How to chose innovation policies to foster SMEs growth. A region - industry - firm type approach

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2004

XXI_IASP World Conference on Science and Technology Parks







Bergamo 2004

20_23 September 2004_Bergamo_Italy

_Regional Attractiveness in the Knowledge Economy

PROCEEDINGS






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A region - industry - firm type approach

1. Introduction

There are several elements confirming the importance of Small and Medium Enterprises (SMEs) for the attractiveness of economic systems. SMEs enhance competition and entrepreneurship and hence have external benefits on economy-wide efficiency, innovation, and aggregate productivity growth. Knowledge-intensive innovative firms are often SMEs, and they can provide high quality services for large companies in need of outsourcing part of their activities. Moreover, SMEs strengthen social cohesion through job creation, thus representing a poverty alleviation tool, also through the role played by women and young entrepreneurs [World Bank, 1994; 2002; 2004].

Nevertheless, SMEs are increasingly facing harsh survival conditions. Globalization, through the growing recourse to delocalization by large firms, the acceleration of technological change and ever hardening competition for markets, is posing opportunities but also serious challenges to SMEs [OECD, 2000].

Safeguarding the competitiveness of SMEs is probably one of the most relevant tasks faced by policy makers with this respect, and this can be mainly achieved through fostering innovation and technology transfer. Innovation is now generally regarded as a fundamental ingredient of economic growth of a given territory, whether one considers the national, regional or local scale. Recalling Porter's seminal works [1990], innovation is crucial for the competitiveness and the attractiveness of territories as well.

In this context, it is important to stress the specificities of the innovation process among SMEs. In fact, rarely SMEs can afford large R&D laboratories, and they lack financial resources for research, but on the other hand small businesses display greater flexibility and capacity to adapt to changes [Bagnasco 1977].

The needs for services of innovation and technology transfer among SMEs have their own specificities as well. For these reasons, traditional innovation policy instruments must be adapted to the specific needs of SMEs. The promotion institutions and policies aiming at sustaining innovation and technology transfer in SMEs can guarantee the survival and the competitiveness of the entrepreneurial system of a given territory or industrial sector, and can contribute to enhance regional attractiveness for investments. But such policies must be carefully planned. In fact, evidence shows that innovation policies that do not take into account the specific features of

SMEs can turn out to be inefficient or even counter producing [INSME, 2002].

This leads to consider how problematic the objective of promoting innovation is, especially in economies based on knowledge. The integrated use of different policy tools becomes necessary, in order to stimulate the different stakeholders of an innovation system. To meet these requirements, it is essential to elaborate a conceptual framework, with the aim of defining the innovation needs of SMEs in each particular case. Such a framework would enable policy makers to adopt a bottom up approach, instead of the traditional, top-down one. The policy tools to be selected should have an influence at the same time on factors such as the skills and the knowledge of potential innovators, the structures and infrastructures needed to strengthen the milieu innovateur [Aydalot, 1986], and on the incentives to innovate.

A careful, preliminary analysis of the targeted system is the first step for the identification of the innovation needs of a target group of SMEs, i.e. in a giver region. Subsequently, policies must be designed and selected, taking into account the fact that they cannot simply be additive, but they should be carefully chosen according to a reference system, and integrated.

It must be emphasized that the present methodology represents a theoretical framework to connect the different variables and indicators among them, and it can represent the base for a decision support system, that can be useful to policy maker and practitioners to:

- Identify the different dimensions of industries/technologies, firms and regions to be considered in a given case study/policy intervention,
- Identify the priority needs connected to the specific hindrances to innovation according to the three perspectives indicated by the economics of innovation, the economics of organization and the regional economics,
- Select a multifaceted set of complementary tools most effective with respect to the identified requirements,
- Support the ex-post or ex-ante verification the validity of chosen policy tools,
- Analyse the territorial or entrepreneurial or technological dimension of a given system of innovation.

In order to support policy making choices, the Italian Institute for Industrial Promotion (IPI) set up a research group within INSME project. Its aim was to elaborate a "methodological approach" for the identification of innovation policy instruments for SMEs. The interdisciplinary conceptual framework which resulted from such work is described in this paper.

The study group was coordinated by Andrea Bianchi and Paolo Guglielmetti (IPI), and was composed by Silvia Grandi, Beatrice Marani, Pier Francesco Cerritelli (IPI), Daniele Archibugi (Consorzio Nazionale delle Ricerche, CNR), Luigi Orsenigo (Bocconi University, Milan) and Maurizio Decastri (Tor Vergata University). Riccardo Cappellin (Tor Vergata University, Rome) was the scientific coordinator.

