



Determinants of spatial knowledge spillovers in Italian provinces

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ABSTRACT

Statistical evidence suggests that the relevance of knowledge spillovers has increased over time. In this paper we focus on regional knowledge spillovers and adopt a new econometric transformation that allows inference on potential inter-regional knowledge spillovers, accounting for spatial interdependencies.

Determinants of inter-regional knowledge spillovers are explained with a sample of 103 Italian provinces. We find that a region's absorptive capacity, measured by local R&D expenditure and social capital, implies a reduction of outward knowledge spillovers.

Identification is based on the use of Two Stages Least Squares and Fixed Effects estimates.

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1. Introduction

In the economics literature, the last 20 years have been marked by countless studies on the notion of knowledge spillovers (henceforth, KS). KS can be defined as a non-rival knowledge market externality, by which the positive effects of the invention of a new technology, product or process spill over to other organizations. This holds true both for firms as well as for spatial units (cities, provinces, regions or countries).

Operationally, the identification of KS has been difficult. In the 1990s two major empirical advancements have been made in this direction. On the one hand, improved spatial econometrics techniques have allowed researchers to estimate spatially lagged parameters of R&D investments, knowledge, and human capital, which can all be interpreted as potential KS (e.g. [1]). On the other hand, the intuition provided by [2] that knowledge may leave a “paper track” when moving around in the form of citations gave rise to a burgeoning literature seeking to identify KS by means of flows of citations.

In both cases, evidence also suggests that, because of the decreasing cost of acquiring information and the increasing human capital endowment in western countries, the relevance of KS has grown significantly in recent years. Fig. 1 plots data from the patent citations data set in [3], in particular showing the ratio of citations per patent granted by the US Patent and Trademarks Office,

confirming this suggestion. While this figure relates to the US, a similar process affects other developed countries.

This time trend is not the only relevant phenomenon related to KS. In fact, their geographic distribution is also uneven. Within the US and the EU, regions and cities display markedly different potential production of local knowledge and accessibility to knowledge flowing from outside. This is particularly relevant as data shows that human capital and knowledge are increasingly concentrating in space, with skilled labor force (including researchers) flowing to innovative areas, where the returns to their skills are higher.

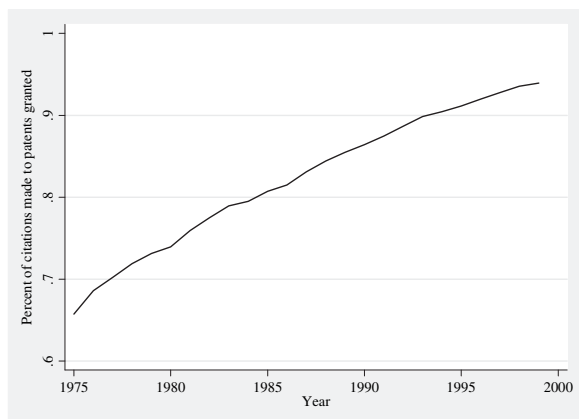
Besides, a recent and interesting direction undertaken in the literature is the identification of more complex notions of space, rather than mere geographical distance, as a vehicle of KS. Theoretically, this issue has been tackled in [4], where proximity has been categorized as cognitive, organizational, social, institutional and geographical. Empirically, recent advances on this side include [5] and [6].

In [5], the effect on growth spillovers of relational proximity, along with more traditional geographical proximity is explored, with the use of data on research networks built upon the EU Fifth Framework Programme and EPO co-patent applications. [6] provides an additional step in the analysis and uses the geographical and relational spatial lag of the performance measure simultaneously as an independent variable.

These arguments can therefore be summarized as follows: KS are becoming increasingly important, wherein their spatially uneven distribution poses a challenge to areas with difficult access to knowledge.

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Source: [3] Hall et al. (2001), authors' elaboration.

Fig. 1. Ratio of patent citations per patent granted, 1975–2000.

