ASSESSING THE RATIONALE FOR THE ESTABLISHMENT OF TECHNOLOGICAL DISTRICTS IN ITALY[1]

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Abstract

This paper has the aim to assess the rationale for the establishment of a specific innovation policy instrument namely technological districts (TDs) in Italy.

The Italian Ministry of Research, consistently with the relevant literature on the topic and with the European practice, has fostered in the period 2002-2006 the creation of high-tech systemic aggregations of firms at regional level. The instrument has been characterized by scarce understanding and it does not yet exist a national framework for its evaluation. Aim of this paper is to shed light on this policy instrument making an attempt to evaluate the coherence between the choices operated by the Ministry of Research together with Italian regions and the actual technological specialization/concentration patterns of the same regions. The main outcome of the paper will be to identify those situations where regional innovation characteristics in terms of technological specialization/concentration patterns do not match with the choices concerning the field of technological specialization for each TD.

Through a factorial analysis that allows to represent 6 indices of specialization/concentration through only 2 dimensions, it is possible to identify different groups of regions. The grouping is robust since performing a cluster analysis on the same indices, we arrive at the same conclusions.

The outcomes of the cluster analysis (the definition of 5 groups of regions) suggest different policy implications for the different groups we have identified.

Key words: Innovation, Technological Districts, High-tech Clusters, Italian Regions.

JEL Codes: O18, O32, O38, O52, R12

1. Introduction

The huge economic literature on the topic suggests that innovation requires policy interventions. The most common argument providing the rationale for policy intervention is the neo-classical notion of market failures related to the nature of knowledge as public good[2]. Neo-classical models converge to the conclusion that private investments, whatever the market structure is, are under provided compared to social optimum[3]. Public intervention is therefore required in order to let the market determine the social optimal quantity of R&D.

Many aspects of the innovation process are missing in the above perspective. The evolutionary approach aims at addressing those deficiencies defining innovation as the introduction of technological and organizational changes (new products, new production processes and new forms of economic organizations) in contexts characterized by non stationarity and strong uncertainty, emphasising the importance of learning and selection, the dynamism of evolutionary patterns, the essential role of firms[4]. In this framework the rationale for policy intervention lies in the solutions of trade-offs between variety and selection[5] and the policy-maker is characterized by bounded rationality and strong uncertainty.

For our purposes it is also useful to consider the wide literature on spatial agglomeration of innovative activities. The Italian experience of industrial districts[6] has renewed the Marshallian emphasis[7] on social and institutional factors for the agglomeration of economic activities. This emphasis has been transferred into the field of innovation highlighting the advantages in terms of knowledge spillovers deriving from spatial concentration of innovative activities[8]. The literature has since elaborated several definitions for this phenomenon ranging from the concept of "technological districts"[9] to "milieu innovateur" [10]

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[2] Nelson, 1959; Arrow, 1962.
[3] Arrow, 1962; Demsetz, 1969; Dasgupta and Stiglitz, 1980; Tirole, 1989.
[4] Nelson and Winter, 1982; Freeman, 1987; Dosi, 1988.
[5] Metcalfe, 1994.
[6] Becattini, 1987; Bellandi, 1982.
[7] Marshall, 1920.
[8] Krugman, 1991; Acs, Audretsch and Feldman, 1992; Feldman, 1994; Anselin, Varga and Acs, 1997; Jaffe, Trajtenberg and Henderson, 1993; Audretsch and Feldman, 1996; Porter, 1998.
[9] Storper, 1989.

to “learning regions”[11]. The debate on the causes of their origins and the best instruments to encourage their birth has been quite rich[12].

The attention to national innovation systems[13] has since been paralleled by an increasing consideration of the regional innovation systems[14] and regions are increasingly becoming the leading actors of their own innovation policies[15].

In line with this theoretical framework the Italian Ministry of Research through the Italian National Programme for Research 2005-2007 has fostered the creation of high-tech systemic aggregations of firms, universities, laboratories at regional level, encouraging regions to develop their own regional innovation strategies and promoting the competitiveness of territorial systems through the cooperation between public and private actors according to a triple helix model[16]. The list of TDs has been provided in table 2A of the Annexes.

The instrument of TDs is quite recent in Italy. It is characterized by scarce understanding and it does not yet exist a national framework for its evaluation.

Aim of this paper is to shed light on this policy instrument trying to understand the economic rationale for TDs establishment.

The paper is organized as follows. This first section, having introduced the subject, briefly summarizes the relevant literature on the topic.

The second section identifies the sectors of interest for the analysis i.e. the sectors of specialization of the established TDs. A correspondence has been defined between TDs' sectors of specialization (technologies) and sectors of economic activity (Ateco/NACE Rev 1.1.).

