externalities with which agglomeration is associated appear to support processes of economic growth and change in them as well. The availability of not necessarily highly skilled labour, but rather of semi-skilled human capital is also linked to the economic dynamism of these regions, as is their capacity to mobilise it. The economic performance of Europe's lagging regions is, finally, mediated by the quality and functioning of their institutions; those that are endowed with efficient and effective institutions are anticipated to outperform those that are not.

It would, however, be unwise to formulate definitive conclusions about the economic performance of, and, more specifically, about the relationship between knowledge, innovation and economic performance in, Europe's lagging regions without separating the continent's low-income regions from their low-growth counterparts.

The disaggregation of low-growth and low-income regions affirms that an inability to mobilise the knowledge generated by locally hosted R&D activities is pervasive. That the economic performances of low-growth and low-income regions alike seems to be detached from the scale of the R&D efforts transpiring within them is not particularly surprising; it has long been postulated that economically disadvantaged regions will be less capable of mobilising the knowledge they generate than their more developed, generally more innovative counterparts.

The aforementioned finding is, in that respect, consistent with theoretically-founded expectation. This inability to mobilise local R&D efforts is explicable by any number of socioeconomic or institutional influences. It is not unreasonable to propose that the intensity, or lack thereof, of R&D investment in the two types of lagging regions may be chief among them. The Schumpeterian perspective posits that investment in R&D will only deliver benefits, in this case in the form of growth, once it exceeds a certain, contextually-contingent 'threshold' (Rodríguez-Pose, 2001). It may be the case, then, that these regions', and especially the low-income ones', meagre financial commitments to generation of knowledge are impeding the translation of their R&D efforts into economic dynamism.

That said, one would be remiss to overlook broader socioeconomic and institutional influences. Low-growth and low-income regions are burdened, albeit to varying degrees, by less-efficient and less-well-functioning institutions and by *relatively* technologically unsophisticated economic fabrics. Both of these deficiencies are anticipated, for reasons outlined in *Section 3.2*, to serve as impediments to the process by which knowledge is translated into dynamism. These, and other, socioeconomic and institutional shortcomings appear to be pronounced enough to curtail these lagging regions' respective capacities to mobilise R&D and are contributing factors to their inability translate knowledge into economic performance.

While an inability to mobilise local R&D activities and the knowledge they yield does seem pervasive, the separation of Europe's low-income regions from their low-growth counterparts reveals that the same cannot be said about their respective facilities for the transformation of innovation into economic dynamism. Europe's low-income regions, unlike their low-growth neighbours, are able to translate at least some of the innovative activity they have managed to cultivate into economic growth. The innovative capacities of these regions are, however, relatively weak; they are considerably less innovative than both their low-growth counterparts and their more developed European neighbours in general. This implies that any facility these regions have for the mobilisation of innovative activity goes under-exploited.

The differences between the two types of regions in terms of their respective abilities to exploit different types and sources of knowledge and innovation do not stop

there. Europe's low-growth regions, despite suffering from an inability to mobilise the innovative efforts they host, display a facility for the productive exploitation of knowledge *and* innovation flows emanating from both their immediate and their more geographically distant neighbours. Their low-income counterparts do not. In fact, the negative relationships between the economic performance of Europe's low-income regions and their exposure to longer-distance knowledge *and* innovation spillovers suggest that regions in the European 'core' may be drawing resources, knowledge and innovations *away* from these lagging territories. Their prospects for future dynamism and development may, in that respect, be suffering at the hand of their more developed neighbours.

There are two explanations for the differences between low-income and low-growth regions' respective facilities for the exploitation of spillovers generated by knowledge-intensive and innovative activities transpiring beyond their borders. The first is socioeconomically and institutionally-related. Neither low-growth nor low-income regions offer contextual conditions that are particularly conducive or amenable to technologically sophisticated activity, or to its conversion into growth. The severity of the deficiencies by which the two types of regions are plagued does, however, vary.

In the case of Europe's low-income regions, said deficiencies seem to be pronounced enough to render these regions all but completely incapable of identifying and absorbing interregional spillovers. They may even be hampering their capacity to embed and retain locally generated knowledge and innovation. Low-growth regions, on the other hand, invest more in R&D and display a greater overall innovative capacity. They benefit from levels of institutional efficiency that exceed those of their less developed neighbours and from economic fabrics that, while not particularly 'innovation prone', are more mature and technologically sophisticated. Low-growth regions even have a marginal edge in the availability of highly skilled human capital. None of these advantages are, in and of themselves, quantitatively massive. It would appear, however, that together, these slight advantages work synergistically to afford Europe's low-growth regions some measure of 'absorptive capacity' (Cohen and Levinthal, 1989; Griffith et al., 2004) that, at the very least, exceeds that of their low-income peers. It is, in fact, evidently sufficient to facilitate the translation of

knowledge and innovation flows emanating from other regions, and from the more geographically distant European core in particular, into economic dynamism.

The second factor relates to the overall innovative capacity – or lack thereof – of Europe's low-growth regions. Levels of R&D expenditure in these regions *do* exceed those of their low-income neighbours. They may even be, as addressed, sufficient to facilitate the absorption of knowledge and innovation flows from abroad. They are not, however, remotely close to those of the vast majority of their European peers. It is therefore not unreasonable to propose that the inadequacy of low-growth regions' innovative efforts – and the lack of technological dynamism to which it has contributed – has given rise to a reliance on externally generated knowledge and innovation that is, in fact, characteristic of economically peripheral environments (Fitjar and Rodríguez-Pose, 2011; 2016; Tödtling et al., 2012; Grillitsch and Nilsson, 2015). This reliance has likely bred the capacity to mobilise extra-local sources of knowledge and innovation that is reflected in the econometric analysis.

Suffice to say, low-income and low-growth regions are marked by different facilities for the exploitation of different types and sources of knowledge and innovation. The econometric analysis does, however, reveal a key similarity between them: both Europe's low-income regions' facilities for the mobilisation of locally generated knowledge, *and* their low-growth counterparts' abilities to exploit extra-local knowledge and innovation seem to be conditional, at least to a degree, on the availability of highly skilled human capital. That is, the coefficient for the patent intensity variable in the low-income region regressions is only significant in specifications in which tertiary educational attainment is controlled for. Similarly, the significance of the coefficients for the spatially-lagged R&D and innovation variables is greater in the low-growth regions specifications to which tertiary educational attainment is added.

Regional skills endowments are therefore *not* entirely unrelated to the economic dynamism of Europe's lagging regions, as the insignificance of the tertiary educational attainment variable would otherwise suggest. Rather, highly skilled, well-educated human capital seems to serve as a mediator or facilitator of the process by which knowledge and/or innovation is transformed into economic growth.

While the aforementioned points of divergence may be the most prominent ones revealed by the separation of Europe's low-income and low-growth regions, the differences between them extend to the socioeconomic, structural and institutional factors that govern their respective economic performances.

The disaggregation reveals, first, that among Europe's low-income regions, it is those that unlock or are endowed with externalities associated with the agglomeration of economic activity; youthful demographic compositions; more industrially-biased economic structures; and sound institutions that are anticipated to be the most dynamic. The economic performance of Europe's low-growth regions is found to be mediated by a different set of influences. Yes, institutional quality and agglomeration externalities are linked to the economic dynamism of low-income and low-growth regions alike. There are, however, other factors to which the economic performance of the latter is also attributed. Geographically-peripheral low-growth regions are, for example, outperformed by those that are less physically isolated and, in turn, more favourably positioned to reap the benefits of ready-access and exposure to extra-local markets. The dynamism of these regions is very much influenced by the depth of their pools of semi-skilled human capital as well.

The panorama that emerges when Europe's low-income regions are separated from their low-growth counterparts is markedly different to that revealed when their heterogeneity is overlooked and they are analysed together as 'lagging regions'. What the aggregation of the two types of regions has in fact done is mask, or misrepresent, fundamentally important differences between the dynamics of growth in the two contexts. Variation in their respective abilities to mobilise different types and sources of knowledge and innovation is the most consequential difference washed away by their aggregation. That said, the profound importance of semi-skilled human capital to the economic performance of Europe's low-growth regions, and, alternatively, the relevance of regional industrial and demographic compositions to the dynamism of its low-income ones is lost in aggregation as well. A failure to separate low-income regions from their low-growth cousins also leads to the decidedly incorrect inference that Europe's low-income regions garner benefit from access to extra-local markets.

Stated simply, the factors, forces and influences that govern processes of economic growth and change in Europe's low-income regions differ tremendously from those at play in their low-growth counterparts. Not only do the two types of regions display different facilities for the productive exploitation of knowledge and innovation, their respective economic performances are influenced in different ways by their structural, socioeconomic, and institutional fabrics. The aggregation of low-income and low-growth regions under the umbrella of 'lagging regions' inhibits the identification and assessment of this heterogeneity. It is not unreasonable to expect that a failure to account for the sorts of differences documented in the preceding section could result in the formulation of inaccurate – or at least incomplete – inferences about the economic realities in Europe's lagging regions. This would seem sufficient cause, in and of itself, for the separation of low-income and low-growth regions for both analytical purposes and for the design of any policies, strategies or initiatives that are to be implemented in them.

## 3.7. Conclusions

This research sought to identify and examine the drivers and determinants of the economic performance of a sample of Europe's most economically disadvantaged regions. Its primary focus was on the role for, and importance of, knowledge and innovation. A comparative econometric investigation of what the European Commission has termed 'low-income' and 'low-growth' regions was employed to (a) determine whether these two types of lagging regions are similarly capable of transforming knowledge and innovation into economic growth and dynamism and (b) formulate more general inferences relating to the factors that mediate processes of economic growth in them.

The empirical analysis revealed, on the one hand, that while knowledge may go un-mobilised in Europe's low-income regions, innovation does not; Europe's most underdeveloped regions are capable of translating locally generated innovation into economic growth. The same cannot be said about extra-local knowledge and innovation. These regions are unable to realise any benefit from spillovers emanating from the innovative activities occurring in neighbouring territories. The analysis also

indicated that agglomeration externalities affect their economic performance as do their demographic profiles, economic structures and institutions.

Europe's low-growth regions, on the other hand, while unable to capitalise on local innovative efforts, are reasonably adept at mobilising extra-locally generated knowledge and innovation. That is, these regions have some facility for the absorption and eventual conversion of the knowledge and innovation flows that emanate from both their more immediate and their more geographically distant neighbours into economic performance. The availability of semi-skilled human capital emerged as a factor affecting their dynamism as well. These regions also benefit from agglomeration externalities, exposure and access to extra-regional markets, and from efficient, well-functioning institutions.

Taken together, the empirical analysis provided cause to assert not only that the economic performances of Europe's low-income and low-growth regions, respectively, are mediated by very different sets of socioeconomic factors, but also that these two types of lagging regions do not display the same facility for the translation of different types and sources of knowledge and innovation into economic growth.

The policy implications of the preceding analysis are numerous. Most generally, it would seem to affirm the necessity of contextually tailored policies in the pursuit of economic growth in lagging regions. Policy-makers in low-growth regions, for example, would be wise to pursue policies, at least in the short-term, that are oriented less towards the upgrading of local innovative efforts and capacities and more towards the promotion of extra-local linkages. Fostering extra-local connections with a view to exploit these regions' abilities to mobilise interregional knowledge and innovation flows may represent a more efficient way to impel domestic growth than attempting to cultivate new knowledge-intensive activities in environments that do not seem *ex ante* especially well-suited to hosting them.

Those tasked with impelling economic growth in low-income environments, on the other hand, must be aware that these regions have some facility for the mobilisation of knowledge-intensive and innovative activity. They would therefore be

wise to channel resources towards the upgrading of regional innovative capacities. This statement is, however, accompanied by two caveats. First, simply increasing R&D investment will not be sufficient to boost the innovative capacities of Europe's low-income regions – balanced, integrated strategies are required. Second, efforts must be made to *embed* innovative activity to ensure that it, and the more general benefits associated with the hosting of technologically sophisticated activities, are not appropriated by other regions.

Of course, efforts to catalyse growth must look beyond the role of knowledge and innovation; socioeconomic and institutional conditions, characteristics and attributes cannot be neglected. Policy-makers must, however, be aware that it will not be sufficient to focus on the same set of generic factors in low-income and low-growth environments alike. Certain commonalities do exist; there is, for example, scope for institutional upgrading in both types of lagging regions. That said, investment in human capital, training and skills should feature prominently in the strategic efforts pursued in low-growth regions. Relatedly, the importance of industrial compositions, and the constraints they could conceivably impose, must be taken into account in the design of growth initiatives for Europe's low-income regions. Similarly, a concerted effort should also be made in low-income regions to ensure that their youth populations – which are, at present, very much an asset and potential catalyst for growth – are provided with sufficient economic opportunity and are not incentivised to emigrate in pursuit of opportunity elsewhere.

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Appendix 1. Low-growth and low-income regions included in the analysis

| **Low-income regions** | **Low-growth regions** |
|---|---|
| BG31: Severozapaden | EL11: Anatoliki Makedonia, Thraki |
| BG32: Severen tsentralen | EL12: Kentriki Makedonia |
| BG33: Severoiztochen | EL13: Dytiki Makedonia |
| BG34: Yugoiztochen | EL14: Thessalia |
| BG42: Yuzhen tsentralen | EL21: Ipeiros |
| HU23: Dél-Dunántúl | EL22: Ionia Nisia |
| HU31: Észak-Magyarország | EL23: Dytiki Ellada |
| HU32: Észak-Alföld | EL24: Sterea Ellada |
| HU33: Dél-Alföld | EL25: Peloponnisos |
| PL31: Lubelskie | EL43: Kriti |
| PL32: Podkarpackie | ES42: Castilla-la Mancha |
| PL33: Swietokrzyskie | ES61: Andalucía |
| PL34: Podlaskie | ES62: Región de Murcia |
| PL62: Warminsko-Mazurskie | ES70: Canarias |
| RO11: Nord-Vest | ITF1: Abruzzo |
| RO21: Nord-Est | ITF2: Molise |
| RO22: Sud-Est | ITF3: Campania |
| RO31: Sud-Muntenia | ITF4: Puglia |
| RO41: Sud-Vest Oltenia | ITF5: Basilicata |
| | ITF6: Calabria |
| | ITG1: Sicilia |
| | ITG2: Sardegna |
| | PT11: Norte |
| | PT15: Algarve |
| | PT16: Centro |
| | PT18: Alentejo |

# Appendix 2. Variables used in the analysis

| **Variables** | | **Source** |
|---|---|---|
| Economic performance | GDP per capita | *Eurostat, Regional statistics by NUTS classification database* |
| Innovative output | Patent applications to the European Patent Office, per million inhabitants | *Eurostat, Regional statistics by NUTS classification database* |
| Regional R&D Expenditure | R&D expenditure as % of GDP | *Eurostat, Regional statistics by NUTS classification database* |
| Availability and mobilisation of human capital | % of population aged 25-64 with a tertiary education<br>% of population aged 25-64 with upper secondary or post-secondary non-tertiary education<br>Unemployment rate | *Eurostat, Regional statistics by NUTS classification database* |
| Industrial composition | Employment in 'industry' as % of employment | *Eurostat, Regional statistics by NUTS classification database* |
| Agglomeration of economic activity | Population density | *Eurostat, Regional statistics by NUTS classification database* |
| Demographics | % of population aged 15-24 | *Eurostat, Regional statistics by NUTS classification database* |
| Market access | Spatially-lagged GDP | *Eurostat, Regional statistics by NUTS classification database* |
| Quality of Government | Quality of Government Index | *Charron et al. (2014)* |

*Note: Missing values for variables were linearly interpolated/extrapolated where appropriate.*

# 4. STRATEGIES OF GAIN AND STRATEGIES OF WASTE: WHAT DETERMINES THE SUCCESS OF DEVELOPMENT INTERVENTION

## 4.1. Is there a need for territorial development policy in lagging areas?

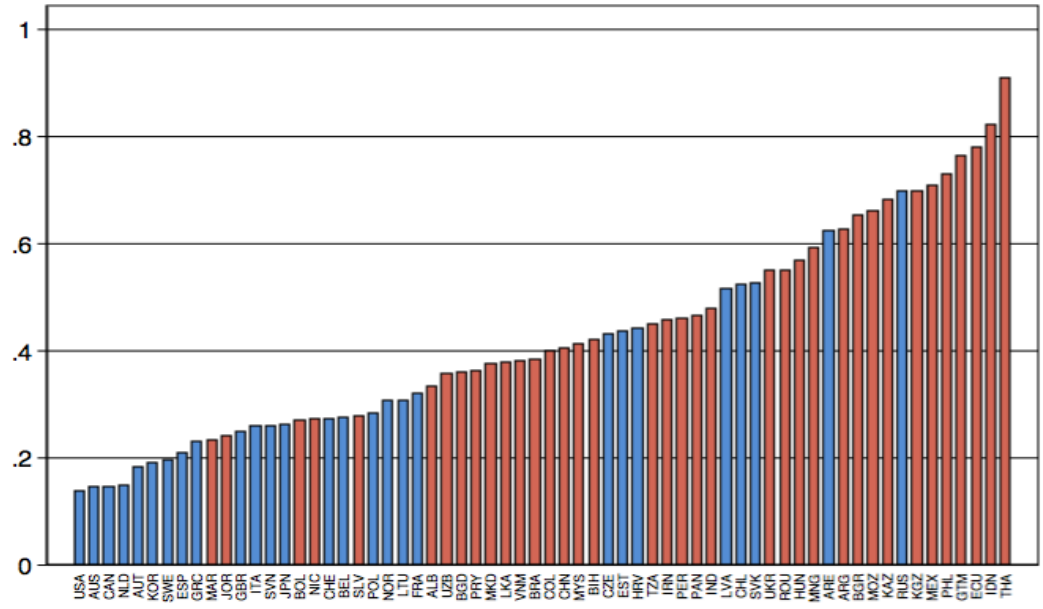
Much has been made in recent years about interpersonal economic inequality. This is not without good reason: levels of interpersonal inequality have increased markedly over the course of the last decade. While this interpersonal inequality is, on balance, more pronounced in less developed contexts, it is by no means confined to them. A number of the world's most advanced and emerging economies are facing levels of interpersonal inequality that are approaching or, in more severe cases, actually exceed all-time highs. In the United States, for example, levels of economic inequality, as measured by the Gini Coefficient peaked (0.481) in 2016 even though considerable progress had been made on both the household income and poverty reduction fronts in the same year (Yadoo and Chandra, 2017). The implications of pervasive interpersonal inequality are numerous. None, however, is more consequential than the adverse effect it can have on economic dynamism and longer-term prospects for economic growth. Recent econometric analyses commissioned by the OECD and the IMF suggest that persistently high and increasing levels of interpersonal economic inequality represent a not insignificant barrier to the pursuit of economic growth and could, by extension, conceivably undermine the policy actions undertaken to drive it (Cingano, 2014; Ostry et al., 2014).

Interpersonal inequality is not, however, the only type of economic inequality that matters. Territorial inequality, while less widely and frequently addressed, is equally pervasive and, as recent political events would seem to confirm, may be associated with equally, if not more, significant consequences.

Economic growth tends not, for a number of generally well understood reasons, to transpire at the same rate and with the same intensity across space (World Bank, 2009). This tendency has produced gulfs between countries' most economically prosperous, often urban, core cities and regions and their lagging, less dynamic ones. As in the case of interpersonal inequality, territorial inequality tends to be more

prevalent in less developed and emerging countries, than in developed ones. This is illustrated by *Figure 4.1*, which depicts levels of territorial inequality in a selection of countries. Less developed and emerging countries (in red) exhibit, with few exceptions, much higher levels of territorial inequality than their more developed counterparts (in blue).

*Figure 4.1. Differences in territorial income inequalities, selected countries (Second Theil Index)*




**Authors' elaboration and calculation. Source: OECD and various national statistical offices; data for 2010 or the closest year available**

There is, of course, an interpersonal element to territorial inequality. Individuals living in core areas, where opportunity (income-generating or otherwise), infrastructure and resources (broadly defined) are generally more abundant, tend to benefit from merely 'being there'. The prospects of individuals living in lagging regions are, on the other hand, more limited. Some will emigrate to more economically prosperous regions, fuelling a brain drain that is associated with economic consequences of its own. The livelihoods and wellbeing, however, of those that opt not, or are unable to do so will likely be adversely impacted by the lack of dynamism and opportunity in the territories where they live.

