2D07

Technological and Geographical distance

- Empirical analysis of its correlation. Case Japan.

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Abstract

Economic activities are highly clustered. Geographic concentration is a predominant feature of modern economies. Empirical studies of the external effects of R&D suggest that both geographic and technological distance attenuate inter-firm spillovers from innovative activity and influence the growing inside the regions. The results to present will focus on localization of Knowledge spillovers that may reflect the propensity of economic growth to agglomerate geographically for reasons exclusive of the geographic dependence of knowledge spillovers.

The purpose is to correlate measures of geographic and technological distance and demonstrate that knowledge spillovers are largest among technological neighbors and that geographic proximity has an impact on this hypothesis. Some authors say that concentration of an industry in a city facilitates inter-firm spillovers and consequently the growth of the industry and the city.

1. INTRODUCTION

Formation of regions in Japan and their development is hypothesized to arise in part from externalities, including those related to knowledge creation. Urbanization, or the agglomeration of a diversity of industrial activity, will occur if knowledge spills across industry boundaries. In either case, agglomeration will only occur if distance attenuates knowledge spillovers. When interaction between and within prefectures occurs there is a strong probability of clustering, produce spatial or geographic concentration and similar development and the only explanation is the existence of knowledge spillovers but it does not constitute a validation of this hypothesis.

It is important to rely on some authors that have been worked on this matter related to spatial organization and geography of the industries.

The mechanisms that accelerate the knowledge transfer and the proximity or geographical distance depends on the type of knowledge, industry or firm it is been analyzed. Direct evidence of spillovers is obtained from an economic behavior inside the regions framework in which knowledge of geographically and technologically proximate prefectures or regions and institutions were found to be correlated. A preliminary analysis is consistent with earlier findings that greater distance in both the geographic and technological dimensions attenuate spillovers from knowledge. It is possible to criticize the findings for the high degree of correlation between geographic and technological distance measures. The main analysis allows an independent assessment of the importance of geographic and technological distance for the strength of spillovers.

The localization of the companies and their research centers, and the increasing of the economic indicators will be seen where there is a high density of university laboratories (1) and Simmie (2) found that the spatial concentration of innovative activity in particular industries was much greater than for all manufacturing, and innovation is highly concentrated in a few states or urban regions. Then as knowledge is a crucial element of innovation it tend to be concentrated geographically in regions or clusters, this knowledge spills from individual firms and institutions to others and so on.

The impression given by the figures of GDP is that the prefectures with a high GDP are surrounded by prefectures with a similar level of GDP, then clustering occurs. It is the necessary to find out and quantify the degree to which the value of a variable in one group of the Japanese prefectures is spatially correlated to the value in neighboring regions.

The hypothesis to prove is that the growing of one prefecture pull others prefectures to grow, because geographical distance, causing clustering and the growing regions or backward prefectures will get transmitted this growing tendency as a contagious disease within a body. The germ in this case will be the exogenous knowledge input and the symptoms will be the growth of the region and other variables.

The pattern presented by the figures show us that there is a non-randomly data, it means there is a positive correlation between the data, since prefectures have similar values.[1]

As Howells (3) pointed, there are different approaches to analyzing Knowledge Spillovers based on a Geographical context such as patent citations, movement of people on the basis that knowledge moves with them and flow of goods. In this paper will be analyzed the idea that regional development is related to the development of the neighbors, that there is a communication pattern between closer neighbors than those located farther, Universities influence the research activity and in the same way back up the development of the prefecture or region were they are concentrated.

Geographical distances, as space variable, will be integrated in the modeling of knowledge spillovers as proposed by Caniëls (4).

2. Data

The data used in this paper correspond to regional information from the years 1985-2001gathered from the software MinRyouku (民力), released by Asahi Shinbun (5). The data can be analyzed per prefecture but taking in account that there is a clustering activity and the initial hypothesis is the spillover between regions, the prefectures will be studied at this level. Regions are then defined as illustrated in table 1.

The data correspond to different indicators per prefecture based on a time series basis and they are:

1. GNP **(K_i)**
2. Number of Universities **(μ_i)**
3. Telephone Calls **(ρ_i)**
4. Number of patents[2] **(μ_i)**
5. R&D Expenditure **(ρ_i)**

The distances between prefectures is calculated according to geographical structures, and the weight is attributed using the concept of nearest neighbors assigning 1 if the regions share borders and decreasing if not. In this way is possible to construct a matrix comparing shortest paths between regions.