2. A method based on a region-firm-industry approach

From the interdisciplinary observation of the literature regarding innovation and development economics, three dimensions emerge. These dimensions are the three forces shaping and defining the innovation needs of a group of enterprises. They can be analyzed to determine the most suitable policies (PI) for the development of SMEs through innovation and technology transfer. The three dimensions are:

- The typology of industrial technology based on the source of innovation (T)
- The firm typology, that is the entrepreneurship, the organizational and learning structure of the SMEs targeted (F)
- The typology of regional context, that is the *milieu* as an expression of a complex socio-economic system localized in a defined area (R)

$$P_i = F(T, Fj, R)$$

An instrument (or a set of instruments) has to be found, in order to best suit the needs (n) expressed by the targeted system. This is why we can define it a "demand driven approach".

In particular, according to the method,

$$P_i = f(n)$$

where

$$n = g(T, F, R)$$

where f indicates a function of choice, whose result is provided by the three tables where the correlations among the different typologies and their needs are reported, based on the opinions of an experts group and data surveys on the field; and g indicates a mathematic matrix function depending from the weights (x) assigned to each specific need (n), and by the weights assigned by the panel of the relative efficacy of the various instruments (y).

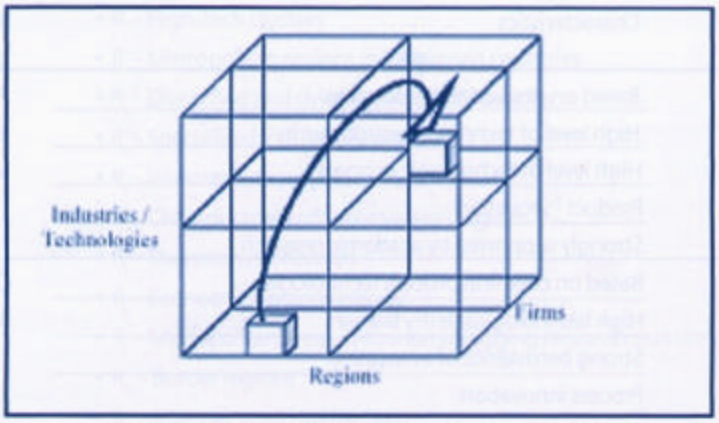

Figure 1. Representation of the three dimensions determining the innovative needs of SMEs (Cappellin, 2002).

In other words, in the evaluation phase, the definition of the typology of each dimension (industry, firm, technology), allows to set a priority list of the needs related to that specific dimension. At the end of the evaluation phase, it will be possible to choose the set of instruments which best suits the most relevant needs, whose weight has been already defined.

Although the method has a semi-mathematic layout, it should not be applied in an automatic or deterministic way. On the contrary, the method was conceived as a support tool for the decisional process of policy makers, in order to help them identifying a set of possible solutions, and removing the impossible and the least appropriate ones.

Moreover, the method is meant to be a potential guide for the and ex-ante analysis of the reference system, suggesting a set of indicators and innovation needs for SMEs, and a framework for the ex-post evaluation of policy choices.

The role of the industry/technology dimension

The technologic trajectory and sources play a key role in the definition of the technologic needs of enterprises [OECD, 1996]. We hereby present a classification based in the "taxonomy of innovative enterprises" elaborated by Pavitt [1984] and modified by Marsili [2001]. In this context, it is important to classify enterprises mainly according to their position in the process of production and use of technology, rather than to their product line. For instance, both moon-boots and slippers could be classified as footwear, but the technological needs of the firms producing the two are indeed very different [Archibugi and Orsenigo, 2002].

- T_1 Science based enterprises
- T_2 - Enterprises based on fundamental processes
- T_3 - Complex knowledge system enterprises
- T_4 - Product-engineering enterprises
- T_5 - Traditional industries

The characteristics of the various industry/technology firms are described in table1.

Following, a list of the needs arise from the technological dimension of SMEs. They have been defined taking into account the industry they belong to as a specific source of variation.