As is true for interpersonal inequality, territorial imbalances are associated with their fair share of ills and implications. One, in particular, has come to the fore of

late: sufficiently pronounced and temporally sustained territorial inequalities sow the sort of social discontent, tensions and political unrest that can, and, in fact, have fuelled the rise of populism and the success of populist movements, leaders and parties (Rodríguez-Pose, 2018).

Populism has long thrived in areas particularly affected by poverty, pronounced economic crises and persistent social problems (Roberts, 1995). Territorial inequality introduces another variable into this equation. As the gaps between 'have' and 'have not' territories, between areas rife with opportunities and those affected by prolonged economic decline, widen, the immediacy and tangibility of the social and economic challenges by which lagging and declining regions are faced increases for those in them. This, in turn, fosters a sense of neglect and disenfranchisement.

Developing countries, given the pervasiveness of territorial inequalities, are most susceptible to 'inequality-induced populism'. That said, even the most economically advanced environments are not immune to it. Now US President, Donald Trump, the successful Brexit movement in the UK, France's Marie Le Pen and her nationalist Front National and Germany's far-right AfD party, among others, have drawn support not necessarily from individuals living in economically prosperous, core cities and regions – where the poorest of the poor have often in recent times voted in line with the economic elites –, but from increasingly frustrated voters in territories that have struggled to cope with the pressures associated with globalisation, technological change and more general economic progress. This populism, much like the proliferation of the inequalities that breed it, is not without economic consequence; the social and political uncertainty and instability it gives rise to can, among other things, stifle public and private investment, limit personal mobility and migration and hamper trade and economic integration, with obvious consequences for productivity, employment outcomes, economic dynamism and, ultimately, growth, both in less prosperous and declining areas and in the very core areas that have often acted as the motors of economies.

All of this begs the question of whether policies are needed to promote growth and development in underperforming, lagging areas. The answer, on the basis of the

above, would seem to be yes. But, and this is the key caveat, the unidimensional, spatially blind and often top-down policies of the past will not be sufficient to affect change in lagging or falling-behind regions and reduce the gulf between economically core areas and their peripheral counterparts. Policies going forward will need to be strongly rooted in theory and in evidence. They will also, however, need to be sensitive to conditions in and the uniqueness of different territories and should focus explicitly on tapping and realising local potential. Such policies will need to make sure that institutional factors and elements are not overlooked in the planning and operationalisation of strategic approaches to development and, where necessary, that steps are taken to tackle institutional inefficiencies and bottlenecks head-on and within the context of the broader strategy.

Policies and strategies that do so can be more efficient than those pursued in the past. That they will be is, however, far from a certainty; the risk that a particular territorial development intervention evolves into a 'strategy of waste' will always remain. It is this risk upon which the remainder of the chapter is focused. More specifically, the following analysis weighs 'strategies of waste' against 'strategies of gain' to identify and understand they key differences between them with a view to ascertain insights into the steps policy-makers can take to maximise the likelihood that territorial development policies fulfil their potential and contribute to the reduction of territorial disparities in developed and developing contexts alike.

### 4.1.1. Overview and introduction

Policy-makers in developed, emerging and developing economies have long relied on a range of strategic interventions to stimulate economic growth and socioeconomic development. The exact strategic approaches that they have turned to have been, in their specificities, as heterogeneous as the contexts in which they have been pursued. The vast majority of these approaches can, however, be assigned to one of four broad categories in accordance with the 'levers' they pull to catalyse and promote growth. That is, development policies and strategies of late have tended to be based on one of the following development axes: (1) infrastructure expansion and development; (2) the attraction of inward investment; (3) the promotion of innovation

and development of human capital; or (4) the cultivation of agglomeration and promotion of physical co-location.

This chapter engages with these four broad policy types with the view to, first, assess and comment on the utility of these approaches in different development contexts, and, second, provide an indication of what exactly policy-makers should prioritise in the design and implementation of these strategic actions. The overarching objective is to learn from these policies in order to better understand the steps that need be taken to increase the likelihood that development interventions contribute substantively to local or regional economic growth and development in what are often very heterogeneous contexts across the world.

The lessons drawn from a review of a series of successful and unsuccessful development strategies are four-fold. First, development strategies informed not by one, but by several complementary development theories, perspectives and schools of thought, and, consequently, composed of multiple related and mutually-reinforcing actions and interventions across development areas tend to deliver better results. Second, strategic approaches for the promotion of economic growth that are solidly grounded in robust diagnoses of the advantages, opportunities, challenges and weaknesses of a city or region – and are tailored and targeted accordingly – are generally more successful. Third, awareness of where exactly a territory is situated on the development spectrum is crucial, as its level of development and, more precisely, its proximity to infrastructure, human capital and technology frontiers will determine whether there are returns to be realised from investment in or attention to these development axes. Fourth, and finally, the institutional dimension cannot be left un- or even under-addressed in the design and implementation of policy interventions. Oftentimes, the environments in which territorial development policies or strategies are most direly needed are also those plagued by the greatest institutional deficiencies. These shortcomings and inefficiencies manifest themselves in any number of ways and can seriously undermine the effectiveness of even the most robustly and carefully designed territorial development policies. This does not, however, mean that territorial development strategies should not be pursued in institutionally unfavourable environments. Rather, an awareness of institutional barriers and deficiencies will reinforce the returns of development strategies, making it imperative – anywhere, but

all the more in areas with poor institutions – that capacity building efforts, technical development exercises and institutional reforms be integrated directly into territorial development strategies. This will help ensure that the potential effectiveness of development approaches is not compromised by institutional inadequacies.

These four lessons are supplemented later in the chapter with more general guidance relating not to where each of the four policy types of interest can, or should, be employed, but rather to how territorial approaches to development – *irrespective of the development axis or axes to which they are oriented* – should be designed for territories at different points in their development trajectories. We propose that that the strategic approaches employed by differentially developed territories should differ in terms of their relative *complexity* – conceptualised as a function of the number and diversity of individual interventions by which they are composed – and the *breadth of their strategic scopes* – understood as the narrowness of the development outcomes or objectives by which they are guided – in ways that reflect the nature of the most immediate development challenges with which the territories are faced. We assert that: (i) the most economically disadvantaged of territories should pursue approaches that are simple in nature and narrow in strategic scope; (ii) that less economically developed territories should opt for simple, but more broadly-oriented strategies; (iii) that emerging territories should rely on broad-based approaches that are, on the other hand, more complex and integrated in nature; and (iv) more developed areas will need to design strategies that are, again, complex but are narrowly and precisely targeted to affect change.

The remainder of the chapter is structured as follows: *Section 4.2* provides a brief introduction to the four broad types of development policies, and to the various theories of economic growth and development from which they have been derived. *Section 4.3* reviews a number of the development policies and strategies that have been pursued by a mix of developed, emerging and developing countries in an effort to identify, on a case-by-case basis, the factors to which the success (*Section 4.3.2*) or failure *(Section 4.3.1*) of each is most readily attributable. It will consider, among other things, how the design of the policy/strategy, its implementation or execution, and the socioeconomic and institutional context within which it was pursued mediated or shaped its outcomes. *Section 4.4* compares the 'strategies of waste' to the 'strategies

of gain' presented in the section that precedes it to derive and provide a series of policy implications. *Section 4.5* contemplates the nature of the development challenges by which different types of territories are faced and proposes a taxonomy of development strategies that features four broad categories of interventions each of which is more (or less) contextually suitable for territories at different points on the development spectrum. *Section 4.6* concludes.

## 4.2. Theories of economic growth and development and the evolution of development policy

### 4.2.1. Infrastructure-driven development and the neoclassical growth theory

Few development strategies have been as ubiquitously employed as infrastructure-oriented development policies.[32] Infrastructure-oriented approaches to development find their conceptual underpinning in the hitherto dominant neoclassical growth theory (e.g. Solow, 1956; Swan, 1956; Aghion and Howitt, 1998; Barro and Sala-i-Martin, 2004). In a neoclassical framework, economic growth is understood to be governed by the relative availability of different factors of production: technology, physical capital, and labour. However, technology and labour are considered exogenous factors, meaning that growth is fundamentally achieved by increasing physical capital, often proxied by infrastructure. Infrastructure is conceptualised either as a factor of production itself (i.e. as 'public capital') *or* an influence on the productivity of other factors of production (e.g. Romp and de Haan, 2007). Investing in and increasing a region's stock of infrastructure is therefore thought to impel economic growth directly (i.e. as an input to processes of economic growth) or indirectly, by facilitating the more efficient exploitation of other factors of production via the reduction of transaction and other costs (Servén, 2010:1).[33]

[32] Dillinger (2007:29), for example, refers to infrastructure-led initiatives as "time-honoured [approaches] to regional development". Similarly, Barca et al. (2012:137) assert that "development policies have until now generally remained instruments for the provision of infrastructure – roads, railways, sanitation, water and the like – and state aid".

[33] See Agénor and Moreno-Dodson (2006) or Straub (2007) for a more nuanced and developed discussion.

Guided by the perception that a sufficiently developed network of physical – transportation, power, telecommunications, among other types – infrastructure is a prerequisite for development (e.g. Calderón and Servén, 2004) and by the expectation that infrastructure impinges on factor mobility and productivity, policy-makers have resorted to devising and implementing strategies that rely on the provision and upgrading of various types of physical infrastructure in the pursuit of economic growth.

### 4.2.2. Inward investment strategies and growth pole theory

A second category of development strategies includes the inward investment-oriented strategies borne out of the 'growth pole theories' most readily associated with the work of Perroux (1950; 1955) and Hirschman (1958). [34] Both Perroux and Hirschman observed that economic growth is not evenly distributed across space and that it occurs in and, in turn, diffuses out from a relatively small number of locations – 'growth poles'. This observation has led policy-makers to believe that the channelling of resources to existing or newly established agglomerations of economic actors may be the most efficient way to promote economic growth and development in lagging regions. Growth pole-type approaches entail targeting the specific areas – within a broader, oftentimes lagging territory – that are endowed with the greatest economic potential and whose individual success could and, in time, would yield more geographically widespread benefits (Parr, 1999). Working off of the assumption that the dynamism of these so-called 'poles' or 'points' tends to be most readily attributable to the hosting of a leading or 'propulsive' (Perroux, 1955) industry or set of industries, inward investment and growth pole policies have been active in pursuing the attraction of large, often more productive and technologically advanced firms (and by extension the industries to which they belong) to less developed regions with a view to lay the foundation for the emergence of a growth pole capable of catalysing and supporting region-wide economic success and dynamism (Parr, 1999).

Special economic zones, industrial parks and science and technology parks are perhaps the most notable of the more specific interventions that fall under the umbrella

[34] See Parr (1999) for a comprehensive review of the origins and development of growth pole-type strategies.

of ‘inward investment-oriented strategies’. At the heart of any inward investment-oriented initiative, however, irrespective of the guise in which it exists, is the expectation that large, especially dynamic firms operating in ‘propulsive’, high-potential industries can be catalysts for development and, moreover, that the attraction of one or more of these firms to a lagging region, via the provision of fiscal and other incentives, will be sufficient to reverse its economic fortunes and ignite self-reinforcing processes of economic growth.

### 4.2.3. Human capital, knowledge, innovation and the endogenous growth theory

The development of the endogenous growth theory gave rise to a set of policies and strategies that are markedly different from the infrastructure and inward investment-oriented approaches that preceded them (e.g. Romer, 1986; 1990; Lucas, 1988; Aghion and Howitt, 1992; Grossman and Helpman, 1994). The endogenous growth theory, by endogenising technology and human capital, brought human resources, education and skills (Lucas, 1988) and knowledge, technological change and innovation (Romer, 1986; Aghion and Howitt, 1992; Grossman and Helpman, 1994) to the fore in development thinking. Policy-makers, following suit, became increasingly concerned with the promotion of innovation and the provision of education and training with the expectation that knowledge-intensive, innovative activities and an able labour force could function as catalysts for economic growth and facilitate the reversal of lagging territories’ economic fortunes.

Within this framework, efforts involving the setting of regional R&D expenditure targets and other initiatives geared towards increasing public and private R&D investment to stimulate the generation of knowledge have been favoured strategic approaches for the promotion of innovation (World Bank, 2010). More holistic, systems-of-innovation-type policies that match more traditional policy instruments with a focus on the encouragement of interactions, cooperation and collaboration between economic actors to achieve these ends have also become increasingly common in recent years (e.g. Tödtling and Trippl, 2005; World Bank, 2010; OECD, 2012). Similarly, policy-makers have relied mainly on general investment in all levels of education, and on a range of more narrowly targeted skills-

development initiatives, vocational schemes, lifelong-learning initiatives, and other training programmes to promote human capital development (e.g. OECD, 2015).

### 4.2.4. Cluster-based intervention and new economic geography and urban economics

The final type of policy intervention considered here emerged from several theoretical perspectives that explore and, in turn, underscore the importance of the co-location of economic actors and activities for innovation, productivity and, ultimately, economic growth: cluster theory, new economic geography and urban economics. Despite considerable differences between the three strands, a central premise of all of them is that the agglomeration of economic activities – and, consequently, a high density of economic actors in any particular place – gives rise to a host of productivity-enhancing externalities from which co-located actors benefit (e.g. Porter, 1990; Krugman 1991; Fujita et al., 2000; Fujita and Thisse, 2002; Duranton and Puga, 2004; Storper and Venables, 2004; Glaeser, 2010). Co-location is understood as a facilitator of interactions, cooperation and collaborations between physically-proximate economic actors. It enables, *inter alia*, the sharing of resources, the establishment of efficient input-output linkages, and the realization of economies of scale and scope. Co-location also supports the transfer and exchange of knowledge, information and ideas within (i.e. Marshall-Arrow-Romer spillovers) and between (i.e. Jacobian spillovers) sectors and industries – and, by extension, the economic actors that compose them – that is thought to foster and support the innovation and technological progress that, in turn, spur growth.

Development policies following these strands have tended to either pay particular attention to the generation and/or consolidation of different types of clusters – including related types of interventions such as science and technology parks, innovation parks/hubs, industrial parks/clusters and the like – or have sought to promote the more dynamic urban centres within specific countries, which often coincide with larger and more dense agglomerations. Cluster-based and new economic geography and urban economics-related policies assume any number of forms. They do tend, however, to involve, in different guises, the development of infrastructure, the provision of incentives to encourage and facilitate the co-location of economic activity

and actions to promote intra-cluster interactions and the emergence of networks. Different types of cluster-based policies and the promotion of agglomeration, more generally, have become popular with policy-makers as viable ways to spur economic growth and development (e.g. Melachroinos and Spence, 2001; Martin and Sunley, 2003).[35]

## 4.3. Comparing 'strategies of waste' and 'strategies of gain'

Development strategies the world over, and in developing and emerging countries in particular, are frequently the children of different economic growth and development theories. Normally one of the aforementioned strands informs and structures the development intervention, leading to policies that put the emphasis, depending on the dominant strand, on infrastructure building, growth poles, skills and innovation, or clusters and agglomeration. However, most development interventions remain firmly embedded in *one* approach and rarely combine elements from different theories, or, in the rare instances when they do so, subjugate other types of intervention to the main development axis promoted by the chosen theory. The resultant policies and interventions tend to feature an overt, unsustainable focus on or prioritisation of one development axis over all others.

In this section, we will use specific examples to explore these policies at work. We will underscore how an excessive focus on one development axis often results, depending on local conditions, in development interventions that leave the treated territory, in the medium- to long-term, in a similar or worse condition than before the intervention, despite sometimes having short-term positive effects. These are referred to as 'strategies of waste'. We will also argue that, by contrast, interventions that combine different development strands and are tailored to the characteristics and needs of the territory in which they are to be pursued are more likely to yield economic outcomes that are, in in the medium- to long-term, more significant and sustainable. These are what we call 'strategies of gain'.

[35] Martin and Sunley (2003:23), for example, assert that "few other ideas can begin to rival the current popularity of the clusters notion amongst economic practitioners and national and regional policy communities". Similarly, Melachroinos and Spence (2001:1701), observe that "conventional wisdom is that [the reduction of technological and, in turn, productivity inequalities] is best promulgated via networks and clusters focusing on small and medium-sized enterprises promoting the use and practical implementation of new technology".

### 4.3.1. Strategies of waste

The growth and development policies and strategies highlighted in *Section 4.2* have been implemented in a diversity of contexts. Some have found success and served as catalysts for meaningful economic growth and development. Many others, however, have not. These are referred to as 'strategies of waste'. Stated simply, strategies of waste are, for the purposes of this chapter, development approaches that achieved little in the way of economic development and, ultimately, amounted to not much more than a waste of scarce resources. Strategies of waste, as the subsections that follow confirm, exist in any number of forms and are by no means confined to one particular theoretical approach, geography, or context.

*The limited returns to transportation infrastructure investment in the European Union*

The sorts of infrastructure-oriented development strategies that emerged from neoclassical theories of economic growth and development have been pursued with particular vigour in developed and developing countries alike. Few policy-making bodies, however, have displayed a greater, more sustained commitment to, and belief in, infrastructure investment as a means to impel economic growth and development than the European Union.

Adhering to the notion that "efficient and sustainable transport services and infrastructure are vital to exploiting the strengths of all EU regions and supporting the internal market thereby facilitating economic and social cohesion" (European Commission, 2014:3), authorities have prioritised investment in infrastructure and have channelled significant amounts of resources towards a wide array of intra- and inter-regional transportation infrastructure-oriented projects. In the 2014-2020 funding period alone, the European Regional Development Fund and the European Union Cohesion fund are set to spend €71.5bn on "a range of investment priorities to promote sustainable transport and remove bottlenecks in key network infrastructures".[36] Another €24.05bn will be spent on a series of projects to develop and expand the

[36] *Network infrastructure in transport and energy*: https://cohesiondata.ec.europa.eu/themes/7

continent's inter-regional transportation infrastructure network via the Connecting Europe Facility, a funding vehicle that operates principally at the European level.[37]

Increases, especially of this magnitude, in transportation infrastructure expenditure should according to the neoclassical growth theory augment regional capital-to-labour ratios and lead to proportional improvements in productivity that are anticipated to drive economic growth and enhance economic dynamism.

Such predictions do not, however, seem to have to come to fruition (e.g. Cappelen et al., 2003; Rodríguez-Pose and Fratesi, 2004; Crescenzi and Rodríguez-Pose, 2012). Considerable investment in transport infrastructure in the less developed regions of the European Union is yet to yield its expected results. In a cross-regional macroeconomic investigation into the relationship between regional economic performance and regional transportation infrastructure endowments, Crescenzi and Rodríguez-Pose (2012) find little evidence of a significant link between regional infrastructure endowments and economic performance (Crescenzi and Rodríguez-Pose, 2012:489), suggesting that the European Union's infrastructure-centric approach to development may be more akin to a strategy of waste than to one of significant gain. This, coupled with evidence of significant relationships between economic dynamism and host of other socioeconomic factors and influences, has raised doubts about the sensibility of the European Union's singular concern for transportation infrastructure. Some voices have even advocated for a revaluation of the privileged position that has traditionally been assigned to infrastructure expansion in the European Union's strategic efforts to promote economic growth and cohesion (e.g. Crescenzi and Rodríguez-Pose, 2012).

There are a multitude of factors to which the limited returns to infrastructure spending in the European Union may be attributed. Chief among them, however, is likely that infrastructure investment is subject to diminishing returns and moreover that there is a 'threshold' – evidently exceeded by the European Union – beyond which investment in infrastructure is unlikely to yield much in the way of economic development (e.g. Canning and Pedroni, 2004; de la Fuente, 2010; Crescenzi and

[37] *Connecting Europe Facility (CEF) Transport*: https://ec.europa.eu/inea/connecting-europe-facility/cef-transport

Rodríguez-Pose, 2012). While well-targeted expenditure that alleviates bottlenecks or addresses specific inadequacies can generate economic returns – even in environments with well-developed infrastructure endowments –, once a territory's most fundamental infrastructure needs are met, as is the case in the majority of the regions of the European Union (less developed areas included) indiscriminate expenditure on the expansion of its infrastructure network is more likely to result in duplications and redundancies than in increases in productivity and economic dynamism.

Relatively poor institutional quality, especially in many of the European Union's less developed regions, is also to blame for the limited returns to transportation infrastructure expenditure (Crescenzi et al., 2016). Self-interested politicians and decision-makers operating in weaker institutional contexts may respond to perverse incentives and elect to channel resources towards projects that might give way to immediate private or electoral returns but are ultimately not sustainable nor likely to produce lasting benefits in the medium- or longer-term. Many of the 'white elephant' projects that are scattered across the European Union are, in part, attributable to this phenomenon (Crescenzi et al. 2016:559).