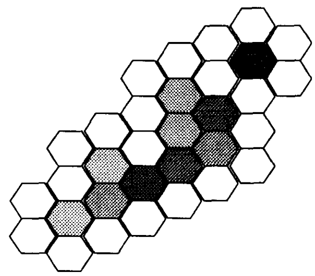

Figure 1 Pattern of distance for lattice of honeycombs. Case Japan

3. Analytical Framework and Model

The model used in this study is the introduced by Caniëls (4), which integrate space into technology gaps models with the concept of geographical distance where region get spillovers from its neighbors according to some specific rules, represented in the growing of the regions.

Then, it is necessary to define the model incorporating geographic and economic theory here ***n*** Regions with total output Q_i and Knowledge stock K_i (i=1,2...n), then knowledge is assumed to be the cause of bigger rate of output or economic growth. Then, the growth rate is proportional to growth rate of knowledge:

$$\frac{\dot{Q}_i}{Q_i} = \beta \frac{\dot{K}_i}{K_i} \qquad (1)$$

The Growth rate of the knowledge stock in region i is a function of output growth as Verdorn-Kaldor law sustains,

[1] With the color notation is easily appreciated that neighbors present successive colors indicating that is very likely that if the region or prefecture grows, It will go towards the range that its most outstanding neighbor.

[2] This data is not available inside the CD-ROM and it is not available in a continuous time series, just four years (1995, 1998, 1999 and 2000) but are still useful for the purpose of analysis.

there is agglomeration of economies, and in this, clustering of prefectures; Spillovers received from surrounding regions (S_i) and exogenous rate of growth (ρ_i).

Then $$\frac{\dot{K}_i}{K_i} = \alpha(\lambda \frac{\dot{Q}_i}{Q_i} + S_i + \rho_i) \qquad (2)$$

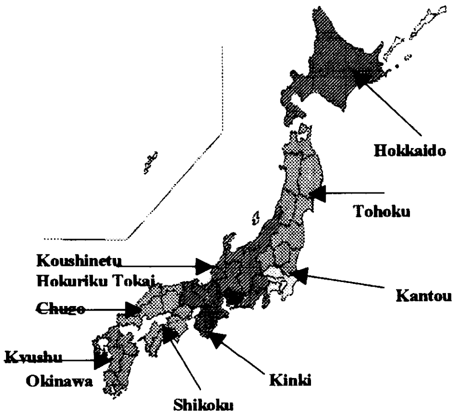

Figure 2 Regions defined to analyze knowledge spillovers related to distance.

The growth of the knowledge stock of a region is partly determined by the spillovers received by surrounding regions, both advanced and backward regions, because of geographical distance since small distances facilitate knowledge flow between regions.

According to Caniëls (4), the spillover S_i is generated by region j and received by region i, and μ_i is the catching up parameter.

$$S_i = \frac{\delta_i}{\gamma_{ij}} e^{-\left(\frac{1}{\delta_i}G_{ij} - \mu_i\right)^2} \qquad (3)$$

And $$G_{ij} = \ln \frac{K_i}{K_j} \qquad (4)$$

(4) is the Technology Gap, or Technological Distance for association purposes, of region i towards region j. γ_{ij} is the geographical distance between two regions, as greater γ_{ij} is, the lower the spillover. δ_i is the learning capability of the region i or social capability of the region to adapt new knowledge, as larger the learning capability is, the more spillover the region will receive.

Regions with a high GNP per capita are surrounded by regions with a similar level of GDP per capita, that is clustering occurs. To quantify the degree to which the value of a variable in one region is correlated to the value in neighboring regions, a concept well known in geography is used. This concept, called spatial autocorrelation has three different patterns and they are: clustered, dispersed and random and can be measured by the coefficient of Moran defined:

$$I = \left(\frac{n}{W}\right) \frac{\sum_{i=1}^{n}{}_{i \neq j} \sum_{j=1}^{n} \left(w_{ij} z_i z_j\right)}{\sum_{i}^{n} z_i^2} \qquad (5)$$

$z_i = x_i - x$, where x_i is the variable under consideration in this case GNP, and x is the average value of the variable over all regions.

$$W = \sum_{i=1}^{n}{}_{i \neq j} \sum_{j=1}^{n} w_{ij} \qquad (6)$$

n is the number of region under analysis, and w_{ij} are the weights between regions according to their distance, w_{ij}=1 if the region i and j share border according to the concept of nearest neighbors. According to this theory and compared with other countries See Caniëls (4):

Table 1 Clustering within different countries

	Coefficient of Moran	(t-value)
Japan	0.34267	2.988
France	0.1662	1.7332
Spain	0.4536	3.3653
U.K.	0.1248	1.1417
Italy	0.6691	3.3172
Germany	0.0221	.3260