- Density of SMEs and needs for entrepreneurial assistance
- Speed for technological change
- Needs for in-house R&D
- Need for strong scientific research

- Need for strong applied knowledge
- Need for IPR regulation
- Need for support in scanning the technological environment
- Lack for awareness of technological needs
- Need for higher education
- Need for firm specific innovation support
- Need for generic technological infrastructures

Table 1. Definitions of the typologies of industry/technology sector

Category	Characteristics	Examles of potential sectors
Science based	Based on physic and life sciences High level of technologic opportunity High level of technologic richness Product innovation Strongly supported by academic research	Pharmaceutics, Electronics, Scientific Instruments
Fundamental processes	Based on chemical process technologies High technological entry barriers Strong persistence of innovation Process innovation Strongly supported by affiliated enterprises innovation	Chemical, Oil, Metallurgy
Complex knowledge system	Based on the combination of knowledge in the Mechanical, Electric/Electronic and Transport sectors Medium-high level of technologic opportunity High technological entry barriers and economies of scale Strong persistence of innovation Differentiation of technological competences, supported by external knowledge sources and academic research	Aerospace, Motors
Product-engineering	Based on mechanical engineering Not very strong persistence of innovation Low technological entry barriers Product innovation stimulated by clients	Machinery
Traditional industries	Fairly differentiated knowledge base Low technological entry barriers and economies of scale Low level of technologic opportunity Weak persistence of innovation Incremental innovation Diversification strategy Dependent on technology suppliers as a source of innovation or by specialized suppliers	Textile, Garments, Sho Food and Beverages, Metallurgy

These are the innovation needs related to the technological dimension of the targeted group of SMEs. They have to prioritized according to the typology of industry/technology, so that, once a typology is defined for a target group of SM one can define the most relevant needs.

The role of the territorial dimension

In theory, location should no longer be a source of competitive advantage. Open global markets, rapid transportation, a high-speed communications should allow any company to source any thing from any place at any time. But in practi

location remains central to competition. The specific characteristics of the territory in which SMEs operate have fundamental relevance. This is confirmed also by a wide geographic literature, by regional economics and by the works o the competitiveness of territories. In particular, these phenomena have been depicted through the theoretical framework o the "Industrial Districts" [Beccattini, 1987]. Another significant impulse to the debate was provided by GREMI (*Groupe d Réflexion sur l'Enseignement des Méthodologies de l'Information*), through the concept of *milieu innovateur* [Aydalo 1986]. Later, Michael Porter's studies and dissemination works granted great visibility to the dynamics of agglomeration o industries, which since then are better known among policy makers as "clusters" [Porter, 1990; 1998].

The characterization of the typology of regions (Ri) used in the method is represented in the following classificatio [Cappellin and Decastri, 2002]:

- R_1 - High-tech clusters
- R_2 - Metropolitan regions in developed countries
- R_3 - Diversified and dynamic industrial regions
- R_4 - Specialized industrial clusters
- R_5 - Intermediate regions
- R_6 - Old industrial and reconversion regions
- R_7 - Transition economies
- R_8 - Economic lagging regions
- R_9 - Metropolitan areas in economic lagging regions/countries
- R_{10} - Border regions
- R_{11} - Internal small rural areas
- R_{12} - 12. Large peripheral areas

They can be organized as represented in table 2:

Table 2 Table of the typologies of regions

Criterion of classification of regions	Belonging regions
Technology and development level	Developed regions
	Intermediate regions
	Economic lagging regions
Urbanization and structure of the urban system	Metropolitan regions
	Intermediate regions
	Rural regions
Diversification of sector composition	Hi-tech clusters
	Diversified industrial regions
	Specialized industrial district
	Rural areas
Dynamism of the industrial sector	Dynamic industral regions
	Old industrial & reconversion regions
	Transition economies
Geographic position	Metropolitan regions
	Border regions
	Internal small rural regions
	Large peripheral areas

by public authorities, as it is in the case of national planning contracts with large private or public firms, territori pacts for employment bringing together many local actors, etc..

D. Governance model 2: here, we refer to those policy instruments, which may be and often are supported b public resources, but were clearly created by private actors, groups and citizens, thus following a bottom-u approach.

Table 4 is a list of the different kinds of innovation instruments, subdivided according to the approach driving them.