The Ciudad Real Airport in Spain is a prototypical example of a 'white elephant'. The airport, which opened in 2008, was supposed to provide a much-needed boost to the local economy in the form of 6,000 direct jobs.[38] Built at a cost in excess of €1bn, the airport, however, sat largely idle until 2012 when bankruptcy forced its closure.[39] The Toledo-Albacete-Cuenca high-speed rail connection represents a similarly misguided expenditure of resources on infrastructure development. The establishment of a high-speed rail line linking the Spanish cities of Toledo, Albacete and Cuenca – with a combined population of 310,000 – managed to reduce travel times between Toledo and Albacete from two hours and 28 minutes to two hours and five minutes and was seen as way to increase the connectedness and, in turn, the economic dynamism of the three provincial capitals. The line opened in December of 2010, but concerns about its financial sustainability led to its closure just seven months later, in

[38] *The white elephants that dragged Spain into the red*: http://www.bbc.co.uk/news/magazine-18855961

[39] *Spain's Ciudad Airport sold at auction for €10,000*: http://www.bbc.co.uk/news/world-europe-33578949

July 2011. The reason: the service was used by an average of nine people per day but cost €18,000 a day to operate.[40]

These two cases, and other similar 'white elephants' exemplify both the notion of limited returns to infrastructure spending beyond a certain minimum threshold – particularly in weak institutional conditions – and the dangers associated with pursuing projects with little more than their most immediate impact in mind. Neither project addressed or targeted a particular bottleneck nor debilitating infrastructure shortage; if anything, they provided duplications of pre-existing and not congested services.[41] It is difficult, for example, to comprehend why a provincial capital with a population, at the time, of 75,000 would need an airport with a four-kilometre runway and the capacity to host 10 million passengers a year, especially when Madrid's Barajas International Airport was less than 190 kilometres away. Similarly, a time saving of 23 minutes on a route that was ultimately used by less than 10 passengers per day does not seem overly consequential. Neither project was sufficiently informed or guided by even the most basic background research that could have, in theory, justified their existence, meaning that a substantive contribution to economic growth and development was just a pipedream. The projects were justified by little more than the short-term electoral gains they could have conceivably generated. They may have even represented efforts to reap the fruits of corruption (Crescenzi et al., 2016).

*Inward investment strategies in the emerging world: Special economic zones in Peru*[42]

The perception that the formation of a single, especially dynamic agglomeration of economic actors and activity – a 'growth pole' – is sufficient to trigger economic growth and development across the entirety of even the most underdeveloped regions has led to the proliferation of a variety of inward investment-oriented strategies across the developing and emerging world (e.g. World Bank, 2008; 2016a; Rodríguez-Pose and Hardy, 2014). The track record of these inward

[40] *Spain cuts high speed 'ghost train: http://www.telegraph.co.uk/news/worldnews/europe/spain/8603392/Spain-cuts-high-speed-ghost-train.html*

[41] Albalate et al. (2015) provide a detailed discussion of the oversupply of infrastructure in the Spanish context.

[42] The proceeding discussion is based on a World Bank (2016b) review of Peru's experience with special economic zones.

investment-oriented approaches – most of which have assumed the form of special economic zones or industrial zones or parks – has, however, been mixed (Farole and Akini, 2011:4). Recent empirical investigation has, in fact, provided a clear indication that many of the special economic zones that have been established in emerging contexts have failed as catalysts for more widespread economic growth and development (World Bank, 2016a). This has, in turn, bred concerns about the general effectiveness of the special economic zone programmes that have been pursued with particular enthusiasm across the developing and emerging world and, in turn, about the sensibility of the continued pursuit of investment-oriented strategies in such environments (World Bank, 2016a).

Peru is but one of the many countries that have attempted to establish 'growth poles' in its less developed areas in hopes that their expected dynamism and success would eventually spread to other lagging territories in the country. Peru's engagement with special economic zones is a reasonably long, but unfortunately not particularly successful one. The passing of Law 28519 in 1996 led to the establishment of three special economic zones in the cities of Ilo, Matarani and Tacna, respectively. Envisioned by authorities as vehicles for the promotion of export-led growth and economic competitiveness and as "economic growth poles in their host communities" (World Bank, 2016b:23), four more zones have since been proposed and 'designated'. Of the country's seven designated zones, however, only four are operational, and moreover, only one of these can lay any claim to have been mildly successful in achieving its economic development goals (*Figure 4.2*). Paita CETICOS, which is the largest (940ha) and also, because of its proximity to a port, the most favourably geographically situated zone in Peru, is considered by Peruvian authorities "to be the most successful of the country's zones from an economic standpoint" (World Bank, 2016b:36). The zone has led to the creation of 1,200 jobs and has supported an increase in trade and exporting, much of which is attributable to SMEs. The development impacts of the other three zones range from modest (Tacna Free Zone) to virtually

non-existent. (Matarani CETICOS and Ilo CETICOS).[43] Why have the outcomes of and returns to the Peruvian zone programme fallen so far short of expectation? While each of the country's zones have suffered from contextually unique challenges and obstacles, the underperformance of the programme as a whole is attributed to a number of factors, shortcomings and inefficiencies that fall into one of three broadly-defined categories: (1) planning failures; (2) institutional failures or (3) failures in execution.

The planning failures were twofold. First, it was concluded that the country's zones were established in the 'wrong areas'. That is, because the zones were conceived and envisioned as catalysts for regional economic development, they were established – without sufficient concern for *ex ante* local conditions, characteristics and attributes – in lagging regions. This "ad hoc" (World Bank, 2016b:45) selection process led to the establishment of zones in less economically dynamic territories with underdeveloped socioeconomic fabrics. This inhibited their capacity to (i) attract and sustain economic activity and to (ii) capitalise on that activity and push region-wide socioeconomic development. Moreover, because the programme focused exclusively on lagging regions and relied on a wholly inadequate selection process, zones were not established in "more promising" intermediate or even more economically advanced areas where the development impacts of a zone might have been greater (World Bank, 2016b:43).

Second, insufficient attention was paid to the "country's comparative advantages, strategic opportunities and development opportunities" (World Bank, 2016b:11) when establishing the zones' sectoral foci. This resulted in mismatches between the activities that were actually prioritised by authorities and the endowments, advantages, and opportunities by which the zones, and the regions in which they are situated, are characterised. Overall, there was a general failure to pursue "the most

[43] The development impacts of Tacna Free Zone, which is situated near the Chilean border in the southern part of the country, have been more on the more modest end of the spectrum. There is evidence to suggest that the zone has provided a boost to the tourism and hospitality sectors in Tacna (World Bank, 2016b:33). The zone has, however, suffered from a number of logistical, institutional, infrastructural and other challenges. Moreover, the zone remains domestically-oriented and has not served as a facilitator of trade and export-growth nor has it served as a particularly powerful engine for employment creation. The development impacts of the Matarani CETICOS have been even more underwhelming. The World Bank (2016b:39) maintains that "with its limited number of investors and a lack of focus on the real potential investment opportunities, it cannot be said that the [Matarani CETICOS] has truly had any significant impact on the development of its host region".

promising economic activities" (World Bank, 2016b:48) that could have perhaps offered greater development potential.


*Figure 4.2. Special economic zones sites in Peru*
**Authors' elaboration**

The programme's institutional failings are also twofold. First, Peru's special economic zone programme is composed of *two* discrete, but markedly similar, legal 'regimes' (stemming from two separate laws that were passed to facilitate the development of the country's special economic zone strategy). The CETICOS zones exist under the first regime. The second regime is associated exclusively with the Tacna Free Zone. The consequences of this are numerous. Firms, investors and other economic actors may be deterred by the unnecessarily high degrees of administrative and bureaucratic complexity that stem from the need to understand and navigate the two regimes (World Bank, 2016b:49). The co-existence and consequent need to monitor and enforce what are "from a legal and administrative perspective [similar regimes]" (World Bank, 2016b:50) also likely results in an inefficient deployment of scarce financial and human resources.

Second, responsibility for the regulation of the zones is shared, almost exclusively, across several subnational authorities; "[little] regulatory authority is exercised at the national level" (World Bank, 2016:53). This highly fragmented regulatory framework not only compromises the cohesion and effectiveness of the overall regulatory and governance regime, it can also increase the compliance costs incurred by firms. Fragmented frameworks like these tend to be prone to inefficiencies, duplications and forgone synergies as well.

The failures that fall into the final category relate to the way in which the programme has been pursued and operationalised. The private sector, for one, has been insufficiently engaged in the programme as a whole. The underperformance of the zones, and the related infrastructural deficiencies by which they are plagued, are attributable, at least in part, to the development, management and operation of these zones almost exclusively by public sector bodies. These bodies tend to be less efficient and experienced than, and often lack the same incentives as, their private sector counterparts.[44] Infrastructural shortages here are a sign of public sector failure and are viewed as a "significant constraint to [the] growth", dynamism and overall performance of the zones (World Bank, 2016b:68).

Additionally, insufficient attention has been paid to ensuring that stocks of skilled labour were and are sufficiently developed so as to meet the needs of the zones and the firms that occupy them; the shortages of skilled human capital by which Peru is characterised act as yet another deterrent to productive activity and investment (World Bank, 2016b:72).

Finally, it appears that the financial instruments and tools that authorities elected to employ and the measures they rely on to incentivise firms, while generous (i.e. income and other tax exemptions), have not necessarily mitigated the specific issues that deter investment or hamper firm (and, by extension, zone) performance (World Bank, 2016b). Simply stated, there was and is an insufficient degree of coherence between the issues that need to be addressed and the tools that policy-makers employ to do so.

*R&D-oriented innovation policy in the European Union*

Knowledge, technological development and innovation are, according to the endogenous growth theory, preeminent drivers of economic growth and dynamism. Promoting innovative activity is increasingly perceived as a way to lay the foundations

[44] A related consequence of the failure to engage the private sector in the operation of the zones themselves has been that that public bodies assume responsibility not only for their management and operation, but also for their regulation and oversight. This has resulted in: (i) authorities being overburdened by tasks that in some cases they did not/do not have the competencies to perform and (ii) considerable scope for conflicts of interest arising from a failure to separate responsibility for operation from that for regulation (World Bank, 2016b:58).

for the increases in productivity that are effectively prerequisite to economic growth, especially in more advanced economies. The shoring up of the innovative capacities of European regions, and of those of the continent's lagging areas in particular, has, accordingly, long been one of the European Union's chief priorities.

The most concerted effort made thus far by the European Union in this direction has involved the establishment and pursuit of R&D expenditure targets (Rodríguez-Pose and Wilkie, 2017a). Shortly after the release of the Lisbon Strategy (2000-2010), which detailed how the European Union would evolve into "the most competitive and dynamic knowledge-based economy in the world" (European Commission, 2010:21), an 'action plan' was released in which it was established that all member states would aim to increase levels of R&D investment to 3% of GDP by 2010[45] – a target that has since been readopted in the European Union's Europe 2020 economic growth and development plan. There is little question that the establishment of this target has given way to greater expenditure on R&D activities across the European Union. That said, there is still considerable progress to be made if the 3% target is to be achieved.[46]

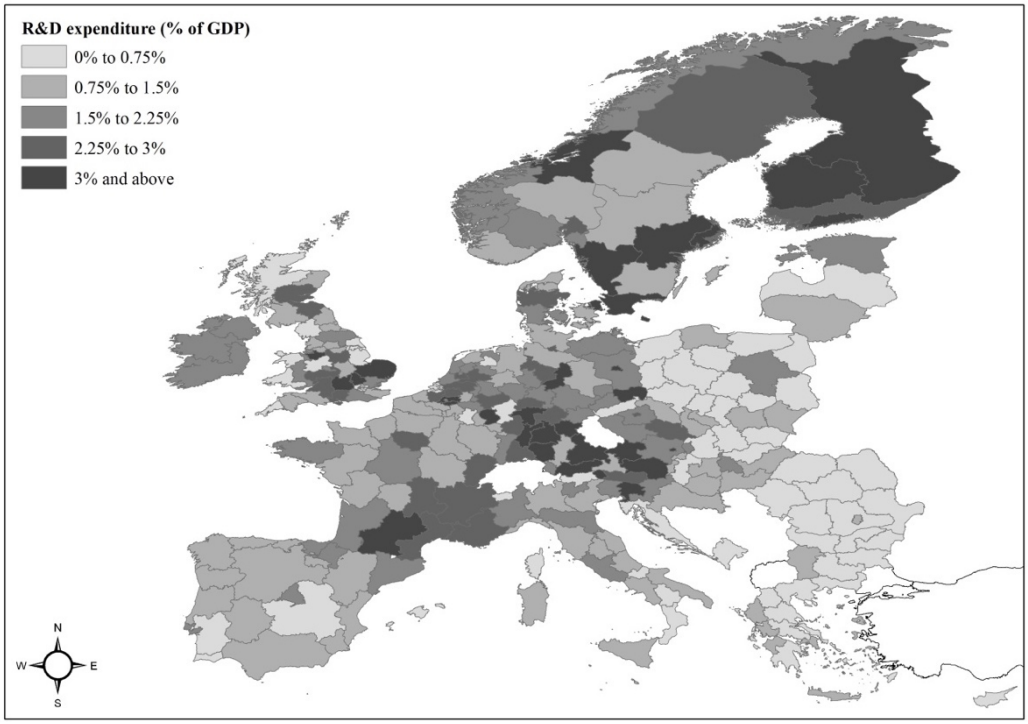
R&D-oriented innovation and growth strategies, the European Union's included, are the direct by-product of more traditional, linear conceptualisations of the innovative process (e.g. Maclaurin, 1953; Grilliches, 1979) in which innovation is understood as a direct consequence of investment in, and the generation of, new knowledge. Socioeconomic and institutional factors tend not to feature in these 'linear models of innovation', which simply predict that greater R&D investment will result in increases in innovative output irrespective of where, and under what conditions the process transpires. A neglect of, and a related failure to integrate complementary strategic interventions to address contextual conditions, features and characteristics, is an important reason why policy approaches inspired and guided singularly by linear conceptualisations of innovation have often, and continue to fail to stimulate

[45] *The 3% objective: brief history. Investing in European Research – Towards 3% of GDP*. Retrieved from: http://ec.europa.eu/invest-in-research/action/history_en.htm

[46] Average R&D expenditure as a percentage of GDP for European Union Member States in 2015 was 1.65%. European Aggregate R&D expenditure as a percentage of Europe's Aggregate GDP was 2.03% in the same year (Eurostat Statistics on Research and Development, obtained on March 7, 2017).

innovation and innovative-driven economic performance in 'innovation averse' (Rodríguez-Pose, 1999), economically disadvantaged territories.

*Figure 4.3. R&D expenditure in the European Union*




**Authors' elaboration**

Europe's lagging regions display, on balance, a relatively weak facility for the translation of R&D expenditure and knowledge into innovation and economic performance (e.g. Oughton et al., 2002; Sterlacchini, 2008; Aristonvik, 2012; Charlot et al., 2012). Moreover, recent quantitative analysis has indicated that the recent increases in the R&D effort of Europe's less developed areas have not delivered the expected returns (Rodríguez-Pose and Wilkie, 2017a). The Lisbon Strategy-inspired increases in R&D expenditure have been associated with a modest increase in the generation of innovative output, though closer examination reveals that this positive correlation is driven entirely by the private sector's knowledge generating efforts. In many of Europe's less developed regions, innovative capacities are all but completely detached from the public R&D expenditure that constitutes a large share of their total R&D commitments. The concerted R&D efforts of Europe's lagging regions have not necessarily been linked to improvements in regional economic performance or decreases in unemployment.

The exact factors to which the underperformance of this unidimensional policy approach is attributed are numerous. Many, if not all, however, relate to the fact that R&D expenditure has been prioritised indiscriminately across the entirety of the European Union with little if any, consideration for the way in which the characteristics, attributes and conditions of its heterogeneous regions might affect their capacity to mobilise and productively exploit it (Rodríguez-Pose and Wilkie, 2017a).

A neglect of the aforementioned characteristics, attributes and conditions represents a failure to consider the very factors that are understood to condition a region's capacity to absorb, mobilise and ultimately exploit R&D expenditure and knowledge. That is, empirical analyses of the European context have revealed that the process by which knowledge is transformed into economic performance is strongly mediated by the socioeconomic and institutional characteristics of the region in which it takes place (e.g. Bilbao-Osorio and Rodríguez-Pose, 2004; Crescenzi, 2005; Charlot et al., 2012; Rodríguez-Pose and Di Cataldo, 2015). A key implication of this is that any weaknesses in a region's socioeconomic or institutional fabric are anticipated to erode its capacity to capitalise on R&D investment or activity. Such weaknesses have adversely affected the capacity of many of Europe's lagging regions to efficiently mobilise pre-crisis increases in R&D investment and activity and translate the knowledge they were anticipated to generate into innovation and, in turn, into economic dynamism and development.

In short, the overall ineffectiveness of the recent R&D drive is a function of the insufficient attention paid by policy-makers to other factors that condition the relationships between knowledge and innovation and, relatedly, innovation and economic performance.

*Supply-side approaches for human capital development: Learning from the Filipino experience*

The human capital development initiatives and strategies pursued by developing and emerging countries, especially in the latter part of the 20$^{th}$ century, displayed a marked focus on the provision and *supply* of skills and training (e.g. di Gropello, 2006; ELLA, 2013; Phan and Coxhead, 2014). Actions in this direction were

viewed, in accordance with the prevailing endogenous theories of economic growth (e.g. Lucas, 1988), as viable ways to increase the skills and capabilities, and, in turn, the productivity of individuals and the regions in which they lived. There was, however, an equally ubiquitous tendency to disregard the way and extent to which educated and/or skilled persons would be absorbed by the labour market. Herein lies the problem. Skilled individuals contribute to economic growth via their engagement in productive activity. The absence of a concerted effort to ensure opportunity existed for them to do so is what would ultimately prove to be the undoing of these insufficiently integrated, unidimensional supply-oriented policies. The Filipino experience is, in that respect, a cautionary tale; it exemplifies the dangers associated with, and the challenges that can arise from, ill-conceived and insufficiently integrated supply-side human capital development strategies (Phan and Coxhead, 2014).

As of 2010, the Philippines had 470 nursing training programmes (Dimaya et al., 2012:4) that, in 2006, were already producing an average of 20,000 nurses a year (Lorenzo et al., 2007:1409). A robust training system, like the one described, should have been sufficient to address the healthcare needs of the large Filipino population. However, despite having trained a large number of nurses over a considerable amount of time, the Philippines still suffers from pronounced shortages of nurses that are attributable to the large scale, almost systematic emigration of Filipino-trained nurses who struggle to find opportunity at home.

This 'brain-drain' phenomenon, which dates back to the early 1970s (Alburo and Abella, 2002), is by no means confined the healthcare sector; it affects a diversity of sectors and industries and has transformed the Philippines into one the world's "leading labour exporting [countries]" (Dimaya et al., 2012). In the case of nurses,[47] brain-drain-induced shortages contributed to the complete closure of 200 hospitals and the partial closure of 800 more between 2003 and 2005 alone (Lorenzo et al., 2007:1414). They have been linked to the marked increases in patient-to-nurse ratios that have been observed in recent years as well (Lorenzo et al., 2007). The emigration of more experienced and qualified nurses also offers part of the explanation for why

[47] Lorenzo et al. (2007:1408), for example, note that nurses [constitute] the largest group of professional workers abroad". Similarly, Finch (2013:E557) highlights that "between 2004 and 2010, nearly 72,000 nurses were newly employed or rehired abroad".

higher numbers of nursing positions have been filled by younger, less-experienced nurses (Dimaya, 2012:4).

Qualitative research has revealed that the brain-drain is driven by a host of 'push' and 'pull' factors that motivate Filipino nurses to actively seek employment opportunities abroad. Many of these factors, however, relate to, or stem from, an undersupply of employment opportunities of a quality that is comparable to those available to Filipino-trained nurses elsewhere in the world.[48] The brain-drain is, in effect, a demand-driven, or at least demand-related, problem (e.g. Phan and Coxhead, 2014).

Nurse shortages in the Philippines are attributable not to an unavailability of training or, relatedly, an inability on the behalf of the country's education and training system to meet the demands of the healthcare sector, but rather to adverse demand-side conditions. The failure by successive Filipino governments and the private sector alike to address the lack of local opportunity has driven Filipino-trained nurses to pursue better paid, higher quality employment opportunities elsewhere, giving rise to a situation where any benefits that could have conceivably arisen from a what would seem a reasonably mature and well-developed education system are essentially forgone.