The third section illustrates some indices for the Italian regions: absolute specialization indices in terms of firms and employees; location quotients in terms of firms and employees; absolute and relative concentration indices. In total they are 6 indices for the 20 Italian regions. They are calculated using data on employment and number of firms for

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[10] Aydalot, 1986; Camagni, 1991.
[11] Camagni, 1991; Florida, 1995; Maskell and Malmberg, 1999.
[12] Saxenian,1994; Markusen, 1996; Bresnahan and Gambardella, 2004; Braunerhjelm and Feldman, 2006; Quadrio Curzio and Fortis, 2001.
[13] Lundvall, 1992; Nelson, 1993; Edquist, 1997.
[14] Cooke et al., 1997; Braczyk, Cooke, Heidenreich, 1998; Cooke, 2001; Evangelista et al., 2002; Asheim and Isaksen, 2002; Asheim and Gertler, 2004.
[15] Tödtling and Trippl, 2005.
[16] Etzkowitz and Leydesdorff, 2000.

the year 2005 (Asia database 2005 provided by Istat) sourced by Istat using Ateco/NACE Rev.1.1 (5 digits) classification. Within this section a factorial analysis is carried out in order to reduce the indices of regional specialization and concentration to a fewer dimensions. The factor analysis has allowed to identify two relevant dimensions: one of concentration and the other one of specialization.

The fourth section contains a cluster analysis aimed at testing the robustness of the previous factor analysis. It is based on the standardized values of the 6 indices and it provides the same outcome classifying Italian regions into 5 groups.

Finally the conclusions attempt to outline different policy implications and likely evolutionary paths for the established TDs in each of the 5 groups of regions.

2. Defining sectors of interest

In order to calculate indicators focused on TD's sectors of specialization/concentration we need to set a correspondence between TDs' sectors of specialization and sectors of economic activity as defined in the Ateco classification used by Istat to group the economic activities in Italy and corresponding to NACE Rev 1.1.

According to the Italian PNR 2002 and PNR 2005-2007, TDs must specialize in technological sectors considered strategic for the economic and technological development of the country. Table 3A reported in the Annexes sets a correspondence between regional TDs and the technology fields they have chosen to specialize in.

The next step is to set a correspondence between TD's sectors of specialization and Ateco/Nace Rev 1.1. classification. This operation implies some critical issues since Ateco/Nace Rev 1.1. classification reflects traditional sectors, while it is quite difficult to capture new technology fields. Nevertheless the use of the most disaggregated level (5 digits) allows us to refine the groupings of economic activities in order to cover technology fields as best as possible. Whenever this operation was not feasible, we considered the nearest application sectors of the specific technology, since vertical linkages are relevant in the context of agglomeration of innovative activities[17].

[17] Krugman, 1991; Porter, 1998.

Correspondences for biotechnology, for ICT and for nanotechnologies have been defined following a two-step approach: a) using Eurostat methodology[18] to set correspondences between technologies (ICT and bio) and patent codes[19]; b) defining correspondences between technologies (identified through patent codes) and economic activities (Ateco/Nace Rev.1.1.)[20].

For the buildinig sector we used the Istat definition of building activities[21].

For Energy and Renewables we used Zoboli, Pontoglio, 2008.

The correspondence between technology fields and Ateco/NACE Rev.1.1 is reported in table 4A of the Annexes

3. A factor analysis of specialization/concentration indices of Italian regions

In order to measure the level of specialization/concentration of each region in the specified sector and to assess the coherence between choices operated by MIUR and the industrial characteristics of the regional innovation systems that host TDs, we have used indices of relative and absolute specialization and concentration widely used in the literature to identify regional and local specialization patterns[22]. They are defined in table A1. They have been calculated using data on employment and firms for the year 2005[23] sourced by Istat using Ateco/NACE Rev.1.1 (5 digits) [24]. We have used year 2005 because this the last year for which we can get Asia's data.

We have calculated a total of 6 indices (relative specialization and concentration indices are identical therefore they have been counted only once) for each Italian region establishing a TD (18 regions out of 20 since 2 of them: VDA and Marche have not yet

[18] Eurostat, Unit F4 'Education, science and culture statistics', (2007), *Patent classifications and technology areas.*

[19] For nanotechnologies we used Igami and Okazaki, 2007

[20] Schmoch U., Laville F.,Patel P. and Frietsch R, 2003; Verspagen B., Morgastel T., Slabbers M., 1994 (MERIT concordance).

[21] Istat, 2009

[22] Ellison and Glaeser, 1997; Sforzi,1997; Puga, 1999; Signorini, 2000; Maggioni, 2002; Combes and Overman, 2003; Iuzzolino, 2005.

[23] Source: Asia database (2005) provided by Istat.

[24] The following limitations have been applied: 1) in Asia database we have considered only firms active since at least six months; 2) we have not considered artisan firms; 3) we have excluded firms with less than two employees.

established any TD). For each region we have associated the indices related to the corresponding sector. Whenever a region hosts more than one TD or the same TD declares a multiple specialization, we refer to the simple average of the indices related to the sectors involved. The outcomes of this calculation are presented in table 5A of the Annexes.

In order to reduce the number of indices to only two dimensions that can be easily scattered on a plot and that best serve to identify groups of regions with different characteristics, we have performed a factor analysis. Factor analysis is a multivariate technique that allows us to determine, from a set of 6 quantitative indices (variables)[25], a lower set (2) of non-observable hypothetical variables, called factors which summarise all the information contained in the original dataset, but at the same time reduce the number of dimensions we have to concentrate on for the purpose of the analysis.

Performing the analysis using the principal factoring method, we have chosen the relevant factors/dimensions having eigenvalues higher than 1. This solution includes two factors explaining a cumulative variance of 86% of the total variance of the original 6 indices considered.

