NETWORKS AND KNOWLEDGE DIFFUSION

Given the immaterial nature of ideas, we could expect them to flow freely between any point of the world. This is however not the case: the literature unambiguously concluded to the existence of a relatively strong spatial decay in the diffusion of knowledge. This led policymakers to implement cluster policies, i.e. to gather innovative firms in the same location in order to avoid the loss of knowledge spillovers due to distance. However, recent empirical work suggests that networks could be the source of the spatial frictions in the diffusion of knowledge. Knowledge percolates through social ties, and given that social networks are spatially clustered, flows occur predominantly between nearby locations. If the mechanism underlying the effect of distance is indeed the percolation of ideas through business networks, cluster policies may be inefficient, since the same level of knowledge spillovers may be achieved at a lower cost by a policy aiming at fostering the creation of ties between innovative firms. This type of policy would indeed avoid some costs of the cluster policies, such as the congestion costs (increase in land prices, for instance) and the moving costs for firms.

Measure of spatial frictions

We proxy knowledge flows using patent citations: when applying for a patent, the inventor must mention all previous patents upon which his work builds. Patent citations therefore constitute a measurable trail of knowledge transfers. We improve the accuracy of this measure of knowledge flows compared to the previous literature since we only consider the citations added by the inventor himself, while previous studies also included citations added by the patent office during the examination of the application. To test for the presence of spatial frictions, we estimate the distance elasticity of bilateral trade flows using cross-sectional gravity equations. If this distance elasticity is significantly lower than zero, this is evidence for the existence of spatial frictions. Cross-sectional gravity allows a very clean identification of the potential effect of distance on trade flows because it controls for any country-specific characteristic that may affect bilateral knowledge flows, such as the stock of knowledge or the degree of openness. We find that distance significantly diminishes citation flows: if patent C is located 10% further away from patent A than patent B, then patent C is 3% less likely to be cited by patent A than patent B. We also note that the magnitude of the spatial frictions is relatively stable over time, as illustrated by fig. 1 below.

A network explanation of the distance effect

In a recent contribution, Chaney (2017) shows that the constant distance elasticity of trade flows can be rationalized by a model of network formation where firms progressively acquire new contacts around their current contacts. Our paper conjectures that an analogous phenomenon takes place for knowledge flows: firms receive some knowledge from spatially clustered contacts and sequentially search for new sources of spillovers. These can be obtained through the contacts of their contacts as well as in their contacts’ geographical locations. The network resulting from this model generates sufficient conditions for the citation flows to exhibit a constant distance elasticity. These sufficient conditions are that firm size (measured as the number of patent applications per firm) follows a Pareto distribution, and that the average squared distance of firms’ citations is an increasing power function of their size. We show that these sufficient conditions hold in our data.

Fig. 2 shows that the Pareto distribution fits very well firm size distribution in our data: it plots the log of firms above size K as a function of size K, in year 2000. Note that this excellent fit holds for all years between 1980 and 2010 and that the shape parameter of the Pareto distribution remains remarkably stable over this period.

Fig. 3 plots the average squared distance at which firms cite as a function of their size. It shows that larger firms are able to cite further away. To our knowledge, we are the first ones to document this phenomenon. Fig. 3 corresponds to year 2000, but this relationship holds for all years between 1980 and 2010.

Taken together, fig. 2 and 3 are evidence that networks indeed underlie the spatial frictions we measured on knowledge flows. Additionally, we aim at running a micro-test to assess the validity of the network formation mechanism.

Empirical micro-test

In order to test how knowledge diffuses within the network, we exploit data from the Eureka network program on the formation of R&D collaborations between geographically distant partners. Eureka is a publicly funded intergovernmental organization which endorses R&D collaboration projects involving partners from at least two distinct countries. We match Eureka participants with the patents they apply for, find a counterfactual non cited patent for each of the patents they cite, and test whether they become more likely to cite patents from their Eureka partners and patents that have never collaborated. If the network collaboration starts. This will confirm that link creation not only produces spillovers between partners, but also allows participating firms to gain access to knowledge from the contacts of their partners.