*Science and technology parks in Greece: Clustering for the cultivation of innovation*[49]

Regions the world over have, often hoping to cultivate the next Silicon Valley, Bangalore or Hsinchu, turned to cluster-based development policies and strategies. Few, however, have managed to do so. Instances of failure are more ubiquitous than the success stories that seem the 'exception to the norm' (Lerner, 2009; Gaisford et al., 2010).

[48] The 'push' factors identified by Lorenzo et al. (2007:1412) include: "low [salaries] at home, no overtime or hazard pay, poor health insurance coverage; work overload or stressful working [environments], slow promotion, limited opportunities for employment [and] decreased health budget". The 'pull' factors highlighted include: "higher income, better benefits and compensation packages [abroad]; lower nurse to patient ratios, more options in working hours, [and] chances to upgrade nursing skills" (Lorenzo et al., 2007:1412). Dimaya et al. (2012:3) identify a similar set of factors; they also note that an abundance of "job vacancies [abroad] due to local shortages" and a consequent greater ease finding gainful employment often entice them to emigrate.

[49] This section draws on the work of Tsamis (2009).

Greece is among the many countries whose cluster policies, initiatives and efforts have yielded outcomes that have fallen short of expectation. Cluster-based development initiatives in the Greek context have, in recent years, assumed the form, as they have in countless other contexts, of science and technology parks (e.g. Rodríguez-Pose and Hardy, 2014). Strategic actions in this direction represent concerted efforts to fabricate environments that support and facilitate the sort of interactions, collaborations and relationships that underpin knowledge-intensive, innovative processes. The eventual dissemination of the ideas, knowledge and innovations generated by these processes to actors both within and outside of the park is anticipated to contribute to the upgrading of the innovative system as a whole and, in turn, foster local economic dynamism.

Paradoxically, identifying and analysing cluster policy failures has proven difficult; Gaisford et al. (2010:317) note that "researchers appear to have been more interested in pursuing insights from successful clusters rather than chronicling failures [and] communities with unsuccessful clusters are hardly likely to publicise the fact because of the damage it may do to their future development prospects." Tsamis' (2009) exploration of the evolution of two Greek science and technology parks – Thessaloniki Technology Park (TTP) and the Science and Technology Park of Crete (STEP-C) – and of the factors behind their limited success relative to expectations represents one of the few exceptions to this trend.

The establishment of TTP and STEP-C were motivated by similar sets of objectives. Both parks sought to: promote the emergence and growth of innovative firms; foster entrepreneurship; facilitate the sharing, dissemination and transfer of knowledge, technology and innovation; and, above all else, catalyse local economic growth and development (Tsamis, 2009:152).

The environments in which the parks were constructed were not especially conducive or well-suited to innovative activity. Neither region displayed a significant, if any, measureable innovative capacity; levels of R&D expenditure in both contexts lagged well behind European average as did their respective propensities to generate innovative output (Tsamis, 2009:158, 159). Moreover, the public sector was, as it still is in many of Europe's less developed regions, overrepresented in what little

innovative activity these regions hosted – the lion's share of R&D investment in both Central Macedonia and Crete was undertaken by public sector actors. The respective economic fabrics of the two territories were relatively technologically unsophisticated as well; Thessaloniki, and the broader Central Macedonia region within which it is situated, specialised in more traditional, less knowledge-intensive activities and sectors, while Crete suffered from a dearth of both high-technology manufacturing and knowledge-intensive services (Tsamis, 2009:157). These socioeconomic shortcomings were compounded by a number of institutional deficiencies that distorted markets, discouraged investment in innovative activity, hampered entrepreneurship and deterred FDI (Tsamis, 2009:166).

The two parks relied upon what might be considered fairly standard interventions and instruments to attract and, in turn, support firms and entrepreneurs. Occupants of the parks were provided with access to both basic and more technologically-oriented infrastructure (e.g. labs, testing facilities) and to a variety of business support services (e.g. accountancy and various consultancy and/or technology transfer services) (Tsamis, 2009:184, 190). Incubators designed to lend support to nascent, high-potential firms served as cornerstones of both TTP and STEP-C as well. Interestingly, neither park elected to design or implement formalised networking programmes or services to promote inter- and intra-cluster linkages, connectivity or interaction (Tsamis, 2009:230).

Neither TTP nor STEP-C have, since their respective inceptions in the mid-1990s, fulfilled their primary objectives or made substantive contributions to regional economic growth or development; while STEP-C was perhaps marginally more successful than TTP, the impact of the parks on their respective broader regional contexts is best described as "very weak" (Tsamis, 2009:230).

The more direct contributions of the parks to local economic output and employment have been limited. In 2004, TTP accounted for less than 0.1% and 0.05% of Central Macedonia's GDP and total employment, respectively (Tsamis, 2009:223). STEP-C's contributions were larger, but still underwhelming: 0.45-0.5% of Crete's regional GDP and 0.38% of total employment. The two parks did, however, account for significant shares of the total R&D expenditure undertaken by their host regions:

TTP and STEP-C hosted 9.7% and 35% of Central Macedonia's and Crete's total investment in R&D, respectively (Tsamis, 2009:223). That the two parks undertook such significant amounts of R&D but did not contribute in an equivalent manner to regional economic output is indicative of the pervasive difficulties park tenants faced in mobilising and applying knowledge. The parks also suffered from by an inability to attract foreign firms, investment and partnerships to their host regions (Tsamis, 2009:224).

The indirect impacts of TTP and STEP-C on the innovative capacities and innovation systems of their host regions have been negligible as well. Tsamis (2009:230) notes that "the research activity [undertaken by the parks] remains disconnected from the local economy with no indication of a role in the development of high-tech clusters or collective learning processes". Even more generally, there is little in the way of evidence to suggest that either park has contributed substantively to the reorientation of their host economies towards more technologically sophisticated, innovative and, ultimately, higher-value added activities or sectors (Tsamis, 2009:226).

The performances of TTP and STEP-C were undoubtedly constrained by a number of factors. Their failure, however, to contribute to economic growth is a function primarily of two factors. The first is that the parks were "largely disconnected from the regional economy" (Tsamis. 2009:227). That is, there was an insufficient degree of connectivity between the activities that were occurring in the parks and the economic actors and activities that existed and transpired beyond them. This stifled any potential diffusion of knowledge and innovation to local firms; precluded the establishment of forward and backward linkages and relationships; and, most generally, hampered the capacity of the parks to contribute to the upgrading of the broader regional innovation systems of which they were theoretically a part. This first factor was compounded by a second, more fundamental one: the parks were established in innovation averse environments that were plagued by a host of deficiencies and, were consequently incapable of sustaining, let alone benefitting from, knowledge-intensive activity and innovation. While the parks were envisioned as means to address the challenges and the limited economic dynamism of the regions in which they were built, in the end, both TTP and STEP-C fell victim to and could not

overcome the pronounced socioeconomic and institutional constraints imposed by their respective regions (Tsamis, 2009:227, 230).

*What leads to strategies of waste?*

Although the five cases presented represent very different examples in scope, dimension and orientation, a number of common features emerge when trying to explain why what, by all means, have been considerable development efforts have not only failed to deliver on their stated goals, but have also resulted in significant opportunity costs that have left many of the regions where the interventions have been operationalised in similar, if not worse, condition than if no development strategy had been conducted.

First and foremost is the unbalanced nature of most of the interventions. Each of the five aforementioned strategies leaned strongly on one development axis linked to a particular dominant theory. Whether it was transport infrastructure in the case of the European Union, special economic zones in Peru, skills provision and training in the Philippines, or science parks in Greece, too much faith was put on the supply of one development factor as a trigger for future economic development. The neglect of other development axes and disregard for the interplay between different dimensions of development intervention represented, in all cases, a serious hurdle for the success of the strategies.

Second, most of the strategies described above paid too little attention to local conditions. The application of simple, theory-linked approaches has been and is guided by the belief that intervention can overcome what were often harsh realities on the ground. However, additional investment in R&D and training, new kilometres of motorways, or growth pole and cluster-type interventions in environments with serious shortcomings in basic endowments have yielded limited results. An excessive focus on the physical development of the zones and ignorance towards sectoral structures, local infrastructure needs, and skills availability in Peru has condemned the zones to almost economic irrelevance. Neglect of local factors and, especially, of the socioeconomic and skill conditions that mediate the returns to R&D investment has stifled innovation in the less developed regions of Europe, while a disdain of issues

related to job availability and barriers to entry in the labour market have pushed Filipino nurses to emigrate.

The most glaring omission, however, has been the limited attention paid to local institutional conditions. The promotion of new infrastructure, clusters, or growth poles in areas with poor quality of government, without parallel measures to improve government capacity, transparency and accountability, and/or reduce corruption, has undermined the returns to these development interventions. If anything, the involvement of poor quality, often corrupt governments in decision-making processes has benefitted the private, short-term economic and political interests of certain local stakeholders at the expense of medium- and long-term economic returns.

*Development strategies that have relied disproportionately on the potential advantages of one type of intervention and been largely disconnected from the realities of the territories for which they were designed have, as a direct consequence, frequently ended as strategies of waste that have yielded, relative to the actions and investments they involved, little in the way of productivity increases, job generation, and economic development.*

### 4.3.2. Strategies of gain

The cases presented in the previous section raise understandable concerns about the general effectiveness of the various types of development interventions that have been pursued with particular enthusiasm the world over and about the sensibility of the continued pursuit of these strategies in developing and emerging environments. However, not all types of development intervention can be easily dismissed as strategies of waste. Soundly-designed and well-executed multidimensional strategies – be they based on infrastructural expansion, investment attraction, the upgrading of innovative capacities and human capital endowments, or the promotion of co-location and positive territorial externalities – can also generate considerable economic returns, leading to ‘strategies of gain’. Strategies of gain can be defined as development approaches that have proven particularly capable of delivering on their expected impacts by fulfilling both their inherent potential and designated objectives. In this

section we will highlight a number of strategies of gain, summarising, at the end of section, the factors behind their success.

*Shoring up 'infrastructure gaps' in Sub-Saharan Africa and Asia*

The pursuit of the infrastructure-oriented development strategies inspired by and grounded in neoclassical growth theories has, by no means, been confined to the European Union or the developed world more broadly. A number of African and Asian nations have sought to develop their infrastructure endowments, often with a view to rectify basic deficiencies and bottlenecks that serve as fundamental impediments to economic performance and ensure that a what is effectively a prerequisite for economic growth is fulfilled.

African nations, and Sub-Saharan ones in particular, have suffered – and still do, to a large extent, suffer – from debilitating infrastructure shortages, transportation or otherwise. Infrastructure shortages in the African context are viewed by many as fundamental – albeit not insurmountable – impediments to economic performance and dynamism; these deficiencies are thought to hamper inter- and intra-regional trade, discourage domestic and foreign investment, slow or prevent territorial cohesion, contribute to the retrenchment of regional disparities and, from a more socioeconomic perspective, obstruct access to basic public services thereby compromising efforts to reduce and eradicate poverty (Calderon and Servén, 2008; Foster and Briceño-Garmendia, 2010; Mbekeani, 2010; Hartzenberg, 2011, Gutman et al., 2015). It is for this reason that infrastructure investment and development, and the filling of the so-called Sub-Saharan 'infrastructure-gap' have been prioritised by governments and international organisations alike. The financial commitments made by the World Bank, the African Development Bank and the OECD Development Assistance Committee to infrastructure development in Sub-Saharan Africa have, for example, increased steadily since 2000, ultimately reaching US$10bn in 2012 (Gutman et al., 2015:24). At the national level, a number of Sub-Saharan countries are directing significant and often increasing amounts of resources to infrastructure development; in 2013, Uganda, South Africa and Botswana were among the African countries that channelled more than seven percent of their respective GDP towards infrastructure

(ICA, 2014:46). The question that must be addressed, once again, is whether this expenditure has provided a measurable boost to economic dynamism.

Taken together, the body of empirical literature that assesses the returns to infrastructure investment and development in Sub-Saharan Africa suggests that transportation infrastructure investment has had a considerable growth-boosting effect. Calderón and Servén (2008), for one, examine the link between infrastructure development and economic growth and inequality in Sub-Saharan Africa between 1960 and 2005. Relying on indices that capture both the quantity and the quality of the infrastructure with which a country is endowed, the study provides "robust evidence that infrastructure development has had a positive impact on long-run growth and a negative impact on income inequality" in Sub-Saharan Africa (Calderón and Servén, 2008:29). Kodongo and Ojah (2016) reach a similar conclusion about returns specifically to infrastructure spending in the Sub-Saharan context. The econometric analysis reveals a positive and statistically significant association between infrastructure expenditure and economic growth and, moreover, provides an indication that relatively less developed Sub-Saharan African countries can expect to reap greater returns from infrastructure investment than their more developed Sub-Saharan counterparts. This latter finding implies that infrastructure investment, even in the Sub-Saharan African context, is subject to diminishing returns. These results are corroborated by country-level studies. Kumo (2012), Bosede et al. (2013) and Chingoiro and Mbulawa (2016) probe the link between infrastructure expenditure and economic performance in South Africa, Nigeria and Kenya, respectively. In each case, the authors unearth evidence to suggest that investment in infrastructure has been an important driver of economic growth.

In short, the pursuit of infrastructure-oriented policies and strategies and the prioritisation of investment in infrastructure development, more generally, in the Sub-Saharan African context have been justified by the returns they have generated and the growth they have brought about. The preeminent explanation for why the returns to these investments have been so substantial relates to the fact that infrastructural endowments in Sub-Saharan Africa have long fallen – and still today fall – below some base-level that is necessary to sustain and support economic activity and dynamism; that is, much of Sub-Saharan Africa is situated far from the 'infrastructure frontier'.

Expenditure on infrastructure expansion in environments where this is the case is, because of their distance to this frontier, less likely to suffer the sorts of diminishing returns that were especially evident in the European context. This implies that as long as infrastructural deficiencies exist, well-targeted and well-executed investments in the expansion and upgrading of infrastructure will continue to generate economic growth.

The realisation of returns from infrastructure development projects should not, however, be viewed as inevitable, even in environments characterised by the most severe infrastructural deficiencies. Botswana's Trans-Kgalagadi Road Project serves, in that respect, as something of a cautionary tale that underscores the importance of strategic planning, thorough diagnoses of local challenges and conditions and the execution of complementary actions and investments.[50]

The overarching aims of the Trans-Kgalagadi Road Project were to "reduce transport costs, enhance social and economic integration of South-Western Part of Botswana and facilitate economic integration with Namibia" (African Development Bank, 2011:7). The project centred on the construction of a 221km of bitumen 'highway' to replace what was previously an unpaved stretch of road between Sekoma and the Namibia-Botswana border crossing at Mamuno. Construction of the highway was completed and the road opened in 1998. With time, however, it became clear that the road was underutilized and that traffic volumes were well below those envisioned in the early stages of the project. Concern that the highway "could potentially develop into a 'white elephant'" (African Development Bank, 2011:18) inspired authorities to undertake a comprehensive review of the project in hopes of developing some understanding of why the project's anticipated outcomes had not yet materialised. The review revealed that the underutilisation was attributable, at least in part, to "non-physical barriers to the cross-border movement of people and goods" (African Development Bank, 2011:19), none of which were considered or factored into the planning process. That is, even though the road was designed as a facilitator of economic integration between Namibia and Botswana, authorities failed to recognise that the cross-border movement of people and goods was inhibited as much by

[50] The proceeding discussion is based on a Project Performance Evaluation Report (PPER) prepared by the African Development Bank for the AfDB-funded Trans-Kgalagadi Road Project (African Development Bank, 2011).

institutional barriers – including, for example, customs or unnecessarily complex transit procedures – as it was by the previous lack of physical connectivity. As a result, the project did not include measures to increase the ease with which goods and people could cross the border between Botswana and Namibia; this shortcoming would prove particularly consequential. It was only after a series of complementary investments were made and initiatives undertaken (including both physical measures such as the establishment of trade-facilitating 'one-stop border posts' and less tangible ones, including institutional reforms and the establishment of bodies – the *Trans-Kalahari Corridor Management Committee* – to oversee and manage the corridor) to transform the highway into a "transit corridor" that the project began to impel and increase interregional cooperation and integration, promote trade, and yield broader development outcomes (African Development Bank, 2011:19, 21).

Infrastructure-oriented development approaches have found success in a diversity of Asian contexts as well. Deficiencies in infrastructure are, as they are in much of Sub-Saharan Africa, ubiquitous across many of Asia's less developed regions. The Rural Transport Improvement Project[51] and Central Yunnan Roads Development Project[52] pursued in Bangladesh and China, respectively, serve not only to confirm that targeted infrastructural investments that address specific deficiencies or bottlenecks can contribute to both economic growth and socioeconomic development in less developed contexts, but also as 'best practices' from which lessons can undoubtedly be drawn.

Bangladesh's rural areas have long been plagued by a host of infrastructural deficiencies. While the implications of these shortages are numerous, one stands out as especially consequential: infrastructure shortages or inadequacies can compromise the capacity of impoverished people living in these rural areas to access and engage in income generating activities. Recognising this, the Government of Bangladesh embarked on a World Bank-supported initiative – the Rural Transport Improvement Project (RTIP) – the principal socioeconomic objective of which was to support

[51] The proceeding discussion is based on a Project Performance Assessment Report prepared by the World Bank Group's Independent Evaluation Group (World Bank, 2016d).

[52] The proceeding discussion is based on a Validation Report prepared by the Asian Development Bank's Independent Evaluation Department (Asian Development Bank, 2016).

poverty alleviation and foster economic growth in rural areas by increasing the physical accessibility of social services and economic opportunity (World Bank, 2016d:2).

The project was implemented and overseen by the government's Local Government Engineering Department and featured eight complementary components that spanned several development axes. The first six were of a more physical nature. They related primarily to the maintenance and upgrading of rural roads, bridges and culverts, rural markets and river jetties; to the acquisition of land needed for this construction; and to the implementation of resettlement and other land/environmental management plans. The final two components centred on the provision of technical assistance and consultancy services, capacity building, human capital upgrading, and institutional development.

The prioritisation of institutional development in this particular project was due to two factors. First, the project's primary socioeconomic objective was accompanied by a second, more institutionally-oriented goal: "to enhance the capacity of relevant government institutions to better manage rural transport infrastructure" (World Bank, 2016d:2). Second, projects like these can be derailed by various capacity constraints and other institutional deficiencies. The shoring up of capacities and capabilities was therefore seen as necessary to facilitate the efficient execution and longer-term sustainability of this, and other, policy initiatives.

While the project was not executed without its share of challenges,[53] at closure in 2012, the project had successfully constructed, rehabilitated or upgraded 1638km of 'upazila' roads (feeder roads); 15,965 meters of missing bridges/culverts; 123 rural markets and 32 river jetties (World Bank, 2016d:7). More importantly, however, there is ample evidence to suggest that the project had profoundly positive economic and social impacts. Average monthly income and expenditure, for example increased in project areas by 73.4% (compared to 14.9% in non-project areas) and 55.8% (33.9% in non-project areas) (World Bank, 2016d:8). The improvements to the infrastructure

[53] The most notable among them were, first, that the earliest stages of project were plagued by minor delays attributable to "challenges associated with land acquisition and compensation and poor contract management" (World Bank, 2016d:4); and, second, that "the capacity building objective only partially achieved its training objectives" (World Bank, 2016d:1).

networks and the increased connectivity they facilitated have also been linked to increases in agricultural and non-agricultural production and trade, though ex-post evaluation has not yet been able to determine the extent to which increases in the latter are directly attributable to the project (World Bank, 2016d:8).

There are also indications that the intervention delivered other socioeconomically-related benefits to rural residents in project areas in the form of improved access to both education and healthcare. Total school enrolment and the total number of healthcare services recipients increased by 12.2% and 32%, respectively, in project areas (World Bank, 2016d:9). These increases materialised in the face of decreases of 60% and 20%, respectively, in non-project areas (World Bank, 2016d:9).