Table 1: Results of the factor analysis

Factor	*Eigenvalue*	*Variance explained*	*Cumulative variance*
1	2.73591	0.6169	0.6169
2	1.06036	0.2391	0.8560
3	0.89072	0.2008	1.0569
4	-0.01113	-0.0025	1.0544
5	-0.09571	-0.0216	1.0328
6	-0.14534	-0.0328	1.0000

Note: software used Stata 8. Extraction method: principal factoring

Only the first 2 factors have eigenvalues higher than 1. In this way we have obtained a rotated factorial matrix that contains the linear correlations between the different indices and the factors. The simpler situation is when the different indices are clearly saturated in

[25] In table 1A there are 14 indices but two of the them: specialization location quotient and concentration location quotient, are identical.

different factors. In order to improve the capacity of saturation by each factor towards each index, rotation techniques are used to create a set of loadings that are more interpretable than those produced by factor analysis.

They aim at achieving a factor matrix which has the greatest likelihood of being interpreted, that is, it fits in with the solution where each index is saturated in a different factor. We have obtained the same outcome with both a varimax (orthogonal) and a promax (oblique) rotation retaining 2 factors. The difference between the two is that the latter implies not orthogonal factors and this allows correlations among them. Choosing varimax rotation, since we prefer orthogonal factors with no correlations, we obtain a correspondence between the two factors and the original six indices through identifying the highest loadings for each index. Factors with their loadings for each index are reported in table 2.

The first factor (we will name it **concentration**) includes the two indices of absolute concentration in terms of firms and of employees. Therefore the first factor provides information on the importance of each region for each sector since it compares the regional share in the selected sectors with the national total for the same sectors.

The second factor (we will name it **specialization**) includes the absolute indices of specialization in terms of firms and employees and the location quotients in terms of firms and employees. The first two indices provide information on the importance of a sector for each region comparing the level of specialization in the specific sector of each region with the total economy of the same region. The other two indices (relative measures of specialization) compare the level of specialization of a region in a certain sector with the level of specialization of the nation in the same sector.

Table 2: Results of the rotation

Variable: Index	*Factor 1 - **Concentration***	*Factor 2 - **Specialization***
Absolute Spec firms	0.29970	0.34324
Absolute Spec empl	0.50183	0.57504
LQ firms	0.23983	0.79500
LQ employees	-0.03533	0.70798
Absolute Conc firms	0.97727	0.08110
Absolute Conc empl	0.90783	0.16820

Note: software used Stata 8. Rotation method: varimax.

The process described until now has the aim of reducing the 6 indices to only 2 dimensions that can be plotted in a two-dimension graph. The 2 new dimensions (Concentration and Specialization) can be transformed into two standardized variables and attributed to each of the regions. The outcome of this process is reported in table 3 and can be visualized in the figure 1.

Table 3: Regions and the new variables

Region	*Variable:* ***Concentration***	*Variable:* ***Specialization***
Piemonte	0.4903252	0.1863256
Lombardia	3.022067	-0.3040117
TAA	-0,3538531	0.4396962
Veneto	0.7531357	0.2296948
FVG	-0.7512101	1.42708
Liguria	-0.5216926	-0.5648471
ER	1.374696	1.394164
Toscana	0.188594	-0.4787394
Umbria	-0.6898964	-0.6160542
Lazio	0.5534992	-0.1195575
Abruzzo	-0.4989347	0.7610942
Molise	-0.9595479	2.035641
Campania	-0.0493029	-0.6874316
Puglia	-0.2991219	-0.7739617
Basilcata	-0.7616677	-0.3288985
Calabria	-0.7263021	-0.9393222
Sicilia	-0.0869058	-0.3457096
Sardegna	-0.6838819	-1.315162

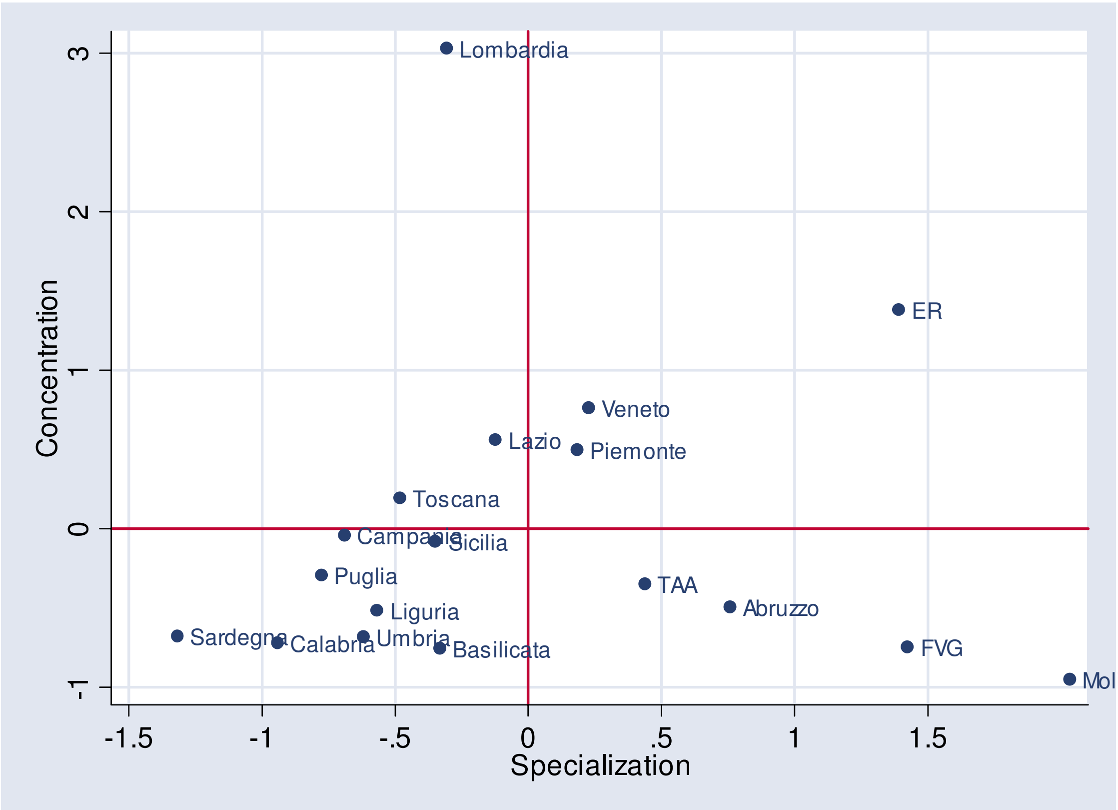
Note: software used Stata 8.