According to (1), that there is a high correlation between Knowledge Stock and GNP (i.e. β=1), and for fitting the model, it is assumed that knowledge gaps are equal to GNP per capita Gaps in the first approach, then;

$$G_{ij} = \ln \frac{GNPperCapita_i}{GNPperCapita_j}$$ and setting that the learning capability and the catching up parameter (δ_i=1 ∀ i and μ_i=1 ∀ i) are equal between regions, solving the equation (3) is obtained the figure 3:

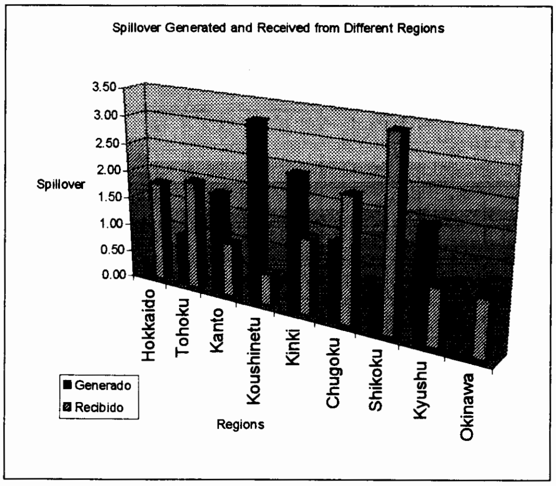

Figure 3 Generated and Received spillover from different Regions Year 2000.

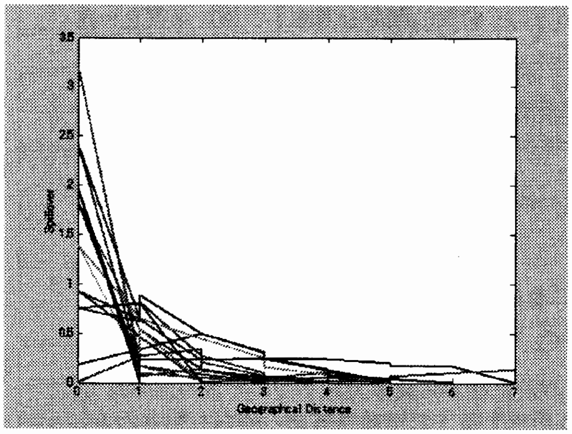

Figure 4 Spillovers vs. Geographical distance. Source:Author

In Fig. 4 (Fig. 5) it is observed at distance cero (0), the potential spillover that every region (Japan) has to share or "spill" over the other regions, and this is decreasing as distance is increasing. It is important to notice that this phenomenon is more appreciated in regions having more Knowledege Stock to share with their neighbors.

In Fig. 5, it can be seen the superposition of the Technological Gap vs. Geographical distance curves of the different regions, to observe completely the behavior, (notice the logarithmic scale of the Y-Axis); closer the regions are, less Technological Gap exists.

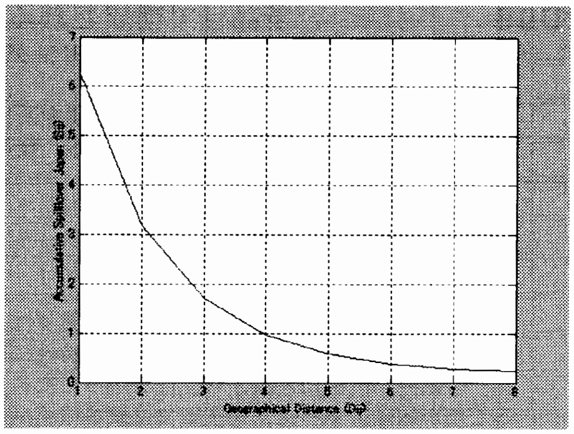

Figure 5 Spillover vs. Geographical distance.

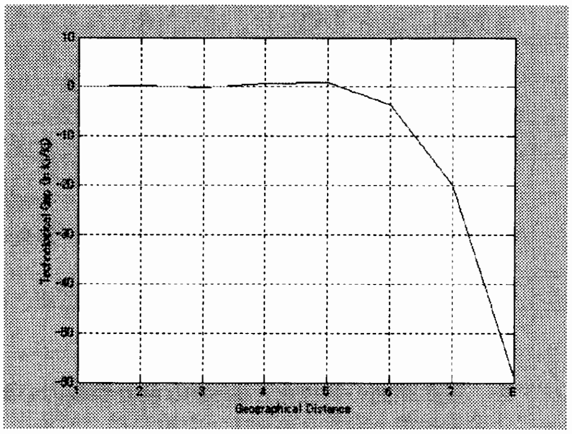

Figure 6 Technological Gap vs. Geographical distance.

4. References

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