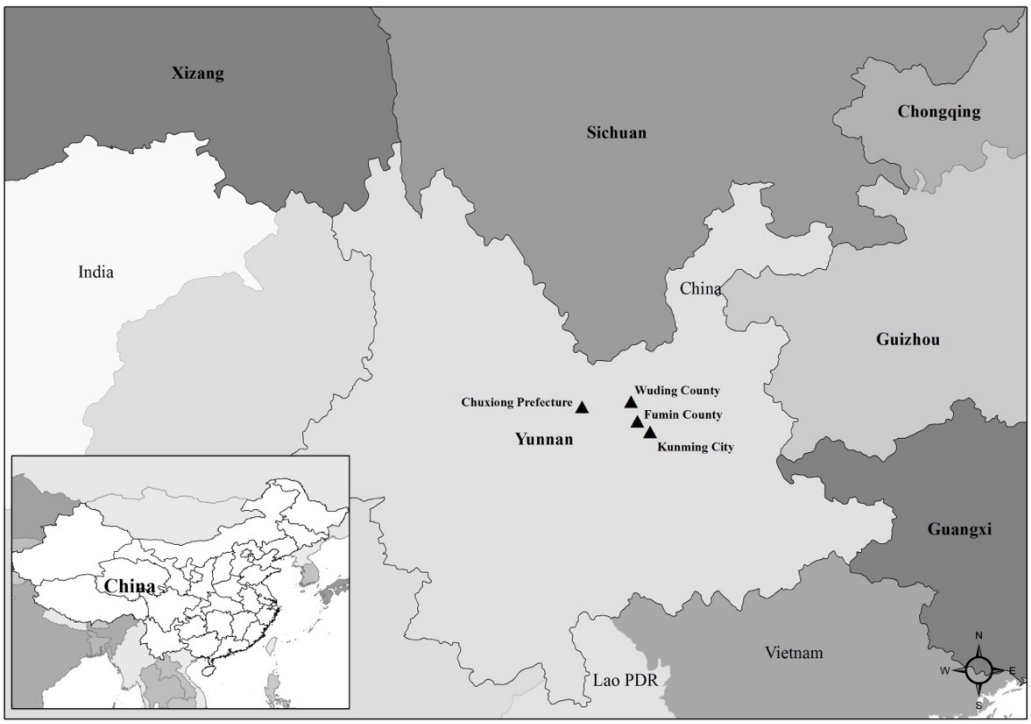
Yunnan province in Southwestern China is among the country's least economically developed regions. A lack of accessibility and infrastructural deficits are thought to be two of the factors to which this underdevelopment and the ineffectiveness of previous poverty alleviation and developments efforts are most readily attributable (Asian Development Bank, 2016:2). The upgrading of intra- and interregional transportation infrastructure has therefore come to be seen as a prerequisite to the achievement of economic growth and the eradication of interregional inequality.

It was this perception that led to the formulation and implementation of the Asian Development Bank-supported Central Yunnan Roads Project. The overarching objective of the project was to establish "a well-functioning integrated road transport system in Yunnan Province and [connect] the rest of the Greater Mekong Subregion" (Asian Development Bank, 2016:2) with the view to catalyse economic growth and promote poverty alleviation in Yunnan. Achieving higher levels of trade between Yunnan and the remainder of the country, and with its more economically developed eastern/coastal regions in particular, was an important secondary goal.

The project was guided by four specific, mutually-reinforcing objectives each of which pertained to a different aspect of the region's infrastructure system. It set out to: (1) construct a Wuding-Kunming expressway; (2) upgrade 190km of local roads; (3) improve road and traffic safety; and (4) develop the technical capacities of parties

responsible for the design and implementation of the project (Asian Development Bank, 2016:3).

*Figure 4.4. Central Yunnan Roads Project area*




**Authors' elaboration**

It was operationalised at the subnational level by two implementing agencies, each of which were responsible for two of the aforementioned objectives. The Yunnan Provincial Department of Transport oversaw road upgrading and safety improvement efforts. The Wukun Expressway Company Limited was tasked with the construction of the highway and the execution of the capacity building and institutional development initiatives.

The targets associated with the project's four guiding objectives were achieved: (1) the 63.6km Wuding-Kunming expressway opened in October of 2013; (2) 190km of local roads were rehabilitated over the course of the project; (3) efforts to improve road safety resulted in a decrease in 'road accident fatalities per 10,000 vehicles' of 30% in 2013; and, finally, (4) staff of both the Yunnan Provincial Department of Transport and the Wukun Expressway Company Limited were provided with 63 person-months of international training (Asian Development Bank, 2016:7).

Upon review, it became clear that considerable progress had also been made towards the project's underlying objectives across the project area (*Figure 4.4*).[54] Ex-post assessment confirmed that the project made substantial contributions to both poverty reduction and economic development in Fumin County, Kunming City, Wuding County and Chuxiong Prefecture (*Figure 4.4*). GDP per capita in the project area increased, for example, by an average of 18.3% between 2008 and 2013. The per capita incomes of farmers in Fumin County (128%), Wuding County (122%) and Chuxiong Prefecture (104%) also increased between 2008 as did the disposable incomes of individuals living Kunming City (96%). The project, and the construction of the expressway in particular, resulted in the creation of 3,930 temporary jobs and 268 permanent jobs as well. Relatedly, the project's contributions to poverty alleviation were also significant; between 2011 and 2013, the number of 'poor people' living the project area decreased by close to 40%, from 204,800 to 124,300.

*Attracting investment to the Dominican Republic: The importance and effectiveness of special economic zones*[55]

Peru's engagement with special economic zones serves, without a question, as a cautionary tale. Special economic zone programmes have not, however, been universally ineffective; experiences like that of the Dominican Republic provide an indication that inward investment-oriented approaches can, under the right circumstances and if appropriately operationalised and overseen, attract and concentrate economic actors, activity and investment and, in time, give birth to 'growth poles' whose success and dynamism pays dividends in the form of regional economic development.

Special economic zones have, in the Dominican context, proven to be "powerful [engines] for job generation, exports and productive diversification", means to attract foreign investment and effective instruments for the pursuit and achievement of economic growth (World Bank, 2016c:8). The country's special economic zones,

[54] The socioeconomic impacts of the project are detailed on page 9 of the Validation Report (Asian Development Bank, 2016).

[55] The proceeding discussion is based on a World Bank (2016c) review of the Dominican Republic's experience with special economic zones.

the first of which was established in 1969, focused initially on textiles and clothing manufacturing, benefitting from the Multi-Fibre Agreement and the import quotas with which it was associated (World Bank, 2016c:7). The end of the Multi-Fibre Agreement in 2005, while a challenge for the country's zones, also served as the impetus for a shift that saw the Dominican Republic's special economic zones become increasingly engaged in more capital-intensive, higher-value added activities in the services, textiles, medical instruments, tobacco and agroindustry sectors (World Bank, 2016c:8). As of 2014, the country's zones, which rely on a mix of incentives in the form of tariff exemptions and a range of fiscal instruments to attract firms and encourage investment, hosted, on average, 11 firms and accounted for 140,000 jobs (World Bank, 2016c:8). By 2015, 65 special economic zones had been established, 47 of which were privately owned and operated (World Bank, 2016c:9). These zones, irrespective of whether they are privately or publically managed, are very much 'outward-oriented', prioritising both the attraction of foreign direct investment as well export promotion and the cultivation of domestic exporters (World Bank, 2016c:9).[56]

The success of the Dominican Republic's zones is attributable to four key factors. First is the Dominican Republic's relationship with the United States. The country's physical proximity to the United States coupled, first, with the Multi-Fibre Agreement and, later, with the Dominican Republic Central American Free Trade Agreement (CAFTA-DR) – both of which granted/grant preferential market access to Dominican exports – increase the appeal of the Dominican Republic's special economic zones to foreign firms as sites for their offshore production activities.

[56] The Dominican Republic's experience with special economic zones, while generally regarded as positive, has not been free of challenges and obstacles. There are concerns, for example, that the potential of these zones as sources of permanent employment creation may be waning as the firms they host become increasingly engaged in more technologically sophisticated and higher-value added *but also less labour intense* activities and industries (World Bank 2016c:13, 14). Movements like these, 'up the value chain', are indicative of a maturation of the zone programme and of the Dominican economy more generally. They also, however, are associated with "important labour implications" that policy-makers must recognise and take steps to address and manage (World Bank, 2016c:13). A second, and perhaps more immediate set of concerns, relates to the emergence of "a duality in [the country's] production structure" and the performance and viability of non-SEZ firms more generally (World Bank 2016c:10). That is, the country's SEZ firms tend to be engaged in sectors and industries that are increasingly different to those within which their non-SEZ counterparts are participating and are, as result becoming increasingly disconnected from them (World Bank 2016c:10). SEZ firms are, for example, still largely dependent on imported inputs (World Bank, 2016c:18, 19). Simply stated, non-SEZ firms are struggling to cultivate relationships with, benefit from and keep pace with the SEZ firms. This inevitably raises questions about the extent to which zones in the Dominican Republic can become a catalyst for more geographically widespread economic growth and development (World Bank, 2016c). This, however, has not gone unnoticed by policy-makers who have since operationalised programmes designed to rectify it (see *Footnote 57*).

Second, the private sector features prominently in the country's special economic zone regime. Not only are the vast majority of the country's zones owned by private bodies that can leverage capabilities, capacities and experience that likely exceed those of their public sector counterparts to efficiently manage and operate the zones, the private sector is also a contributor to the policy dialogue via an "association of SEZ entrepreneurs (ADOZONA)" and representation on the committee that is responsible for the oversight and regulation of the country's special economic zones (World Bank, 2016c:9). It is, as a consequence, immediately engaged in the development of the country's special economic zones programme. This engagement is anticipated to help ensure that the policies and initiatives that are linked to the programme are, and continue to be, sufficiently attuned to the needs and priorities of the stakeholders they target.

Third, the country's special economic zone programme is overseen by a single and effective regulatory body – the Consejo Nacional de Zonas Francas Especiales (CNZFE). Streamlined regulatory systems impose lower transactions and administrative costs on firms and contribute to the creation of contexts that are conducive to investment and economic activity; the assignment of oversight responsibilities to a single actor, as is the case here, reduces the potential for coordination challenges and minimises the complexities associated with navigating the country's special economic zone regulatory regime. The CNZFE also assumes responsibility for efforts and initiatives to attract foreign firms and investment, effectively doubling as an inward investment agency. It has in recent years, "established a Statistical Department, an Economic Analysis and Competitiveness division and a Promotion department" all of which have contributed to the programme's success "attracting investors from a number of emerging industries" (World Bank, 2016c:9).

Fourth, the Dominican Republic's special economic zones programme has been *actively* managed. More specifically, policy-makers have successfully navigated a series of profound challenges via the reformation of domestic regulations and policies (World Bank, 2016c:9). They introduced a number of changes to special economic zones legislation to ensure not only that the country's special economic zones are compliant with WTO rules, but also that the zones remain as attractive and

competitive as possible and can, in turn, continue to serve as catalysts for export and economic growth (World Bank, 2016c:22).

Relatedly, policy-makers have also recently acknowledged and taken steps to rectify a pronounced weakness of the zone programme: the zones are becoming increasingly detached from the remainder of the economy. Recognising that greater connectivity between the zones and the territories in which they are situated must be fostered if the zones are to contribute to more geographically widespread, inclusive socioeconomic development, authorities have pursed initiatives to promote greater interaction between firms situated inside the country's zones and those that are not. Most notably, they have established a 'match-making programme'[57] to promote the establishment of inter-firm linkages (World Bank, 2016c:21).

*Market-oriented education and training: Vietnam's Vocational and Technical Education Project*[58]

The stock of suitably skilled human capital with which a region is endowed does, as postulated by the endogenous growth theories, influence its economic performance. Consequently, actions geared towards its expansion could contribute to the achievement of economic growth. If not mobilised and engaged in productive activity, however, skilled individuals cannot contribute to economic growth and development. It is for this reason that education and training-oriented initiatives must, as they were in the Vietnamese Vocational and Technical Education Project, be aligned with the needs of firms and the demands of the labour market more generally. Moreover, training schemes should be integrated into broader development strategies that balance supply-side efforts with actions that address demand-side conditions.

[57] 'Match-making' efforts thus far have involved the facilitation of "business-to-business meetings". The ultimate aims of these meetings are to expose SEZ firms to local, non-SEZ firms (and vice-versa) and, ideally, lay the foundation for the establishment of more formal, mutually beneficial relationships between them (World Bank, 2016c:21). In 2015, for example, the CNZFE piloted a "match making round in which more than 60 business-to-business meetings took place" (World Bank, 2016c:21). It was the intention of the CNZFE to, in subsequent iterations, expand and open participation in these 'rounds' to a variety of other actors, stakeholders and institutions, including "national associations of exporters, representatives of chambers of commerce, and other industry representatives" (paraphrasing World Bank, 2016c:21). It should also be noted that these concerted match-making efforts are supplemented by the provision of training to domestic firms – again by the CNZFE – to ensure, that local suppliers are aware of the "quality certifications needed to become suppliers of SEZ firms" and, importantly, in a position to meet, if not exceed them (World Bank, 2016c:21).

[58] The proceeding discussion is based on a Performance Evaluation Report for Vietnam's Vocational and Technical Education Project prepared by the Asian Development Bank (2013).

Shortages of skilled labour have long been identified as a preeminent development challenge for Vietnam. In 1998, for example, "about 80% of the labour force was unskilled…and only 10% had formal training" (Asian Development Bank, 2013:4). This shortage of skills was mostly attributable to a weak supply-side-oriented vocational and technical education system that was neither robust enough to cope with the country's increasingly large and expanding labour force nor capable of catering to and fulfilling the shifting needs of the its labour market and industries (Asian Development Bank, 2013:4). Reformation of this system was therefore seen as means to overcome the pronounced skills deficit facing the country. The Asian Development Bank-supported Vocational and Technical Education Project represented an effort to do just that.

The project was motivated in equal measure by an awareness of the various inadequacies of the country's vocational and technical education system and by the more general perception that the provision of training and the expansion of the country's skilled labour pool were crucial to achieving both the aims of Vietnam's market-oriented industrialisation policy (Asian Development Bank, 2013:1) and economic growth and development, more broadly (Asian Development Bank, 2013:11). Overseen by the Ministry of Labour, Invalids and Social Affairs and implemented by the government's General Department of Vocational Training, the project was guided by three specific objectives (Asian Development Bank, 2013:1): (1) improve the market-orientation of the country's vocational and technical education system; (2) improve the efficiency of the vocational and technical education programmes offered by 'key schools'; and (3) strengthen the institutional capacity of the General Department of Vocational Training to facilitate both the implementation of the project and provide the government with the capacity to undertake future reforms.

The project featured three discrete but inevitably interrelated components, each of which corresponded to the one of its three main objectives. The first component was composed of initiatives to increase the market-orientation of the vocational and technical education system and increase its coherence with the skills requirements and priorities of employers. These included the development of a 'labour market information system' and other enterprise surveys to facilitate the "systematic

assessment of the demands of enterprises and employers" (Asian Development Bank, 2013:6); efforts to increase the 'career guidance' available to students; and the development of new curriculums, and corresponding teaching guides and learning materials, that are more closely aligned with the "skills requirements of employers" (Asian Development Bank, 2013:6). The second component centred on the construction and/or renovation of, the installation of new equipment and technologies in, and the overall upgrading of the 15 key schools that were the focus of the project (Asian Development Bank, 2013:7). The third, capacity-oriented component featured actions to establish unified qualification and assessment systems and frameworks for monitoring and certification purposes; increase the accessibility of vocational and technical education to women, minorities and other disadvantaged groups; and provide training to and, in turn, improve the technical capacities of teachers and policy-makers alike.

The more immediate outcomes of the project were numerous. With regards to its first objective, the project resulted in the implementation of 48 new curricula and the establishment of a market-oriented, stakeholder-driven process for the design of curricula that reflect labour market demands and the skills requirements of employers (Asian Development Bank, 2013:18). The second objective was fulfilled by upgrading the facilities and equipment at the 15 key schools to the benefit of both students and the schools themselves (Asian Development Bank, 2013:18). From the perspective of students, the upgrading of the schools, equipment and resources improved their overall learning experience and afforded students the opportunity to become familiar with the technologies, tools and equipment relied on by their to-be employers. The reputations of the 15 target schools were enhanced by the upgrading as well. This, in turn, increased their capacity to attract students. Some progress was also made towards the achievement of the third, institutionally-oriented objective, though this is the front on which work remains. Curricula development training was, for example, provided to 4,900 teachers and administrators. The success of the project on other fronts also implies that any capacity building initiatives undertaken with the view to facilitate project execution were at least somewhat effective. Accreditation, certification and qualification frameworks and systems were, however, not established to the expected extent (Asian Development Bank, 2013:20). Similarly, efforts to increase the

participation of women, minorities and other disadvantaged groups were not as successful as envisioned (Asian Development Bank, 2013:20).

The project's more general labour market impacts were sizeable as well. The project expanded the country's stock of skilled and vocationally trained labour. Between 2001 and 2007, the 15 key schools graduated 210,600 people, many of whom participated in, and benefitted directly from, one of the newly devised, market-tailored curricula (Asian Development Bank, 2013:27). Similarly, the majority of the targeted schools' graduates encountered little difficulty obtaining employment. A follow-up assessment revealed that only 4.1-6.2% of graduates were unemployed two to three years after the completion of training (Asian Development Bank, 2013:28). Graduates also tended to earn higher and faster rising incomes than non-graduates (Asian Development Bank, 2013:29).

The most significant labour-market impact of the project may, however, also be its least quantifiable. The *ex post* performance review indicated that the project "helped to orient [the overarching] vocational and technical education system toward a market-driven approach" (Asian Development Bank, 2013:27). That is to say, the project had a profound effect on attitudes towards, and policy-thinking about, the way in which vocational and technical education systems should be structured and, relatedly, the necessity of adopting market-oriented approaches that integrate demand-side factors and concerns into supply-side policies and initiatives. Overall, it impelled a shift away from the supply-driven policies of the past towards more flexible and sustainable integrated, demand-driven policies that yield benefits for employees and employers alike.

*Promoting interaction and connectivity in Brazilian clusters: Brazil's APL policy*[59]

Cluster-oriented development policies have, as alluded to in the previous section, encountered their share of difficulties and challenges. Far too often, policy-makers have sought to establish clusters in economically disadvantaged regions without sufficient concern for the capacity of those regions to sustain and, in turn,

[59] This section draws on Garone et al.'s (2015) econometric investigation into the effectiveness of Brazil's APL policies in two of its provinces.

benefit from them. Similarly, insufficient attention has been paid to the promotion of linkages and connections between the cluster and its host territory, or to the encouragement of interactions, cooperation and collaborations *within* the cluster. The neglect of these considerations explains the underperformance of many of the world's cluster policies. Brazil's Arranjos Productivos Locais (APL) policy, however, serves as a reminder that carefully designed, contextually tailored cluster-based development strategies can have profound, positive impacts on the economic fortunes of the places in which they are pursued.

Quantitative impact analysis of cluster policies, in the emerging world in particular, are few and far between (Garone et al., 2015). This absence of evidence impairs our capacity to form robust conclusions about the more tangible outcomes associated with, and overall effectiveness of, cluster-based development strategies. Garone et al. (2015) address this barrier by exploring the employment generation, value creation and export-propensity outcomes associated with Brazil's APL policies for a selection of the country's clusters. In doing so, they provide, in their own words, "the first rigorous impact evaluation of a cluster development policy in Latin America" (Garone et al., 2015:926).

APLs are defined as "clusters of firms within the same administrative area (e.g. municipalities) that share a particular economic specialisation" (Garone et al., 2015:929). Operation in close physical and sectoral proximity is not, however, the main characteristic of these clusters; Garone et al. (2015:929) are careful to stress that it is the interaction, collaboration and cooperation among co-located parties that set APLs apart from mere agglomerations of economic actors and activity.

Prior to 2004, APLs were established and supported by various, unconnected public and private SME-promotion agencies. In 2004, however, recognising the inherent potential of these APLs as tools for the promotion of local economic development, Brazil introduced an official APL policy. The overarching aims of the policy are to support job creation and bolster the competiveness of firms, and the regions they occupy, via interventions designed to increase efficiency of, and interaction and cooperation between, co-located firms (Garone et al., 2015:929). The APL policy programme, which is now manged and overseen by a purpose built 'APL

Permanent Working Group' within the Federal Government's Ministry of Development, Industry, and Foreign Trade,[60] has since become a prominent feature of the country's industrial policy.