This new set of variables highlights that some regions score well above the average as far as the dimensions of their technological sector is concerned, especially Lombardia and ER (factor 1). Referring to factor 2, it highlights the level of technological specialization in the specified sectors that is especially high for regions such as FVG, ER, Molise. This not necessarily means that those regions have strong high-tech sector. Instead they have

chosen sector of specialization for their TDs that fit particularly well with their industrial and economic structure.

In order to better identify groups of regions with similar characteristics it is possible to plot the above variables in a two way graph as obtained below in picture 1.

Picture 1: Regions and the new variables



Note: graph elaborated using software Stata 8.

In this graph it is possible to identify 4 groups of regions. In the right-upper quadrant we find regions that show a coherent pattern between choices of technological sectors for their TD and technological specialization patterns of their economies. At the same time those regions represent a relevant quota of the Italian total for the sectors of interest. This is the best situation where coherence goes together with relevance. In this group we find Piemonte and Veneto. We can also include Lazio that is just on the border and with a special outlier position ER.

In the second group, in the right-lower quadrant of the diagram, we find those regions that show a high coherence with choices operated for the establishment of TDs, but at the same time, being mostly small regions, they are not very relevant compared to national total for each sector. They are TAA, FVG, Abruzzo, Molise.

In the third group in the left-upper quadrant, we find only one region that performs as an outlier and can not be associated to other regions: Lombardia that presents a very strong position in terms of concentration being very relevant in the national economic scenario, but does not present very marked specializations in the sectors chosen for the establishment of the TDs. The incoherence may derive from the existence of a very rich and diversified industrial and economic structure with no accentuated patterns of specialization.

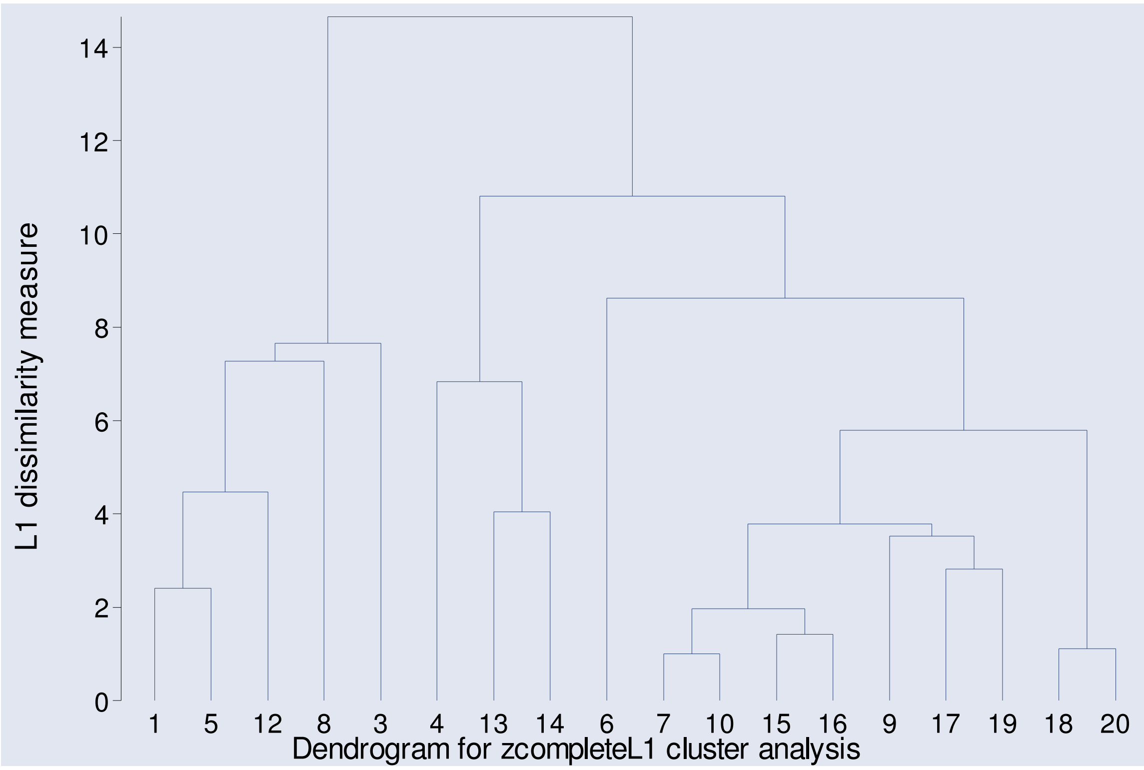
Finally the fourth group includes all the regions present in the left-lower quadrant of the diagram plus Toscana that is on the border. The group gathers those regions not very relevant in terms of their weight on the national total concerning the sectors of interest, and that, at the same time, have not succeeded in defining specialization sectors for their TDs in line with the main specialization features of their economies. This can be due to the fact that the field of specialization has not been enough specified or it has too many applications, determining a too large range of possibilities that hamper the analysis (Liguria and Campania). Or to the fact that too many specializations have been chosen so exceeding regional possibilities (Puglia, Sicilia) or to the fact that there is a strong specialization pattern at sub-regional level (province) that does not emerge with evidence at the regional one (Toscana). Finally, in this group, there are cases where the willingness to establish districts in specific technologies is based on very limited expertises that are in embryonic state and still need a long path of development before spreading their effects to the industrial regional structure (Umbria, Basilicata, Calabria, Sardegna).