Previous applied work on the notion of KS has mostly been carried out on nations, or on a set of nations or states (e.g. EU countries, or US states), mainly because of data availability. One major issue in this case is the proper definition of geographical distance over which knowledge travels: in this respect, the best option would be to base our study on micro-data, bearing information on individual, as well as aggregate (i.e., cultural and social) characteristics, and then aggregating data at the spatial scale that maximizes the measure of KS. However, this option is not open for the Italian case, as no valid micro-data set is available as yet.¹

A second major issue is the choice of the proper spatial setting for a study on KS. [7], among others, stresses the importance of basing studies on KS on the whole world. According to his view, KS face no physical constraints and thus, empirical analyses should be based on the whole set of possible countries, in order to avoid the risk of losing relevant information and obtaining distorted estimates of the true KS parameters. This is a relevant critique, but has no easy way out. In fact, data on knowledge production and KS determinants are not to be found for all world countries; moreover, it becomes even less easy at the spatial aggregation level of this paper's analyses. Furthermore, innovation is historically a spatially-concentrated activity. USPTO statistics show that in 2009 about 94% of total patent applications to the USPTO, the single most important patents and trademarks office, came from OECD countries (the share is slightly declining over time, but still remains consistent).²

In the light of this evidence, therefore, extending the analysis of KS to a world setting may remain in our view a very promising line of research for future improvements of our understanding of KS.

In this paper, we address the relevant question of the determinants of KS within the Italian framework. This choice is due to the particular nature of Italy, which is characterized by spatial imbalances, not only in terms of income and schooling levels, but also, and consequently, in terms of potential access to knowledge.³ More than in many other countries, inter-regional KS represent a major source of competitive advantage for Italy's regions.

Moreover, the choice of the provincial spatial scale is related to the historically rooted geographical division of the country. For centuries, even before the country was united from single region-states in 1861, most of the current provinces were already present

in the form of administrative departments of pre-unitary States, which in turn reflected cultural, language and income diversities.

The choice of administrative departments is not exempt from flaws. Ideally, data should be collected over areas defined according to economic functions. In Italy, this is done with the collection of data for Local Labor Systems (LLS), which represent aggregations of statistically and geographically compatible municipalities, linked together by commuting flows, according to criteria defined in the 1980s.

However, in the present case, our exercise could not be carried out on the basis of LLS since data on KS determinants at this scale are not available. For future research, our framework would therefore benefit from continuous collections of micro-data (i.e., labor surveys), whose spatial aggregation can be optimized in order to better capture underlying economic interactions.

The paper starts from an indirect and general econometric approach to the measurement of KS. In particular, it looks for potential productivity spillovers, i.e., the latent inter-regional flows of productivity that may accrue to provinces by means of being exposed⁴ to better managerial techniques, more advanced technologies etc.

Details on the technique are described later in the paper. However, one characteristic of this econometric transformation is of particular relevance. It is based on a partially non-rival, non excludable notion of knowledge. Hence, as new knowledge is produced in a region, it is not a negative issue per se if neighboring regions tend to attract and absorb its positive effects. On the contrary, as this input-output mechanism of inter-regional knowledge exchange increases, the aggregate stock of knowledge, and therefore, aggregate welfare, may also benefit.

In this paper we control for intellectual property rights, which reinforces the idea that the potential knowledge transfer captured by our outward knowledge spillovers (henceforth, OKS) measure does indeed represent a net value. In fact, recent micro analyses show that regime switches improving the protection of property rights may indeed have caused an increase, rather than a decrease, in knowledge transfer (see [8]).

Thus, KS become one possible way to conceive of the spatial externalities driving regional performance. As in traditional endogenous growth models, access to localized KS may determine the formation of increasing returns to production factors, improving our understanding of why certain regions grow more than others with similar factor endowment.

The concept of KS can be closely linked to that of absorptive capacity. In fact, individuals, firms and regions must have been previously exposed to relevant knowledge in order to fully understand, decode and commercially exploit new knowledge coming from outside (see [9]). In particular,

"Research on memory development suggests that accumulated prior knowledge increases both the ability to put new knowledge into memory, what we would refer to as the acquisition of knowledge, and the ability to recall and use it" ([9], p. 129).

A recent attempt to link the firm's behaviour with regional innovation performance is made by [10]. In this paper, two British firm-level data sets are combined in order to measure the role of the firms' absorptive capacity in driving regional innovation performance. Results show that a larger share of R&D employees, the use of new management techniques and collaborative behaviour are all positively associated with an increase in regional innovation performance.

In [11] and [12] the concept of regional absorptive capacity and the notion of outward knowledge spillovers are for the first time explicitly modelled together. A cognitive approach ([4] and [13]) is employed in order to empirically assess the negative association

¹ More on this issue can be found in Section 3. Data and Methodological Issues.

² A time series of this share is shown in Appendix 1.

³ Details on some of the mentioned spatial imbalances are provided later in the Data Section.

⁴ In turn, because of geographical proximity.

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