APL interventions have not been pursued indiscriminately. Authorities rely on a rigorous assessment process to determine if and where policy efforts will be implemented (Garone et al., 2015:929). The primary reason for doing this diligence is to ensure that scarce resources are channelled to support clusters that, on the one hand, are sufficiently developed to actually benefit from the policy but, on the other, still face challenges and obstacles that hamper their performance and warrant policy intervention. Interventions are therefore, in effect, targeted, at clusters characterised simultaneously by "certain levels of SME concentration and specialisation (often defined as existing or potential APL)" (Garone et al., 2015:929) and "credible development potential" (Garone et al., 2015: 930). The extent to which a particular cluster could contribute to processes of local economic development is also integrated into the selection process (Garone et al., 2015:931). The implication of the employment of a rigorous selection process is that APL policy interventions are not guided by the objective of *physically creating* clusters, but rather by the aim of transforming a group of co-located firms into a 'prototypical' cluster in which interaction, cooperation and collaboration are ubiquitous (Garone et al., 2015:930).

Brazil's APL policy interventions are composed of two distinct stages. The first stage centres on the development of a 'strategic development plan' that is informed by both comprehensive diagnostic analyses and by the involvement and insights of private and public sector stakeholders. It is at this stage that institutional strengthening and capacity building-type activities are also undertaken. This first planning stage, and APL interventions more generally, are bottom-up and participatory in nature; Garone et al. (2015:929) highlight that the key foci in the policy elaboration phase include the fostering of cooperation within the targeted APL; the promotion of interactions between its main agents; and the identification of the local leaders who will be responsible for the implementation of policy interventions.

[60] While the APL Permanent Working Group is responsible for the oversight and coordination of APL policies, the interventions themselves are implemented at the local level often by the Brazilian Service to Support Micro and Small Enterprises (SEBRAE) (Garone et al., 2015).

The second stage of the process involves the actual operationalisation of the development plan and the implementation of the specific actions it envisions. The sets of tools and instruments relied upon by different APLs will vary in accordance with their respective development plans and the challenges they face. That said, interventions, irrespective of where they are pursued, tend not to target individual firms; they more often focus on cluster-level actions and on promotion intra-cluster networks, cooperation and interaction (Garone et al., 2015:929, 930).

APL interventions have been pursed across Brazil. They have, accordingly, targeted agglomerations that specialise in any number of industries. Garone et al. (2015), however, focus their empirical analysis on a handful of APL policies implemented by the Brazilian Service to Support Micro and Small Enterprises (SEBRAE) in São Paulo and Minas Gerais.

The picture that emerges from this econometric exercise is a favourable one. The study provides evidence to suggest that the APL policy interventions have contributed to job creation and value generation in, and increased the export propensity of, the clusters in which they were pursued (Garone et al., 2015:936). Moreover, the employment- and export-related outcomes are interpreted as evidence that APL policies, and the interventions by which they are composed, have augmented the overall productivity of the firms that compose clusters targeted by these strategic actions. The authors assert that "the simultaneous effects of employment and export measures [would] hardly be achievable without a significant increase in firms' productivity" and, consequently, that "the efficiency enhancing activities put in place by the APL policy…were actually effective" (Garone et al., 2015:936). The analysis also indicates that firms that were not explicitly targeted by the APL interventions but were physically proximate to those that were benefitted over the medium-to-long term from spillovers (Garone et al., 2015:336). The inference to be drawn here is that APL policies have contributed to more than just efficiency and productivity gains for targeted firms; they have served as instruments for the pursuit of more widespread local economic development (Garone et al., 2015:942).

*Putting together strategies of gain*

What are the main differences between the aforementioned strategies of gain and strategies of waste? The line by which they are separated is a fine one. The success of a development strategy appears, on the basis of the above, to be predicated on the consideration and employment of a series of basic principles – during both the policy design and policy implementation phases – in a nuanced, thoughtful and holistic way.

The first principle relates to the need to pay attention to local conditions, regardless of the theory that informs the strategy. Awareness of the local context has been and is paramount to the success of the special economic zones in the Dominican Republic and plays a key role in the dynamism of Brazilian APL clusters. The Dominican government has gone the extra mile to actually explicitly link the economic activity generated inside the zones to the rest of the Dominican economy. In Vietnam – and in contrast to countless other human development and skill building strategies that have been operationalised in the emerging world – vocational training was carefully aligned with the needs of local firms. It was this attention to context and, more specifically, solid diagnoses of local conditions, bottlenecks and potential, that explain, at least in part, the relative success of the intervention.

This awareness of local context needs to be accompanied by the skilful integration of interventions into broader development strategies. Road building projects in Bangladesh fulfilled their goals because there were complemented by the provision of technical assistance and consultancy services, and by the concurrent pursuit of capacity building schemes and other measures aimed at improving local institutional conditions and human resource endowments. The Vietnam vocational training scheme was similarly integrated into a broader industrialisation-based economic development strategy.

Finally, distance to so-called ‘frontiers’ may have been a factor in the success of certain schemes. Infrastructure endowments in sub-Saharan Africa and in Bangladesh and Yunnan province are still sufficiently underdeveloped such that investments in their upgrading are not yet subject to diminishing returns. This means that additional investment in infrastructure is unlikely to be associated with high

opportunity costs and can, importantly, conceivably continue to impel economic growth.

## 4.4. Separating strategies of gain from those of waste

Taken together, the cases presented in the preceding section provide an indication of the potential of territorially-targeted development interventions as means to impel sustainable and locally embedded economic growth. They also, however, serve as reminders, in the first instance, that the pursuit of these approaches can be fraught with challenges and, moreover, that great care, contextual awareness and a cognisance of the pitfalls to which these strategies often fall victim must be employed in both their design and implementation. The question that must therefore be addressed is, quite simply: *what separates the strategies of gain from those of waste?* The proceeding sections expose and address four points of divergence between the two classes of approaches. It is from these differences that a series of policy implications are gleaned.

### 4.4.1. The importance of multidimensionality, integration and balance

Each of the strategies of waste was guided by a different overarching objective ranging from, *inter alia*, the expansion of regional infrastructure endowments, to the attraction of non-local investment and enterprises, to the fostering of co-location and the unlocking of the productivity-enhancing externalities with which it is associated. These interventions were clearly embedded in the extant theoretical approaches to growth and development, but generally fished in one particular theoretical pond, ignoring the benefits of alternative approaches; they were effectively informed and underpinned by a single, different theoretical perspective and were, as a result, 'unidimensional' in nature.

Accordingly, the strategies of waste presented share one especially prominent similarity: they focused exclusively on one 'development axis'. That is, each intervention concentrated excessively on the rectification of one particular deficiency through one type of policy instrument or intervention. As a consequence, they

neglected the way and extent to which other, not-immediately-related factors affect and can actually compromise the overall efficacy of interventions.

In the European Union, the neoclassical growth theory-inspired perception that increasing a region's stock of infrastructure would, directly and indirectly, augment regional productivity and, in turn, spur growth, has led to the channelling of significant resources to the expansion of what is a reasonably mature transport infrastructure network. A failure, however, to consider how exactly the establishment of new infrastructure would complement or unlock a region's assets of capabilities – or, relatedly, could be rendered ineffective by a lack thereof – has resulted in the indiscriminate allocation of scarce financial resources to actions that have, at best, failed to alleviate or rectify infrastructural deficiencies that inhibit productivity and stifle economic growth and, at worst, merely provided duplications of existing infrastructure or services. In Peru and Greece, special economic zones and science and technology parks, respectively, were simply imposed, without complementary or supportive policy actions, on regions by policy-makers that did not, or were unable to, integrate them into the economic fabrics by which they were underpinned. This failure undermined the theoretical potential of these interventions to serve as growth poles that leverage external investment and, in the case the science and technology parks, the externalities associated with co-location, to catalyse the growth of the broader geographic regions in which they are situated. The Filipino education system displayed a similar, equally problematic 'unidimensionality'. The country's robust medical training system that churns out the skilled human capital that should, according to endogenous theories of growth, drive economic growth, has been rendered ineffective by an absence of efforts to match a focus on the supply of skills and education with initiatives to create sufficiently high-quality employment opportunities through which educated persons could exploit their skills and contribute to economic growth. The innovation-oriented, endogenous growth theory-guided efforts undertaken by the European Union to foster economic dynamism via investment in knowledge generation have been ineffective, again, in large part because of the omission of strategic interventions to ensure that the regions to which more and more R&D resources have been channelled had, or were able to develop, the capacity and capabilities to mobilise and exploit them.

The strategies of gain were not, on the other hand, characterised by this 'unidimensionality'. They were marked both by a distinct multidimensionality and by an integrative, balanced nature. In both China and Bangladesh, infrastructure-oriented development projects were composed of several complementary components – that were also supplemented by institutionally-oriented reforms – that together promoted both the alleviation of specific bottlenecks and the general upgrading of the infrastructure networks of the targeted environments. Similarly, concerted efforts, in the form of network and linkage-promotion interventions and regulatory reforms, have been made an integral part of the Dominican Republic's special economic zone programme to embed the zones in their host regions. The inclusion of these efforts was motivated by the need to ensure, first, that local firms – and the regional economies they compose – can tap into and realize benefits from the zones to which they are proximate and, second, that the zones do not become entirely disconnected from the environments in which they were established. In Vietnam, the strategic efforts to reform the country's vocational and technical education system were, unlike many of those pursued elsewhere in the emerging world, devised with full awareness of the skills demands of local firms and the opportunities that existed in the labour market. The reforms were also envisioned as a vitally important part of, and were integrated into, the country's broader market-oriented industrialization effort. Finally, Brazil's APL cluster policies rely on an array of mutually-reinforcing interventions and instruments that both provide support to the individual firms that compose the cluster and promote interactions and relationship-building between them. Together, these actions enhance the overall dynamism of the cluster to the benefit of the region in which it is situated and, via feedback mechanisms, the clustered firms themselves.

Unidimensional approaches to development, including the aforementioned strategies of waste, that operate along one development axis are informed by a very narrow understanding of the factors that condition and shape processes of economic growth and change. That is, they adhere, unfailingly, to the policy prescriptions that emerge from a single development theory (e.g. Barca et al., 2012:137). As a consequence, these approaches tend not to account for the facts, first, as the evolution of growth and development theories would seem to confirm, that the economic performance and dynamism of any given region is governed and mediated by any number of contextually specific factors, characteristics and attributes and, second, that

economic underperformance tends not to be attributable to one particular deficiency, but rather to several, inevitably interconnected ones (e.g. Dosi et al., 1994; Adelman, 1999; Dang and Pheng, 2015; Pike et al., 2017).

Certain deficiencies may very well be, in some environments, more pronounced than others which may, in turn, lead development strategies to be oriented more squarely in one direction over another. Moreover, contextual conditions in certain environments may, for any number of reasons, be more receptive or amenable to certain types of policy interventions than others.

Infrastructure investment can, for example, because of the diminishing returns to which it is subject and the expectation of limited returns beyond a certain threshold, be a suitable cornerstone for development strategies pursued in less developed territories plagued by infrastructural deficiencies that stifle economic activity, trade, processes of territorial integration and/or individual mobility. Similarly, certain territories with burgeoning industrial or sectoral specialisations, and the competitive advantages and socioeconomic and institutional conditions to sustain it, may be in position where the inflow of foreign capital and firms could lead to the rapid and sustainable expansion of that sector. Policy-makers in such territories should consider awarding inward investment-oriented actions a privileged position in the development strategies they devise and pursue.[61] In a similar vein, the sorts of human capital or knowledge-oriented initiatives prescribed by the endogenous growth theory may be more viable in more economically advanced environments where other, perhaps more fundamental, socioeconomic or structural deficiencies have been addressed and conditions are such that skills, knowledge and innovation can be mobilised and

[61] It is critically important to note that the existence of 'favourable' socioeconomic conditions is not, in and of itself, sufficient justification for the pursuit of an inward investment-oriented approach designed to attract a particular sector or industry to a territory that has no pre-existing familiarity with, or competencies of relevance to it. Inward investment-oriented strategies will only succeed in first, attracting, and second, embedding (to the benefit of the host economy), the inward investment activities if there is a relevant foundation upon which they can draw. The reasons for this are two-fold. First, firms, increasingly guided by knowledge or competency acquisition intentions, are not attracted to environments from which they cannot benefit in one way or another. Second, a host economy will only benefit from the attraction of foreign firms and investment if it is capable of embedding it/them. Integration of this nature is not possible if local firms lack the skills, competencies and knowledge bases needed to engage, interact and develop relationships that will allow them to acquire knowledge from extra-local firms, and similarly, if workers lack the relevant skills and training needed to work for or provide services to the imported firms. Simply stated, the attraction of inward investment in a particular sector or industry to a region that is *ex-ante* not specifically suited to it will either be immediately ineffective or not sustainable. Trying to establish a new industry from scratch focusing only on the attraction of foreign firms is more likely than not going to end up as a strategy of waste.

productively exploited. There is perhaps even scope for the establishment of economic growth strategies underpinned by cluster-based actions or initiatives in territories where dynamic economic actors are *already* located in close physical proximity and, consequently, the focus of initiatives need not be on fostering physical co-location but rather on the promotion of cooperation, collaboration and general interaction within the pre-existing agglomerations, and, by extension, on the establishment of linkages between the cluster and the territory that hosts it.

All of this does not, however, imply that other, perhaps less pronounced, shortcomings by which a region is plagued or its more general characteristics and attributes can be overlooked or that a wholly unidimensional approach will ever be appropriate. Development strategies need to consider the complexity of the factors that hinder development and involve a series of complementary structurally-, socioeconomically- and institutionally-oriented actions and initiatives.

The reason for this is simple: local or regional economies are complex systems that feature and are characterised by any number of co-dependent relationships (Pike et al., 2017). The success of any given development action or intervention will therefore, almost inevitably, be a function of, and critically dependent on, several factors. Individual interventions along different development axes that together compose an integrated, multifaceted development strategy will, if designed appropriately with reference to local contextual conditions, work in a synergistic and mutually reinforcing manner to address all relevant deficiencies and produce outcomes that will exceed those of the unidimensional approaches rendered ineffective by the very factors and conditions they neglect.

### 4.4.2. Understanding and responding to local characteristics and conditions with precisely targeted interventions

The strategies of waste presented in *Section 4.3.1* were plagued by a second weakness: the tailoring and targeting of the interventions by which the strategic approaches were composed were generally guided by theoretical tenets and did not take into consideration the conditions of the local economy. This was not the case in the strategies of gain.

The returns to the European Union's efforts to expand its transportation infrastructure endowment have been limited in large part because of their indiscriminate and imprecise nature. That is, resources that were earmarked for infrastructure development have been spent not on projects that alleviate particular bottlenecks or address deficiencies in the continent's transportation infrastructure network, but rather – and often because of aforementioned institutional failures – on larger scale, higher visibility projects in environments with little concern for their social and economic suitability. Infrastructure expenditure is subject to diminishing returns. Precise and efficiently targeted investments in environments that suffer from productivity-hampering infrastructure bottlenecks, deficiencies and shortages are therefore anticipated to yield considerably higher returns than those made in environments that are closer to or beyond the infrastructure frontier, as many of the European regions in which the infrastructure funds have been spent, in fact, are. The continent's R&D drive has been, to the detriment of the development outcomes it was anticipated to give rise to, pursed in a similarly indiscriminate and imprecise way. European regions, because of the inevitably heterogeneity by which they are characterised, have different facilities for the transformation of R&D activities, and the knowledge they yield, into innovation and, in turn, economic growth. R&D expenditure has, however, been prioritized universally: it has not been geared towards or targeted at the European Union's more developed, innovation prone regions, nor has the innovation drive considered or accounted in any way for the characteristics or attributes of the continent's lagging regions that could conceivably compromise their capacity to realise benefit from it. The returns to this strategic approach in the European Union's innovation averse, less developed territories have, therefore, been meagre. In the Filipino case, the targeting failure is manifested in a complete neglect of the preeminent factor to which the limited returns to the country's robust medical education and training system – and the well-developed stock of skilled human capital it has cultivated – are attributable. Policy-makers have failed to target and, in turn, develop interventions to address the demand-side weaknesses (i.e. a dearth of higher-quality employment opportunities) that prevent skilled workers from engaging in productive activity and contributing to economic growth. The Peruvian special economic zone programme and the Greek science and technology park initiative have suffered from a related targeting failure. In both cases, policy-makers pursued these interventions in environments that were *ex ante* incapable – because of a multitude of

structural, socioeconomic and institutional deficiencies – of benefitting from them. Because both the zones and the parks were conceived exactly as instruments to promote growth and development, the primary criterion considered in the targeting process was a region's level of development. The very fact that the inadequacy of their underlying socioeconomic, institutional or structural fabrics could undermine the success of activities within the zones or parks was overlooked. The initiatives where therefore pursued exclusively in less developed regions that, at the time of implementation, not positioned to benefit from them.

Conversely, the strategies of gain examined have been particularly impactful, in part, because of the way and extent to which they either targeted and mitigated the exact deficiencies that hamper local and regional economic performance or, similarly, targeted and leveraged the advantages with which a region was, or is, endowed. The infrastructure development initiatives and actions undertaken in across Africa and in China and Bangladesh were, for example, geared exactly, in the former, to rectifying large-scale infrastructure shortages and, in the latter, to addressing and correcting bottlenecks and deficiencies in regional infrastructure networks. The environments in which these efforts were pursued featured insufficiently developed infrastructure endowments meaning that any expenditure channelled towards their upgrading and expansion, that would otherwise be subject to diminishing returns, could yield returns in the form of economic growth. In the Dominican Republic, authorities recognised the advantages afforded to the country's economy by its physical and institutional proximity to the United States and, in turn, devised what would prove to be an especially successful special economic zone programme. The programme explicitly targets and contains measures to leverage and capitalise on this particular strength. Similarly, efforts to reform the Vietnamese vocational and technical education system sought to address a pronounced flaw that plagued it: prior to the execution of these initiatives, the country's vocational and technical education system was all but completely detached from the labour market. Policy-makers engaged the private sector to correct for this and foster a greater matching between the education system and the skills requirements of firms to the benefit of newly educated individuals, local firms and the economy more broadly. Brazil's APL policies rely, to a greater extent than any of the other policies and strategies considered here, on formalised processes that facilitate the efficient and effective targeting of the interventions by which they are

composed. Great care and thorough analysis are exercised and employed when selecting the clusters that will be subject to policy actions. The consequence of this is that APL policies are only operationalised in environments where there is a reasonable, objectively informed expectation that they can catalyse local economic growth and development.

Ensuring that policy interventions are both tailored to the geographies in which they are to be pursued and are targeted towards either specific challenges or weaknesses by which they are faced or particular comparative or competitive advantages with which they are endowed should therefore be seen as essential if the scarce resources that are allocated to efforts to promote economic growth and development are to be deployed in an effective manner. Efficient policy 'tailoring' and 'targeting' akin to that exemplified by the aforementioned strategies of gain is facilitated by robust diagnoses of local conditions and the performance of comprehensive situational analyses.

Different regions are characterised by distinctly different strengths and opportunities and, conversely, challenges and vulnerabilities that are all products of local contextual conditions. Analyses of these conditions shed light not only on where viable opportunities for sustainable economic growth lie and what they might be, but also on the weaknesses and vulnerabilities that the strategy must mitigate. These diagnostic processes function, in that respect, as means to cultivate and collect the insights that constitute the foundation of economic development strategies that respond and are tailored to local conditions and the opportunities they offer (e.g. Cities Alliance, 2007).

### 4.4.3. Understanding frontiers and diminishing returns

The literature on economic growth has, for decades, emphasised the importance of the position of a territory on the development spectrum as a factor determining the expected returns of any type of intervention (Rostow, 1960; Gerschenkron, 1962). How close a territory is to a specific frontier can determine what type of investment is required to maximise the returns of intervention. It has often been argued that being far from a frontier allows countries and regions to pursue basic

investment and factor-endowment promotion strategies more freely than in those cases where a specific territory is closer to its respective frontier – as indicated by Acemoglu et al. (2006:68) when referring to the technological frontier. The closer a country or region gets to a specific frontier, the greater the likelihood that any intervention on a particular development axis will be subject to diminishing returns.