4. Classifying TDs basing on a cluster analysis

In order to confirm the outcomes of the previous analysis, we have also carried out a cluster analysis on the original indices. In this way we check whether the groupings of regions we have delineated in the above scatterplot are confirmed according to a different approach.

The technique used for this purpose is the cluster analysis that is a multivariate technique which enables units of observation (in this case regions) to be classified into groups. The grouping method adopted is the hierarchical one. The linkage method used to specify what should be compared between groups that contain more than 1 observation is the complete linkage that uses to compare units of the farthest pair of observations between two groups. The measure of distance adopted is the absolute value distance (L1) that reflects the greater or lesser similarity among units of observation. Since this measure of distance can be affected by the type of units being handled, the problem has been corrected by standardising the variables according to the Z scores method. We have therefore standardized the original variables (the 6 specialization/concentration indices) in order to obtain 6 standardized variables with zero mean and standard deviation equal to 1.
The results of the cluster analysis are reported in figure 2 where 5 groups can be identified using a level of L1 dissimilarity higher than 7.

Figure 2: Results of the cluster analysis (regions are identified through their statistical code)



Note: software used Stata 8. Clustering method: hierarchical; linkage method: complete linkage; dissimilarity measure: absolute-value distance (L1)

According to the above diagram and considering a level of dissimilarity higher than 7, it is possible to identify the following 5 groups of regions going from left to right.

The first group includes Piemonte, Veneto, Lazio and ER that perform above average in terms of all or almost all the indices considered.

The second group is composed only by 1 region, Lombardia, that can be considered an outlier since in terms of concentration (importance of its technological sector compared with the national total), it has a disproportionately lead being the most populous and industrial Italian region.

The third group is composed by TAA, Abruzzo, Molise regions that perform better in terms of specialization especially relative than in terms of concentration being small regions.

The fourth group is composed by a single region FVG. In terms of characteristics this region would be similar to the previous group and in fact according to the previous analysis it had been included in that group. Since the region has a very high score, far higher than the average, in the relative specialization index (employees), this is reflected in the cluster analysis that considers the original indices (even if standardized) and in this respect it can be considered an outlier.

Finally the fifth group includes Liguria, Umbria, Campania, Puglia, Toscana, Basilicata, Sicilia, Calabria and Sardegna that, as in the previous analysis, do not perform higher than the national average in terms of specialization nor in terms of concentration,

This analysis therefore brings to the same outcomes as the analysis carried out in the previous paragraph except for FVG classified in a separate group as an outlier for the reasons we have already explained. The cluster analysis confirms the robustness of our previously illustrated principal factor analysis.

5. Conclusions and policy recommendations

From this analysis it is possible to outline different policy implications and to delineate forecast of likely future paths for TDs based on the belongingness to the specified groups.

For the regions in the first group, establishing TDs in the selected sectors presents good opportunities to create international champions. The choices of TDs' specializations fit with the industrial profiles of those regions and, at the same time, those regions have a technological weight on the national total that makes reasonable to exploit agglomeration

economies Going on with investments in those regions is meaningful from the policy maker point of view.

For Lombardia unique actor in the second group, the huge dimension of the technological sectors leave room for becoming an international player in the technologies selected even if the levels of specialization are not particularly high and its economy is quite diversified.

Regions in the third group have properly chosen their specialization, but being quite small, they will hardly become international champions in the selected technological fields. However encouraging them could be important in order to develop technological niches in the specified sectors. It makes sense going on investing in those regions provided aan adequate financial commitment and a strong institutional setting of the TDs themselves. The same considerations can be valid also for FVG that belongs to the fourth group, but can be considered similar in its characteristics to the regions in the third one.

Finally for the regions included in the fifth group, the effectiveness of technological policies is not so straightforward. In some regions those policies could produce good results in the sense that technological poles may contribute to regional technological and economic development reducing the gap with more advanced regions. It seems however unlikely that those TDs may evolve into international technological champions. Investing in those regions may make sense for the policy maker in terms of mitigating regional disparities. However if the commitment by the regional policy maker is low and interventions are not properly followed up and monitored, the risk is to waste public money.