Table 4: Policy-making approaches and instruments of innovation policies

A) "Government" model	**B) "Market" model**
1. Public owned industries	1. Privatisation of public industries
2. Subsidies to strategic private industries	2. Market deregulation
3. National agencies of sectoral industrial plans	3. Liberalization and MNE attraction
4. Public funding of R&D	4. IPR regulation and national patent offices
5. Regional offices of national agencies or departments	5. Private professional services
6. Public demand and fiscal incentives	6. Private technology brokers
7. Large public R&D institutions	7. Private venture capital
8. Science Parks	8. Private research companies
9. TT service centres (fully public financed)	9. Technological education centres
	10. Public information and benchmarking centres
C) "Governance" model 1: public-private strategic partnership	**D) "Governance" model 2: local networking and cooperation**
1. Strategic planning contracts with large firms	1. Cooperative research projects between SMEs (CRAFT)
2. Territorial pacts with local actors	2. Autonomous - non governmental research institutions or foundations
3. Regional technological parks and centres	3. Business Innovation Centres (BIC) and Innovation Relay Centres (IRC)
4. TT centres and programmes (partially nationally publicly financed)	4. TT centres of industry associations and chambers of commerce
5. University – industry liaison offices	5. Local incubators of innovative firms
6. Professional continuous education centres	6. Regional/local development agencies
7. National programs for R&D and innovation networks	7. Local stakeholders coordination tables
8. National networks of TT service centres	8. RIS - regional innovation system
9. National financial trusts for financing innovative firms	9. Territorial knowledge management (TKM)
10. International networks of TT centres	10. Regional innovative start-up funds

4. The analitical part of the method

The last step we have to take to complete our framework is to create a tool to put together all information concernin regions, firms, technologies, needs and instruments to address them. This is in fact the function of the matrix. We alread introduced in chapter 2 the basic mechanism lying behind the method. Let us now explain it in a more extended an complete form.

The procedure to compute the scores of the matrix may be illustrated through the following analytical expressions. Give the following indexes:

h: index of the need to be considered in an industry/technology and regional and firm dimension (h = 1..38),

p: index of the policy instrument to be considered in a specific industry/technology or firm or regional dimension (= 1..39),

t: index of the various industry/technology to be considered (t = 1..5),

r: index of the various region type to be considered (r = 1..12),

f: index of the various firm types to be considered (f = 1..4),

we may define:

x_{ih}, x_{ih}, x_{ih}: scores of the need (i), respectively in the dimension of industry/technology (t) or of firm (f) or of region (r),

y_{ip}: score of the policy instrument (p) in response to the need (h).

In the actual calibration of the model, the scores (x_{ih}, x_{ih}, x_{ih}) have been defined with a value between 1 (low importance) an 5 (very important), with the constraint that the summation of the scores of all the needs will be the same for eac industry/technology or firm type or region considered type. This assures the comparability of the results, between th

industry/technology or firm type or region t considered type, and makes it necessary to identify a well defined priority between the various needs for a given industry/technology or firm or region type.

Similarly, the scores ($y_{..}$) have been defined with a value between 0 and 3, where the value 0 indicates that a given policy instrument does not have any specific effect on a specific need, while the score assumes the value 3, when the instrument is particularly appropriate to respond to a specific need. All the scores are the result of the consensus reached within a group of experts with different background and competencies.

Finally, the weights (W), to be assigned to a specific policy instrument (p) according to the three dimensions considered: industry/technologies, firms and regions (t, f and r), can calculated as the product of two matrixes:

1. $W_{..} = \sum_{m} y_{..} x_{..}$
2. $W_{..} = \sum_{m} y_{..} x_{..}$
3. $W_{..} = \sum_{m} y_{..} x_{..}$

that is, as the multiplication of the scores attributed to the individual needs by the specific scores attributed in the effectiveness of the specific policy instrument to be considered with respect to these same needs.

Since the model enables to compare the scores for different instruments in the case of a specific industry/technology and of a specific type of firm or of a specific type of region, it is possible to combine the three dimensions.

Thus, once the case study to be considered has been characterized with respect to the specific industry/technology (t), firm type (f) and region type (r), an overall score can be computed for the policy instrument to be considered and this score can be compared with that of the other policy instruments. the overall weight (W_p) of a specific policy instrument (p) could be computed by simply adding W_t, W_f and W_r:

$$W_p = W_{t.} + W_{.f} + W_{.r}$$

The choice of the policy instrument can therefore be done according to the score of each of the 39 instruments. To be more accurate, it is important to remind once again that the model dose not pretend to supply decision makers with an imperative receipt, but rather with a decision support tool, or even an instrument to reduce the chance, excluding impossible or not applicable solutions.

An application of the method was performed in the framework of a technical cooperation programme between the Italian Institute for Industrial Promotion (IPI) and the Iranian Small scale Industries Organisation (ISIO). The target group of SMEs was the textile area of Yazd (Iran) and the table presented in Annex 1 is the result of the work of an experts group from IPI. The result seems consistent, and it indicates that the method can be implemented, as it provides useful hints regarding the policies to be selected in order to foster innovation and competitiveness among SMEs.