This seems to be confirmed by the cases reported in the preceding sections. Countries and regions at earlier stages of development are able to address shortages in basic development factors without their actions being subject to diminishing returns. In the cases of Sub-Saharan Africa, Bangladesh or Yunnan province in China, considerable investments in infrastructure have yielded considerable economic growth. This is far less true for less developed regions in the European Union. Greater distances to the infrastructure frontiers in Sub-Saharan Africa and the two Asian examples explain this outcome. Pronounced infrastructural shortages in Sub-Saharan Africa meant that additional kilometres of road have contributed to addressing a fundamental shortcoming of the local economy and facilitated further development. Basic infrastructure shortages in Europe's' less developed regions, on the other hand, did not and do not prevent them from engaging in basic economic activities. They were and are closer to the infrastructure frontier than countries in Sub-Saharan Africa. Hence, additional investments in road infrastructure will *only* bring about significant economic returns if specifically targeted to addressing well-identified, profound development bottlenecks. The indiscriminate nature of most infrastructure investment in the periphery of the European Union – frequently geared towards increasing the number of airports, ports or kilometres of motorways and high-speed rail – implies, however, that this condition has not been fulfilled. The economic returns to additional investment have, as a result, been and likely will continue to be meagre.

The diminishing returns of additional investment are, moreover, affected by deficiencies in other development axes. Poorly targeted infrastructure investments in the European Union have been, to a considerable extent, a consequence of low government quality. Feeble governments and local decision-makers have often put short-term private and political gains before medium- and long-term sustainable socioeconomic outcomes (Crescenzi et al., 2016). Similarly, low quality institutions have dented the returns to R&D investment in the economic periphery of Europe

(Rodríguez-Pose and Di Cataldo, 2015) or to the Greek science and technology parks initiative. The territories in which these strategies of waste have been pursued are far closer to the technology frontier than the areas where the more successful Brazilian APL clusters or the Dominican Republic's special economic zones have been operationalised.

Simply stated, the farther a territory is from a given frontier, the greater the likelihood that investments targeting basic deficiencies in infrastructure, human capital, and/or technological endowments will succeed in delivering meaningful growth. Once the very basic needs for development to take off are fulfilled – that is, the closer a country or region comes to the infrastructure, human resources or technological frontier – the diminishing returns that undermine the potential of additional investment become more likely. As territories approach these frontiers, a 'switch' involving the careful consideration of other factors influencing development is required (Acemoglu et al., 2006); more holistic and integrated development strategy need be employed.

### 4.4.4. Institutions, institutional reform and the pursuit of spatial development strategies

The final lesson to be drawn from the cases presented in *Section 4.3* comes less from the underperformance of the strategies of waste and more from the successes of those of gain, and, more specifically, from a key factor to which their effectiveness is attributable: recognition of the 'institutional dimension' and of the importance of mitigating and minimising the potential for institutionally-related failures. This recognition is manifested in one of two ways.

First, the infrastructure-oriented interventions mobilised in China and Bangladesh, the APL cluster policies employed by Brazilian authorities, and Vietnam's efforts to reform its vocational and technical education system all featured or feature explicit actions and measures to promote technical development, institutional upgrading and capacity building. The function of these actions, in each of the approaches but also more generally, is to facilitate the design, operationalisation, and ongoing monitoring and maintenance of the strategies themselves. They are,

however, also often employed with the view to leave a longer-term, lasting impact on the capabilities, efficiency and overall functioning of the institutions and institutional actors they target.

Second, the special economic programme pursued in the Dominican Republic is characterised by an ongoing attentiveness to the broader institutional environment. Attention has been paid to and efforts have been made to adapt the regulatory and governance framework within which the programme is pursued to ensure that the zones are and will remain, even in the face of macroeconomic changes and volatility, competitive and capable of fulfilling their mandate as catalysts for economic growth and development. Moreover, the development and implementation of the programme was matched by the establishment of a purpose-built institutional body, whose principle function is to regulate and oversee the country's various zones. This awareness of the institutional environment in which the development approach exists has served to ensure not only that the interventions are, and will remain, unimpeded by regulatory or governance-related inefficiencies or obstacles, but also that the broader institutional framework continues to evolve and stays one that supports and is conducive to the strategy and its overarching objectives.

Consequently, cognisance of the 'institutional dimension' is a fundamental requirement in the design and implementation of spatial development policies. More specifically, there is scope, if not an outright need, to incorporate institutional reforms and capacity building initiatives into the development approaches themselves, and also to employ a general awareness of – and where need be, to take action to address – broader institutional conditions and factors (Rodríguez-Pose and Garcilazo, 2015).

Capacity building and technical development-type interventions provide authorities and institutional bodies with capabilities, knowledge and resources (e.g. Whyte, 2004; World Bank, 2005; OECD, 2006; World Bank Institute, 2009). It should never be taken for granted, especially in less developed contexts, that authorities have the competencies needed to initiate and enact development strategies. Capacity constraints are not uncommon in the developing and emerging world (e.g. World Bank, 2005; OECD, 2006; Cardenas, 2010; Sanghvi et al., 2011; Haque et al., 2015). Integrating these sorts of actions and instruments into development approaches serves

to ensure, or at the very least increase the probability that, the viability, sustainability and performance of spatial development policies are not compromised or damaged by capacity deficiencies that are navigable and manageable.

Capacity constraints can exist in any number of forms. What exactly authorities do to address and mitigate institutional deficiencies will greatly depend on the nature of the deficiency. The outcomes of any development intervention are, for example, shaped by the quality and capabilities of the authorities that are tasked with its design, operationalisation and oversight. Technical deficiencies in the form of a lack of skills, knowledge, experience or competencies will undermine the execution of any exercise, policy or strategy. Capacity building efforts in environments plagued by technical shortages should trend in the direction of training initiatives and programmes, the establishment of knowledge-sharing programmes and initiatives or the use of external resources and expertise (i.e. short-term consultants) to shore up these skills deficiencies. Relatedly, certain environments will suffer from other types of resources shortages. Policy-makers may, for example, not have access to, or the resources (human and/or financial) and infrastructure to collect or cultivate, the data and information needed to design, monitor and/or modify suitable development interventions. When this is the case, efforts should be pursued to first identify the resources shortages before channelling financial resources accordingly. The provision of these resources must, where necessary, be accompanied by initiatives (including those outlined above) to ensure that the authorities to whom they are provided have the competencies and skills needed to make the most of them. There may also be scope here for intra- or interregional cooperation and resource sharing to address resource deficiencies and 'stretch' scarce resources. Similarly, vertical and horizontal coordination failures represent another type of institutional failing that can derail development actions. Misaligned incentives or priorities, or even an insufficient awareness of what other parties are doing or responsible for will lead, at best, to overlaps that result in an inefficient deployment of resources or, worst, oversights and failures that will undermine the success and viability of otherwise sound interventions. Capacity building actions to address institutional obstacles of this nature will focus on the facilitation of communication and dialogue, the promotion of transparency and clarity and the clear delineation of responsibility. The identification and appointment

of leaders or, relatedly, the establishment of specific bodies or institutions with narrowly and explicitly defined mandates represent means to achieve the latter end.

This is by no means an exhaustive list of the institutional failings to which territories, and underdeveloped ones in particular, fall victim. It is provided merely to illustrate that simple solutions for all of the institutional deficiencies to which a particular region could conceivably be susceptible may be difficult to devise. With this in mind, it becomes clear that the starting point for any effort to address institutional bottlenecks is their exact identification. By taking steps to identify and understand the nature of the institutional challenges they face, authorities can devise suitable reforms to address and overcome them.

Capacity building efforts should be matched by a general awareness of the efficiency, soundness and functioning of the broader institutional environment. With the 'institutional turn' in economics has come the increasingly widespread consensus that the effectiveness of any given development strategy will be mediated in one way or another by the institutional environment in which it is pursued (e.g. Rodríguez-Pose, 2013). Rodríguez-Pose (2013:1043), in fact, goes so far as to assert that "development strategies need to understand and be specifically tailored to the potential of place-bounded institutions in order to make the most of [other interventions]". Ignorance of institutional factors and conditions could therefore be, in and of itself, sufficient to derail what may otherwise be sound development strategies.

These two 'lessons', and the first one in particular, should ring especially true in devolved contexts. Subnational governments have, via the processes of devolution that have and continue to transpire across the emerging world, been afforded both the opportunity to implement development interventions that are reflective of local needs, preferences, priorities and contextual conditions and the more general capacity to tailor expenditure and decision-making in these directions (e.g. Ascani et al., 2013; Rodríguez-Pose and Wilkie, 2017b).

This can, as the Bolivian experience demonstrates, yield profoundly positive outcomes. Faguet's (2004) examination of the post-devolution expenditure patterns of Bolivian municipalities reveals that authorities did capitalise on the resources and

autonomy entrusted to them and channelled resources towards the provision of public goods and services in a manner that was consistent and coherent with the preferences of the citizens of, and the contextual conditions in, the jurisdictions for which they are responsible. Outcomes like these are, however, far from assured. Empirical analysis has, for example, indicated, first, that decentralisation – especially in the face of poor local government quality – may not only have little to no effect on economic performance but, in some circumstances, can actually undermine it (Rodríguez-Pose and Ezcurra, 2011; Ezcurra and Rodríguez-Pose, 2013) and, second, that in less developed and emerging contexts, decentralisation can exacerbate regional inequalities (Rodríguez-Pose and Ezcurra, 2010).

Whether devolution yields more favourable outcomes, as in the Bolivian case, or less-favourable ones depends critically on the institutional context within with it is pursued and, more specifically, on the capacities and capabilities of subnational authorities. That is, capacity constraints may, according to Rodríguez-Pose and Ezcurra (2010:622) "limit the potential of subnational governments to make the most of [decentralisation]". The implementation of capacity building exercises, as advocated for above, could go a considerable way towards mitigating what Parker and Serrano (2000: 26) term "one of the biggest challenges confronting local institutions as well as managers designing and implementing programs of development" and, in turn, ensuring that subnational authorities can fulfil their responsibilities, whether they relate to the design and implementation of development policies or otherwise.

## 4.5. Where should different types of strategies be implemented? Designing contextually suitable strategies

Different territories require, as we have asserted in previous sections, heterogeneous development approaches. These approaches must respond to the scale, scope and nature of the development challenges that the territories for which they are designed face, and the opportunities and potential with which they are endowed. It is therefore impossible to state exactly where infrastructure-based, inward investment-based, innovation- or human capital-oriented or cluster-based approaches should be pursued.

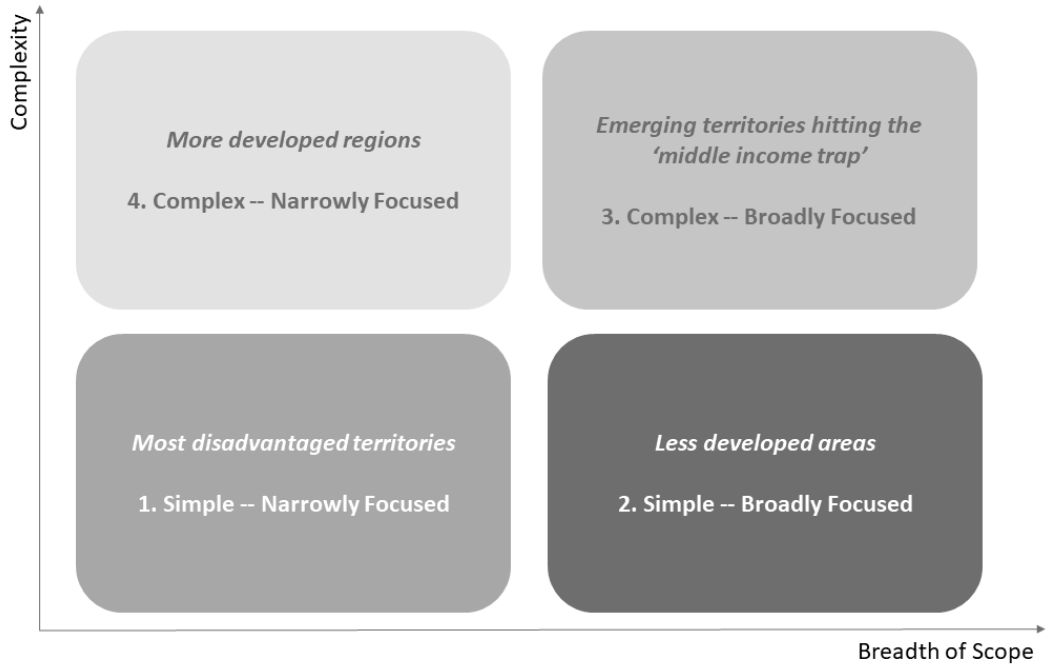
General guidance as to how strategic approaches should be designed for different types of territories at different points on the development spectrum can, however, be provided. More specifically, the following section reflects on the nature of the development challenges with which different types of territories are confronted to construct a broad taxonomy of territorial development approaches.

Our taxonomy is founded on the notions of what we term (1) *complexity* and (2) *breadth of scope*. *Complexity* is understood as a function of the number and, importantly, diversity of the individual elements or interventions by which a broader strategic approach is composed. More tangibly, an integrated strategic approach that features a diversity of mutually reinforcing interventions and works across a range of development axes is deemed more complex than one that relies on a single type of instrument or action to affect change. *Breadth of strategic scope* refers, on the other hand, to the narrowness of the development outcomes or objectives by which a strategy is guided. The strategic scope, for example, of an approach that pursues a single, narrowly and precisely defined development outcome is narrower than that of one that aims to affect more broad-based, perhaps economy-wide change.

We posit that the approaches employed by territories at different points on their respective growth trajectories should, *irrespective of the development axis (or axes) to which they are oriented*, differ in terms of their complexity and the breadth of their strategic scopes in ways that reflect the nature of the most immediate development challenges with which they are faced.

The underperformance of territories at the very bottom of the development spectrum is often attributable, at least in part, to what can be considered the most fundamental of structural deficiencies. These inadequacies are generally not difficult to identify nor are they insurmountable; policy-makers in Bangladesh and Central Yunnan, for example, found success channelling financial and other resources towards the construction of basic physical infrastructure – roads, bridges, etc. – the absence of which was both a readily apparent and particularly pronounced impediment to economic dynamism (*Section 4.3.2*).

*Figure 4.5. A 'complexity-strategic scope' based taxonomy of development approaches*




**Authors' elaboration**

The shoring up of deficiencies of this nature is, however, wholly prerequisite to the achievement of economic growth and development and, moreover, lays a foundation upon which subsequent development efforts can build. The scope of the territorial development policies pursued in these environments should therefore not extend beyond addressing these specific debilitating deficiencies. Their complexity needs to be kept to a minimum as well; not only are less integrated approaches often sufficient for managing deficiencies as precisely defined and comparatively basic as those by which the most economically underdeveloped of environments tend to be faced, they are less prone to derailment by the technical capacity constraints that are not uncommon in these contexts (*Section 4.4.4*).

*Simply stated, development approaches designed for the most economically disadvantaged of territories would benefit from being characterised by a minimal degree of complexity and a relatively narrow strategic scope. We term this first type of strategic approach 'simple and narrowly-focused' (Figure 4.5).*

As we move up the development spectrum to underdeveloped territories where pronounced challenges remain but the debilitating factors of the sort highlighted above

are less ubiquitous, the strategic scope of territorial development approaches can begin to widen. The development challenges by which territories like these are faced relate less to rectifying and overcoming specific barriers that are *preventing* economic growth and more to cultivating a broader socioeconomic context that underpins, and is itself supportive of, all manner of economic activity with an ultimate view to *spark* and *actively promote* dynamism and development. In Vietnam, for example, authorities prioritised general upskilling and human capital development to initiate the transformation of the country's labour force into one that could participate in and contribute to the drive towards industrialisation and to its more general efforts to place the economy on a sustainable and rising growth trajectory (*Section 4.3.2*).

It follows that the narrow focus that should be characteristic of the development approaches undertaken by the most economically disadvantaged territories need to be replaced here by a concern for affecting more broad-based change. Once again, however, these strategies need not be overly complex. They will in all likelihood, because of the more broadly-defined development outcomes they pursue, rely on a comparatively greater number and diversity of individual interventions. That said, technical capacity constraints that compromise policy efficiency and effectiveness remain a concern for policy-makers in these environments (*Section 4.4.4*) and, moreover, the change these approaches seek to affect – i.e. more general contextual upgrading and conditioning – is still sufficiently fundamental that the degree of integration and multidimensionality by which they are characterised need not be massive.

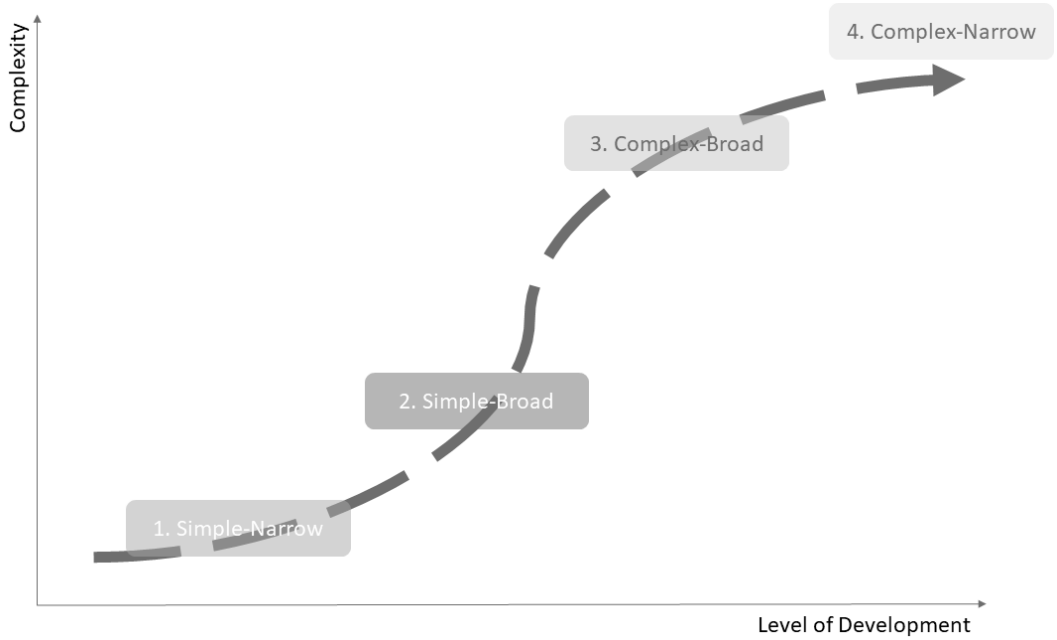
*Development approaches that are simple in nature and but broad in strategic scope are most suitable for less economically developed territories. 'Simple and broadly focused' strategic approaches are the second type included in the taxonomy (Figure 4.5).*

A different tact will need to be taken in emerging territories. The most pressing development challenge that they tend to face relates not to addressing debilitating structural deficiencies or weaknesses in underlying socioeconomic fabrics, but rather to the avoidance of economic stagnation and of something akin to a 'middle income trap' (e.g. Nallari et al., 2011; Kharas and Kohli, 2011; Eichengreen et al., 2013). That

is, these territories have often successfully navigated a range of more fundamental development challenges – including those addressed above – and, in turn, likely benefitted from a sustained period of economic expansion. The pace of that growth will, however, be slowing or, in more extreme cases, have stagnated.

The options for escaping this so-called 'trap' are few. Meaningful increases in productivity (e.g. Kharas and Kohl, 2011) are perhaps the best, if not only, way to do so. Achieving these involves repositioning the economy *as a whole* towards higher-value added, more knowledge-intensive activities and undertaking a range of institutional reforms to make the territory amenable, if not wholly conducive, to innovation and more technologically sophisticated activity.