It is possible to conclude that only in some cases, choices on TDs' specializations have been operated considering the existing specialization patterns of the regions. In many cases those criteria have been disregarded and have been superseded by considerations of territorial equilibrium in the allocation of funds and of technological development as a tool to promote economic development. This happens when no empirical evidence in terms of technological specialization/concentration seems to underpin the operated choices.

Criteria of TDs establishment and related targets are quite variegated as the analysis suggests. Therefore establishing TDs in Italian regions should take into account those differences, elaborating differentiated paths, objectives and level of resources. Under this perspective the approach implemented by Italian MIUR leaving the initiative to the regional level, is promising. However it does not eliminate the need for a strong supervision and monitoring in terms of objectives and performances achieved. Even a differentiated

regional approach must be coupled with a strict, mid-term monitoring procedure both at central and regional levels in order to avoid abysmal failures and wasting of public money.
In order to confirm this analysis, it is important to take into consideration on the one hand the performances of the regional innovation systems to which TDs belong and, on the other one, the institutional setting of TDs themselves. These can be considered paths of future research and will be subject of subsequent works.

Annexes

Table 1A: Indices of specialization/concentration

Index	Description	Data source	Year
Absolute specialization index (firms and employees)	$Spec_r^i = \frac{X_r^i}{\sum_i X_r^i} = \frac{X_r^i}{X_r^{TECON}}$	Database “Asia” 2005	2005
Relative specialization index (LSQ) (firms and employees)	$SLQ_r^i = \frac{\frac{X_r^i}{X_r^{TECON}}}{\frac{X_{NAT}^i}{X_{NAT}^{TECON}}}$	Database “Asia” 2005	2005
Absolute concentration index (firms and employees)	$Conc_r^i = \frac{X_r^i}{\sum_r X_r^i} = \frac{X_r^i}{X_{NAT}^i}$	Database “Asia” 2005	2005
Relative concentration index (CLQ)* (firms and employees)	$CLQ_r^i = \frac{\frac{X_r^i}{X_{NAT}^i}}{\frac{X_r^{TECON}}{X_{NAT}^{TECON}}}$	Database “Asia” 2005	2005

Table 2A: Italian Technological Districts (TDs): an overall framework at March 2009

Region	TD	Sector	Coordinating agency	Protocol Agreement	Framework Programme	Public funding (million €)	Private funding (million €)
Piemonte	Torino Wireless	ICT	Torino Wireless Foundation	11/12/2001	30/05/2003	52,5	30
Lombardia	Biotechnologies	Biotechnologies	Lombardia Region	22/12/2003	22/03/2004	26	22
	ICT	ICT		22/12/2003	19/07/2004	24	22
	Advanced Materials	Advanced Materials		22/12/2003	19/07/2004	40	34
Veneto	Nanotech	Nanotechnologies	Veneto Nanotech	17/12/2002	17/03/2004	42	26
TAA	Habitech	Sustainable technologies for building and for the environment; renewable energy	Distretto Tecnologico Trentino Scarl	-	28/02/2006	NA	NA
FVG	CBM	Molecular Biotechnologies	CBM	21/11/2003	05/10/2004	36,5	29,5
	Ditenave	Maritime Technologies	Ditenave	31/12/2006	-	25	NA
Liguria	SIIT	Intelligent Integrated Systems	SIIT	27/09/2004	28/09/2005	44,5	36
ER	Hi-Mech	Advanced Mechanics	ASTER	09/12/2003	13/05/2004	50	50
Toscana	ICT & Security	ICT & Security	Toscana Region	-	29/04/2005	7,5	NA
Umbria	TD Umbria (DTU)	Materials, Nanotechnologies, Mechatronics	Umbria Region	-	28/02/2006	49	49
Lazio	DTA	Aerospace	FILAS	05/05/2004	30/06/2004	60	40
	Cultural Heritage	Cultural Heritage (ICT)	FILAS	-	31/05/2008	60	40
	Biotechnologies	Biotechnologies	FILAS	-	04/04/2008	60	17
Abruzzo	Food safety and quality*	Food safety and quality	Consortium for food quality and security	-	22/12/2005	9	3
Molise	Mina*	Agro-industry	MINA	-	NA	6,5	5
Campania	IMAST*	Polimeryc Materials	IMAST	17/07/2003	09/03/2005	50,5	20
Puglia	Dhitec*	Nanotechnologies and ICT	Dhitec	16/02/2000	28/04/2005	20	18

	Dare*	Agro-industry	Dare	16/02/2000	28/04/2005	15	11
	Medis*	Mechatronics	Medis	16/02/2000	28/04/2005	7	-
	Ditne	Renewable energy	Ditne	-	31/08/2007	40	NA
Basilicata	TeRN*	Hydro-geological and seismic risks	TERN	-	NA	6	2
Calabria	R&D Log*	Logistics and Transport	R&D Log	19/10/1999	03/08/2005	18	17
	Culture and Innovation*	Cultural heritage preservation	Culture and Innovation	19/10/1999	03/08/2005	11,5	10,5
Sicilia	Micro and Nano-systems*	Micro and Nano-systems	-	13/09/1999	14/06/2005	11	9
	Agro-bio and Eco-fishing*	Agro-bio and Eco-fishing	-	13/09/1999	14/06/2005	42	27
	Maritime Transports*	Maritime Transports	-	13/09/1999	14/06/2005	8,5	3
Sardegna	Biomedicine	Biomedicine	CPR	-	27/05/2005	34	26,5

* CIPE del. N° 17/2003

Source: Our elaboration from various sources (among them the following internet sites: http://www.miur.it/; http://www.ricercaitaliana.it/distretti.htm; http://www.riditt.it/page.asp?page=networks_districts; http://www.distretti-tecnologici.it/home.htm; http://www.adite.it/; http://www.sviluppoitalia.it/.).

Table 3A: Regional TDs and their technology fields of specialization

Technology fields	**Regions**
Aerospace	a) Lazio
Biotechnology for health	a) Lombardia b) FVG c) Liguria d) Lazio e) Puglia f) Sardegna
Biotechnology for food (food and agro-industry applications) and advanced techniques for food production and security.	a) Lombardia b) Abruzzo c) Molise d) Puglia e) Sicilia
Bulding (sustainable technologies)	a) TAA
Cultural heritage	b) Lazio c) Calabria
Energy and Renewables	a) TAA b) Liguria c) Puglia
Information and Communication Technologies (ICT)	a) Piemonte b) Lombardia c) Liguria d) Toscana e) Lazio f) Puglia g) Sicilia
Logistics	a) Calabria
Maritime technologies	a) FVG b) Calabria c) Sicilia
Mechatronics	b) Liguria c) Emilia Romagna (ER) d) Umbria e) Puglia
Nanotechnology	a) Lombardia b) Veneto c) Umbria d) Campania e) Puglia f) Sicilia
Hydro-geological and seismic technologies	a) Basilicata

Source: our elaboration on MIUR Strategic Guidelines for Research and on regional TDs websites.

Table 4A: Correspondences between technologies and ATECO classification of economic activities

Technology field	Ateco/NACE Rev.1.1
Aerospace	35.3 Manufacture of aircraft and spacecraft
Biotechnology for health	24.14 Manufacture of other organic basic chemicals
	24.41 Manufacture of basic pharmaceutical products
	24.42 Manufacture of pharmaceutical preparations
	24.66.1 Manufacture of organic products obtained by fermentation
	33.1 Manufacture of medical and surgical/ orthopaedic equipment
	33.2 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes.
Biotechnology for food	15 Manufacture of food products and beverages
Building	20.3 Manufacture of wooden parts for bulding
	26.4 Manufacture of tiles and brick for building
	26.5 Manufacture of cement, lime and chalck
	26.6 Manufacture of concrete products
	26.7 Cutting stones and marble for building
	28.1 Manufacture of metallic products for building
	45.1 Preparation of building yard
	45.2 Building
	45.3 Putting in place services in buildings
	45.4 Completion of buildings
	74.20.1 Architectural and engineering services
	74.20.2 Integrated engineering services
Culture heritage	73.20 R&D in human studies
	92.31.0 Production of artistic works
	92.51 Libraries and archives
	92.52 Museums and management of other cultural heritage
Energy and Renewables	23.3 Nuclear fuels
	24.15 Manufacture of natural fertilizers and compost
	28.22 Manufacture of boilers
	29.11.2 Manufacture of turbines for mechanical production of energy
	29.12 Manufacture of pumps and compressors
	29.21.1 Manufacture of burners
	29.7 Manufacture of equipment for domestic use
	31.10.1 Manufacture of engines
	31.20.1 Manufacture of electric equipment
	32.10 Manufacture of electronic valves and tubes
	37.20.2 Recycle of urban and industrial solid waste and biomasses
	40.11 Electric energy production
	40.12 Electric energy transport
	40.13 Electric energy distribution and commerce
	40.21 Gas production
	40.22 Gas distribution and commerce
	40.30 Production and distribution of heat and cold
	73.10 R&D in natural sciences
	74.20.4 Seismic, hydrographic and geodetical analysis
	90.02 Collection and disposal of solid waste