*Figure 4.6. The 'complexity-economic development' nexus*



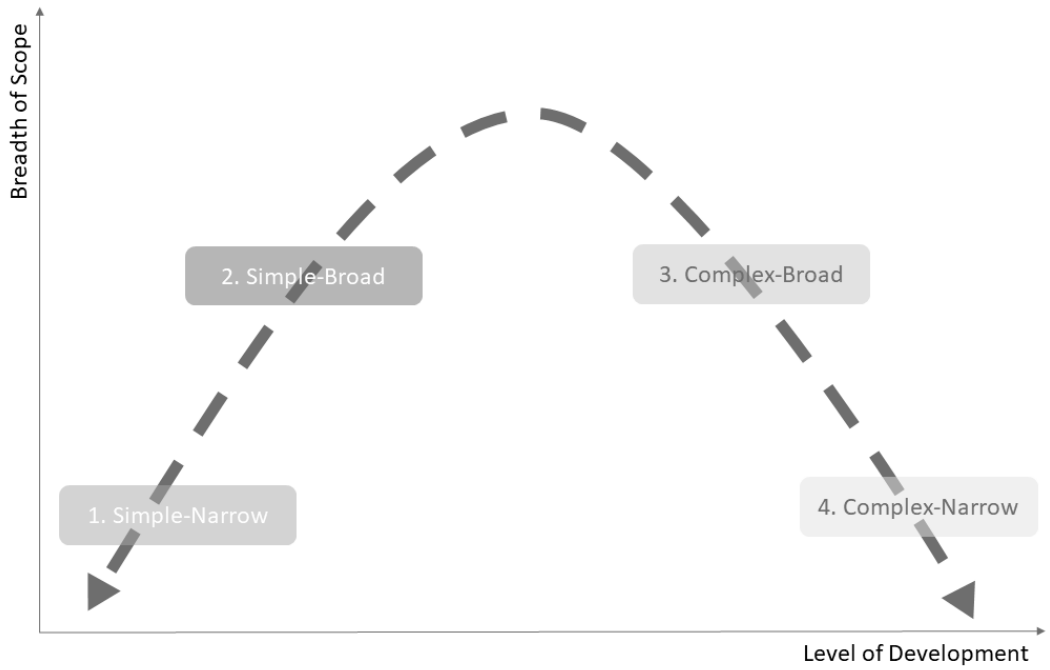

**Authors' elaboration**

Suffice to say, strategic approaches undertaken in these emerging environments should, like those pursued in the aforementioned less developed territories, be broad in strategic scope; they will, after all, be geared towards economy-wide reformation. The nature of the change these approaches must aim to affect, however, demands that they be far more complex, integrated and multidimensional than those designed for environments less developed than they. That is, repositioning an economy and, more specifically, upgrading its innovative potential and capacity to

engage in knowledge-intensive activities entails working across structural, socioeconomic and institutional dimensions which, in turn, implies that strategic approaches need to be composed of a diversity of mutually reinforcing interventions and actions that span these, and other, development axes.

*Emerging territories therefore have little choice but to pursue more complex, integrated development approaches that operate across several development dimensions and are oriented towards affecting broad-based, economy-wide change; such approaches are understood in our taxonomy as 'complex and broadly focused' (Figure 4.5).*

*Figure 4.7. The 'breadth of strategic scope-economic development' nexus*




**Authors' elaboration**

In more developed territories, the focus shifts away from development challenges *per se* towards what can be considered development opportunities. That is, more economically advanced territories will likely – whether it is due to resource endowments or constraints, the economic activities they engage or specialise in, or any other number of territorially-unique factors – have specific avenues available to them that they may pursue to promote further growth and development. Moreover, the returns to broad-based reform will be limited in these more dynamic territories where growth-impairing structural, socioeconomic or institutional deficiencies are fewer and

farther between and, in turn, the scope for generalist, 'corrective' interventions is minimal.

The job of policy-makers in these environments is therefore to, first, identify where these latent opportunities lie and, in turn, develop focused policies geared narrowly and explicitly towards their exploitation. More complex, multidimensional approaches should be relied upon to do so. Policy-makers in these environments are often unencumbered by resource and/or technical capacity constraints leaving little reason not to pursue the integrated, multi-axes approaches that, as previous sections have suggested (*Section 4.4.1*), are anticipated to yield the greatest returns.

*The fourth and final type of approaches included in our taxonomy are those that are ideally suited to the most economically developed of territories. These integrated approaches will pull a range of policy levers to fulfil precisely and narrowly defined objectives and are thus referred to as 'complex and narrowly focused' approaches (Figure 4.5).*

## 4.6. Conclusions

The development policy landscape has, in recent years, been dominated by four types of interventions each of which finds its conceptual or theoretical underpinning in a different theoretical perspective or paradigm (*Section 4.2*).

1. Infrastructure-oriented development approaches emerged from a neoclassical growth theory that understands economic growth as a function of the relative availability of different factors of production – capital, technology and labour – the productivity of which can be positively augmented by investment in and the expansion of regional infrastructure endowments;

2. Policies and interventions geared towards the establishment of 'growth poles' via the attraction and concentration of external investment and non-local firms grew out of 'growth pole' theories that posit that the economic fortunes of entire regions are linked to the success and dynamism of single points or nodes within them;

3. The endogenous growth theory, and, more specifically, an awareness of the first-order importance of knowledge and technological progress placed both regional innovative capacities and regional human capital and skills endowments squarely in the crosshairs of policy-makers and gave rise to a host of innovation- and skills-oriented interventions and policies; and

4. Strategic efforts to promote the physical co-location of firms and the establishment of clusters of economic activity are inspired by theories proposed by both the urban economics and new economic geography schools as well as by cluster and industrial districts theories that suggest that the operation of economic actors in close physical proximity gives rise to productivity enhancing externalities from which those actors, and by extension the cluster and the region that hosts it, benefit.

Policy-makers in developed, emerging and developing context alike have turned to one or more of these strategic interventions to increase the economic dynamism of the territories for which they are responsible (*Section 4.3*). The performance history of each of the four broad policies types includes both instances of success (*Section 4.3.2*) and failure (*Section 4.3.1*). No one *type* of intervention is, however, on its own, more likely than the next to amount to a failure – a strategy of waste – or a success – a strategy of gain. That is, the success or failure of a particular intervention is a function not necessarily of what theoretical strand it is based on or of what it focuses on to impel growth but rather of where, how and by whom it is pursued. This, of course, begs the question: what makes for a successful development policy or intervention?

A review of a handful of both strategies of gain and strategies of waste revealed four key differences between them from which policy implications were inferred:

1. Territorial development policies must operate across and address more than one development axis. Because of the way and extent to which processes of economic growth are governed and mediated by any number of contextually specific factors, characteristics and attributes, strategic approaches to

economic development are more likely to be successful if they are 'multidimensional' in nature. Hence, concerted efforts are needed to integrate and balance actions that target all relevant development axes;

2. Territorial development should rely on robust diagnoses of local economic conditions to facilitate the tailoring of the interventions by which they are composed to the specificities of the territory in which they are to be pursued. They also need to be targeted towards specific weaknesses, deficiencies or bottlenecks that represent genuine and pronounced impediments to regional economic growth and dynamism, and/or towards any advantages or opportunities with which a region might be endowed;

3. Where on the development spectrum a territory finds itself should inform the choice of development approach. The greater the endowment shortages and the farther away from infrastructure, human capital and technology frontiers, the greater the chance that basic investments in human capital, technology and infrastructure lead to significant economic growth. Once basic endowments in one or more of these areas are covered, the risk of diminishing returns to additional investment increases; and

4. Institutionally-oriented interventions and actions – capacity building efforts, technical development exercises, institutional reforms and the like – must be integrated directly into territorial development strategies.

The potential of theory-led, territorial developed approaches – whether infrastructure-, inward investment-, innovation-, skills- and cluster-based – is considerable if the four principles outlined above are taken into consideration. Development approaches can, and in fact have, served as catalysts for regional economic growth and socioeconomic development in radically different contexts. Yet the line separating strategies of gain from those of waste is thin. Policies and programmes that are composed of and balance numerous mutually-reinforcing interventions; are tailored and adapted to local conditions and realities; and are integrated into broader strategic efforts are likely to have a greater economic impact. The gearing of interventions towards the challenges facing any given place and the

opportunities with which it is endowed and the concurrent consideration of the institutional context in which it is to be operationalised – and, if necessary, the pursuit of measures to upgrade and rectify deficiencies from which it suffers – facilitates the realisation of results that will likely outstrip those available to interventions that are based on one particular, often 'fashionable', theoretical strand. Processes of economic growth are not governed by one single influence. They are shaped and mediated, at any one time, by any number of socioeconomic, structural and institutional factors *all of which must be taken into account in and addressed by efforts that aim to stimulate such processes*. Moreover, processes of economic growth transpire in different ways across heterogeneous contexts – that is, they react differently to different realities – simply because contextual conditions impose different challenges and offer different opportunities and avenues for growth. The key to success in the design and operationalisation of policy interventions is ensuring that approaches are not detached from this reality. Adherence to the aforementioned four principles will, in most cases, increase the probability that interventions do not fall victim to a multitude of pitfalls and, more importantly, that the promise and potential of economic development interventions is fulfilled.

The provision of policy guidance more specific than this is challenging. Notably, we must refrain from prescribing infrastructure-based, inward investment-based, innovation- or human capital-oriented or cluster-based approaches to heterogeneous territories in a categorical or definitive manner. It would be unwise, for example, to assert that any one of these approaches is more or less suitable for a more or less economically developed territory. What we can do, however, is reflect on the nature of the development challenges by which different types of territories at different points on the development spectrum are faced and devise more general guidelines centring on the notions of policy complexity and breadth of strategic scope.

We posit that (i) the most economically disadvantaged territories should embrace strategic approaches that are simple in nature and narrow in scope; (ii) that less economically developed territories should opt for simple, but more broadly-oriented strategies; (iii) that emerging territories should rely on broad-based approaches that are, on the other hand, more complex and integrated in nature; and

(iv) that the more developed areas should turn to strategies that are, again, complex but are narrowly and precisely targeted to affect change.

Strategic approaches to development cannot be designed on the basis of this taxonomy alone. That said, it does provide policy-makers with a framework and a set of criteria for thinking about what a suitable approach for the promotion of economic development in the territories for which they are responsible should (or should not) look like.

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# CONCLUSION

This thesis broached the subjects of innovation and economic growth in less developed territories from a diversity of perspectives. Its overarching objective was to shore up a pronounced deficiency in the literature on the economic geography of innovation and scrutinise an assumption that a synthesis of relevant literature suggested was not defensible: namely that socioeconomically and institutionally heterogeneous lagging territories are, from an innovation perspective, actually homogenous entities.

The first two chapters unpacked the processes of innovation less developed territories host, focusing specifically on the factors and territorial characteristics that drive and shape them. *Chapter 1* revealed considerable heterogeneity in the territorial dynamics that govern processes of innovation in North America's and Europe's less developed regions, respectively. Similarly, *Chapter 2* unearthed evidence to suggest that the innovative processes and, ultimately, systems in China's lagging cities are decidedly less complex, integrated and mature than those in the country's more economically developed ones. The third chapter went a step further to examine the link between innovation and economic performance with the view to assess whether all lagging territories are similarly capable of mobilising knowledge and innovation and transforming it into economic growth. *Chapter 3* confirmed that Europe's low-income and low-growth regions have cultivated radically different facilities for the translation of different types and sources of knowledge and innovation into economic dynamism, that are themselves reflections of their respective socioeconomic and institutional underpinnings.

The single most academically substantive contribution of the thesis is derived from these first three chapters. Together they disprove the very presumption the thesis set out to study and test. The prevailing view has for some time been, as the *Introduction* explores, that the socioeconomic, institutional, structural and even geographic deficiencies from which lagging territories suffer, and the related challenges they impose, render these areas incapable of cultivating and sustaining innovative activity (e.g. Rodríguez-Pose, 1999; 2001). This, coupled with the

perceived pervasiveness and homogeneity of the challenges by which lagging territories are faced, is what bred the presumption that economically disadvantaged areas are effectively the same from a broadly defined innovation perspective, and that, when they do manage to innovate, they do so in markedly similar ways.

The overarching conclusion drawn from the first three chapters flies directly in the face of this presumption. Together they suggest that lagging territories not only innovate in fundamentally different ways, but also that they are differentially capable of translating innovation into economic growth via processes that are far from homogeneous across space. *The heterogeneity of these places does, in fact, matter. It is manifested and readily visible in the way these territories introduce innovation and the extent to which they can leverage their innovative capacities in the pursuit of economic growth, development and dynamism.*

The importance of moving beyond the aforementioned assumption and correcting the discourse with the conclusions forwarded by and lessons drawn from the thesis cannot be overstated. Continued adherence to what seems to be a misguided presumption is not without consequence. The most obvious will be reflected in the approaches policy-makers opt to pursue to impel innovation and innovation-driven economic growth in lagging environments. That is, ignorance of the heterogeneity of innovation in economically peripheral territories can lead to the implementation of the same, or similar, generic instruments and actions in the pursuit of innovation in lagging areas the world over.

*If* processes of innovation in lagging areas were unaffected by context and contextual conditions, 'one-size-fits-all' (e.g. Tödtling and Trippl, 2005) policies would be sufficient to upgrade their innovative potential. *The reality, however, is that they are not*. Policy-makers are, in turn, likely to find little success trying to impel innovation with a-spatial approaches that rely purely on indiscriminate investment in 'relevant-only-in-theory' drivers of innovation, including the R&D-oriented policies that have, and continue to dominate the innovation policy landscape.

The thesis is, in that respect, yet another a call for greater, if not exclusive, reliance on contextually tailored, spatially-targeted – or as they are increasingly

known, 'spatially sensible' – policies to promote innovation and economic growth in lagging territories (e.g. Tödtling and Trippl, 2005; OECD, 2009; Barca et al., 2012; Iammarino et al., 2017).[62] There will be, in every territory, actions that are objectively anticipated to lead to innovation – i.e. those that identify the exact factors and resources that serve as catalysts for innovation, treat them as policy levers, and pull them accordingly – and actions that are unlikely to have any meaningful effect on their innovative capacities – i.e. those that are rooted purely in theory but are blind to local realities and processes. The *most* efficient and impactful expenditure of scarce policy resources involves the pursuit of the former. Similarly, because different places have different facilities for the mobilisation of innovation, it will not be sufficient for policy-makers to simply prioritise innovation and expect growth to follow in tow. They need to evaluate both *what kinds* of knowledge and innovation are stimulants for growth in the territories for which they are responsible and, importantly, *how* they do so. Only then, can they devise strategies and take steps to ensure that returns, in the form of economic growth and dynamism, to the cultivation of innovation and innovative capacity are maximised.

This is, in fact, the angle from which *Chapter 4* approaches the topics at the heart of the thesis. The chapter's contribution is no less significant than that made by the first three. It is, however, geared more explicitly towards the policy sphere and related discourse. *Chapter 4* asked, and answered, what steps should be taken to ensure that development interventions and strategies, *be they oriented towards the promotion of innovation or otherwise*, actually amount to and function as catalysts for economic growth.

The conclusions it yields mirror those drawn from the three that precede it: there is a need to address the diversity of development problems across lagging areas in the developed and developing world through the design of innovation and growth strategies that respond to their heterogeneity. The failure of territorial development policies is often attributable to a failure to account for and respond to the specificities of the territories for which they are designed. Similarly, the most effective

[62] The more exact policy implications gleaned from the thesis' constituent components were addressed in detail at the end of each chapter and elaborated on extensively in the fourth.

interventions are those that are tailored to the exact nature of the challenges by which they are faced and take concerted actions to leverage their latent potential.

The chapter's primary value added lies in the policy guidance it provides. It outlined four specific principles and offered a series of more general guidelines that, if integrated into the design and operationalisation of strategic approaches to development, increase the likelihood that interventions and policy actions achieve their objectives. Its main message is that multidimensional strategic interventions that are both designed with a cognisance of where on the development spectrum a territory is situated and tailored to reflect the opportunities with which they are endowed, and the socioeconomic and institutional deficiencies from which they suffer, are most likely to succeed in driving economic growth and development in lagging areas.

This final chapter renders the thesis more than a just a call for spatially-targeted policies for the promotion of innovation and economic growth in underdeveloped areas; *Chapter 4* offers a general sense of how to design and operationalise these sorts of policies. What, however, in more practical terms should they focus on? What does the thesis say about how scarce financial and policy resources are best allocated to impel innovation and economic growth in lagging areas? There are limits, because of the extent to which policies need to be tailored to reflect the heterogeneity of the places for which they are designed, to how exact or precise the policy guidance provided here can be. Three actionable principles do, however, emerge.

First, efforts to cultivate and condition a structural and socioeconomic context that is itself conducive to and supportive of innovative activity are as, if not more, important than direct, explicit actions to impel innovation and economic growth in lagging territories. The analysis implies that a less developed territory's capacity to introduce innovation is as much a function of the resources it directs to generating knowledge as it is of the receptiveness and amenability of its underlying structural and socioeconomic fabric to that knowledge. This, however, is where lagging territories tend to be deficient (e.g. Rodríguez-Pose, 1999; 2001; Tödtling and Trippl, 2005). Less developed territories plagued, as many are, by, *inter alia*, human capital and skills shortages; weak, innovation averse industrial fabrics; or basic infrastructural inadequacies *will* struggle to innovate and/or translate innovation into growth,

irrespective of how robust their respective commitments to R&D and knowledge generation may be. Policy-makers in less developed areas must, therefore, prioritise more than R&D expenditure; special attention must be paid to rectifying the unique contextual deficiencies by which each is faced. What exactly they focus on from a structural or socioeconomic perspective will be informed by diagnostic analyses – like those undertaken in earlier chapters – of the drivers of innovation and economic growth in the territories for which they are responsible. The shoring up of whatever innovation- and growth-impairing deficiencies the diagnostic exercises reveal is prerequisite to the achievement of innovation and economic dynamism.

Second, institutions are, as is posited with increasing frequency (e.g. Rodríguez-Pose, 2013), of the utmost importance. While structural and socioeconomic conditions and factors are important for both the genesis of innovation and achievement of economic growth, it may very well be that it is the institutions with which a territory is endowed that have the most profound effect on its innovation and growth potential. Data limitations precluded the integration of the institutional dimension into the analyses upon which the first and second chapters are based (a limitation that is, in fact, addressed below). The third chapter, however, confirmed that the growth potential of lagging regions in Europe cannot be abstracted from the quality and functioning of their institutions. Similarly, the fourth chapter demonstrated that a failure to address or account for institutional conditions in the design and implementation of development interventions can, and often does, undermine their effectiveness. Suffice to say, policy makers must be attuned to the institutional dimension. Reforming institutions, especially informal ones, is notoriously difficult and, moreover, only feasible in the longer-term (Rodríguez-Pose, 2013). Weak institutions are, however, a barrier to innovation and growth in less developed territories that cannot be ignored. Institutional upgrading and efforts to improve the quality, functioning and efficiency of formal institutions, in particular, need be prioritised in less developed territories if their innovative capacities are to be bolstered and their growth potential unlocked.

Third, extra-local influences cannot be overlooked. The thesis' constituent components provided an indication that processes of innovation and economic growth in lagging territories, be they in North America, Europe or China are affected by

factors that exist and processes that transpire beyond their borders; economically peripheral territories have a somewhat unprecedented but increasingly acknowledged (e.g. Tödtling et al., 2012; Grillitsch and Nilsson, 2015; Fitjar and Rodríguez-Pose, 2016) ability to harness knowledge and innovative outputs generated beyond their immediate borders and transform them into innovation and economic growth. To leave this facility unexploited seems unwise; should every available catalyst for innovation and economic growth not be exploited in territories that, by and large, have struggled to generate knowledge and innovation or achieve economic dynamism? Policy-makers must therefore be simultaneously inward and outward looking. That is, they must be aware of and able to address the above local conditions and influences. They must also, however, recognise that the economic fortunes of the territories for which they are responsible are affected by extra-local processes and activities that are beyond their immediate control. It is imperative that policy-makers take action to leverage whatever facilities their territories have for the mobilisation of extra-locally generated knowledge and innovation. The steps they take will, again, vary from territory to territory. That said, relevant actions may include general structural, socioeconomic or institutional upgrading (in a vein similar to that suggested above as part of the first principle) to increase territories' 'absorptive capacities' (Cohen and Levinthal, 1990), or the implementation of more precisely targeted 'pipeline-type' initiatives (e.g. Bathelt et al., 2004).

The above summarises where this research leaves us. It is, in some respects, an end in itself. Like any exploratory research, however, it has proven more a means to expose further questions and additional avenues for investigation. The first chapter, for example, provides a compelling reason for more spatially granular data to be made available so that the heterogeneity of innovative processes hosted by lagging territories in North America and Europe can be assessed not at a macro-regional-level but at the county- or even city-level at which innovation systems also exist. The second chapter raises what are, at present, unanswerable (because of data limitations) but profoundly interesting questions about the way in which processes of innovation in China's more and less developed cities are shaped by institutional factors. The same can, in fact, be said for the first chapter as well. The third chapter would be usefully supplemented by microeconomic or qualitative research to that goes beyond the identification of associations to the examination of the channels and mechanisms through which local

and extra-local knowledge and innovation are transformed into economic growth in the territories of interest. The fourth chapter provides just cause to devise ways to measure the success and quantify the defining features and characteristics of territorial development interventions with the view to study a large number them in a more systematic way to probe the generalisability of the inferences and lessons drawn from a sample of case studies. The pursuit of these and other avenues will enhance our collective understanding of innovation and economic growth in less developed territories beyond that which is furnished by this thesis.

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