ICT	29.24.2 Manufacture of balances and machinery for sales/distribution
	29.24.5 Automatic machinery for measuring, packaging, wrapping
	29.56.4 Manufacture of industrial robot
	30.0 Manufacture of office machinery and computers
	31.3 Manufacture of insulated wire and cable
	32.1 Manufacture of electronic valves and tubes
	32.20.1 Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
	32.20.2 Manufacture of electric appliances for TLC
	32.3 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
	33.2 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes
	33.3 Manufacture of industrial process control equipment
	33.40.3 Manufacture of optical elements and fibers
	33.40.4 Manufacture of optical precision instruments
	33.40.5 Manufacture of photographic equipment
	64.2 Telecommunications
	72 Computer and related activities
Logistics	63.1 Material handling and warehousing
	63.2 Other Transport Activities
	63.4 Transport Agencies' activities
Maritime technologies	35.1 Building and repairing of ships and boats
	61 Maritime and other naval transports
Mechatronics	29.1 Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines
	29.21.1 Manufacture of furnaces and furnace burners
	29.22.1 Manufacture of lifting and handling equipment
	29.23.1 Manufacture of non-domestic cooling/ventilation equipment
	29.24.1 Manufacture of material for not electric welding
	29.24.2 Manufacture of balances and machinery for sales/distribution
	29.24.3 Manufacture of other general purpose machinery
	29.24.4 Manufacture of machinery for chemical and oil plants
	29.24.5 Automatic machinery for measuring, packaging, wrapping
	29.31.1 Manufacture of agricultural tractors
	29.32.1 Manufacture of other agricultural and forestry machinery
	29.4 Manufacture of machine-tools
	29.5 Manufacture of other special purpose machinery
	29.71 Manufacture of electric domestic appliances
	33.20.1 Manufacture of electric instruments
	33.20.2 Manufacture of instruments and appliances for measuring, checking, testing including meters
	33.20.3 Manufacture of instruments and appliances for navigating and other purposes including hydrology and meteorology tools.
	33.20.4 Manufacture of instruments and appliances for drawing, computation and precision tools
	33.3 Manufacture of industrial process control equipment
	34.10 Manufacture of motor vehicles
	34.30 Manufacture of parts/accessories for motor vehicles/engines
	35.20.1 Manufacture of railway locomotives and rolling stock
	35.20.2 Manufacture of tramway locomotives and rolling stock

	35.41 Manufacture of motorcycles
Nanotechnology	24.1 Manufacture of basic chemicals
	24.3 Manufacture of paints, varnishes and similar coatings
	24.4 Manufacture of pharmaceuticals, medicinal chemicals and botanical products %
	24.5 Manufacture of soap and detergents, cleaning and polishing preparations,perfumes and toilet preparations
	24.66 Manufacture of other chemical products
	25.2 Manufacture of plastic products
	26.1 Manufacture of glass and glass products
	26.23 Manufacture of ceramic insulators and insulating fittings
	26.24 Manufacture of other technical ceramic products
	26.26 Manufacture of refractory ceramic products
	26.8 Manufacture of other non-metallic mineral products
	27.3 Other first processing of iron and steel and production
	27.4 Manufacture of basic precious and non-ferrous metals
	28.40 Forging, pressing, stamping and roll forming of metal
	28.51 Treatment and coating of metals
	29.14 Manufacture of bearings, gears, gearing and driving elements
	29.42 Manufacture of machine-tools for metallurgy
	29.51 Manufacture of machinery for metallurgy
	30.0 Manufacture of office machinery and computers
	31.40 Manufacture of accumulators, primary cells and batteries
	31.5 Manufacture of lighting equipment and electric lamps
	32.1 Manufacture of electronic valves and tubes
	32.20.1 Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
	32.20.2 Manufacture of electric appliances for TLC
	33.1 Manufacture of medical and surgical/orthopaedic equipment
	33.2 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
	33.3 Manufacture of industrial process control equipment
	33.40.3 Manufacture of optical instruments and fibers
	33.40.4 Manufacture of optical precision instruments
	33.40.5 Manufacture of photographic equipment
Hydro-geological and seismic technologies	73.10 R&D in natural sciences
	74.20.1 Architectural and engineering services
	74.20.2 Integrated engineering services
	74.20.3 Cartography activities
	74.20.4 Seismic, hydrographic and geodetical analysis

Source: our elaboration on Ateco/Nace Rev.1.1 classification.

Table 5A: Indices of absolute specialization for firms and employees (Indimpspe and IndAddSpe), relative specialization for firms and employees (slqimp and slqadd), absolute concentration for firms and employees (IndImpConc and IndAddConc) for the 18 Italian regions considered.

Codice regione	Regione	IndImpSpe	IndAddSpe	SLQ Imp	SLQ Add	IndImpConc	IndAddConc
1	Piemonte	0,032901	0,050913	1,114486	1,058812	0,087871	0,090106
3	Lombardia	0,020947	0,046537	1,409088	1,294793	0,269391	0,326316
4	TAA	0,043767	0,059703	0,959202	0,823422	0,021136	0,016155
5	Veneto	0,021363	0,064867	1,221478	1,085023	0,11361	0,103014
6	FVG	0,00238	0,022847	1,275114	4,462557	0,028383	0,099842
7	Liguria	0,009145	0,029659	0,72674	0,757306	0,024034	0,018816
8	ER	0,023975	0,102509	1,801923	1,792099	0,161478	0,171304
9	Toscana	0,025935	0,031887	0,87852	0,663125	0,069838	0,041381
10	Umbria	0,009284	0,034469	0,606223	0,589255	0,009414	0,007529
12	Lazio	0,009397	0,031796	1,087529	1,437362	0,097365	0,172673
13	Abruzzo	0,01756	0,035965	1,700352	1,561639	0,035822	0,027155
14	Molise	0,023217	0,055412	2,248019	2,406022	0,00925	0,006356
15	Campania	0,01341	0,033042	0,766735	0,552692	0,056805	0,030695
16	Puglia	0,010614	0,019088	0,848838	0,518953	0,041476	0,018289
17	Basilicata	0,01941	0,008141	1,035498	0,895418	0,00695	0,004746
18	Calabria	0,002518	0,008354	0,617916	0,800813	0,012575	0,010229
19	Sicilia	0,011583	0,018192	1,121648	1,137517	0,061642	0,042345
20	Sardegna	0,001407	0,002202	0,606952	0,196784	0,013863	0,003212

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