5. Conclusions

This paper aimed at defining a common methodological framework for the evaluation and decision regarding innovation policy instruments, suitable for an international comparative approach. It may be useful in empirical analysis and operative projects.

In particular, the originality of the methodology are the interdisciplinary approach, considering all three main factors affecting innovation systems, especially when thinking to SMEs: the territorial, the technological and the entrepreneurship dimension.

In addition, the methodology has adopted a demand driven approach, based on the precise identification of the needs of services, by analysing them according to different dimensions: industries/technologies, firms and regions.

Thus, the study has adopted a strategic perspective and it indicates that the identification of the strengths, weaknesses, opportunities and threats is facilitating the identification of the actual needs and demand of technology transfer services in a given region.

The methodology is also characterized for having analysed a wide variety of the instruments, which can be used in innovation policies ranging from a top-down, governmental approach to a bottom-up and market approach. This model allows to support decision makers in measuring in a more rigorous and quantitative way the complementarities and the trade-offs of these innovation policy instruments, while aiming to respond to various and interdependent needs, which may have a different priority in various industries, firms and regions.

This is clearly also an effective approach to investigate on regional attractiveness factors and it is a new method of evaluation when applying the model reversely, as well as it is useful to identify most suitable initiatives to apply to enhance the competitiveness of a territory.

SOURCES

1. IPI Istituto per la Promozione Industriale viale Pilsudski, 124 00197 ROMA (Italy) www.ipi.it. Authors email: guglielmetti@ipi.it; bianchi@ipi.it; grandi@ipi.it. For contacts: Silvia Grandi, grandi@ipi.it (tel: +39 06 80972215 fax: +39 06 80972443)

2. In the original model, the overall weight (W_p) of a specific policy instrument (p) could be computed through the following expression: $W_p = a W_{ip} + b W_{mp} + c W_{rp}$, where the weights (a, b and c) could be used in order to standardize the various scores or to assign a different importance to the industry/technology, firm and regional perspectives. Nevertheless, it was shown that the coefficients do not modify the priority order of instruments, but they simply amplify the distances between them. Therefore, the use of the coefficient can be eliminated without modifying the achievements of the model.

	Instruments	RANKS INDUSTRIES (W1)	RANKS FIRMS (W2)	RANKS REGIONS (W3)	PRIORITIES Y AVD (W1)
A	1. Public owned industries	21	52	35,6	108,6
A	2. Subsidies to strategic private industries	34	61,6	43,56	139,16
A	3. National agencies of sectoral industrial plans	34	30,2	35,2	99,4
A	4. Offices for public funding of R&D	47	52,2	36,24	135,44
A	5. Regional offices of national industrial agencies or government departments	48	53,8	61,96	163,76
A	6. National patent offices	41	44	21,04	106,04
A	7. Large public R&D institutions	48	53,2	45,84	147,04
A	8. Science Parks	68	62	65,92	195,92
A	9. TT service centres (fully public financed)	61	69	50,2	180,2
B	1. Privatisation of public industries	21	58,8	49,36	129,16
B	2. Market deregulation	21	62,2	49,4	132,6
B	3. Liberalization and MNE attraction	49	65	61,68	175,68
B	4. IPR regulation and fiscal incentives to R&D	39	40,4	31	110,4
B	5. Private professional services	48	71	39,64	158,64
B	6. Private technology brokers	62	83,8	42,28	188,08
B	7. Private venture capital	48	73,8	43,64	165,44
B	8. Private research companies	53	70,6	49,2	172,8
B	9. Technological education centres	39	58,4	60,12	157,52
B	10. Public information and benchmarking centres	63	61,6	51,16	175,76
C	1. Strategic planning contracts with large firms	34	55,8	60,08	149,88
C	2. Territorial pacts with local actors	45	60,4	71,04	176,44
C	3. Regional technological parks and centres	67	76,4	68,48	211,88
C	4. TT centres and programmes (partially nationally publicly financed)	64	73,4	76,32	213,72
C	5. University – industry liaison offices	48	62,2	62,88	173,08
C	6. Professional continuous education centres	61	74,8	68,08	203,88
C	7. National programs for regional R&D and innovation networks	48	65	48,12	161,12
C	8. National networks of research and TT service centres	47	56,2	64,8	168
C	9. National networks of financial trusts for financing innovative firms	52	41,6	51,04	144,64
C	10. International networks of TT centres	45	49,6	44,96	139,56
D	1. Cooperative research between SMEs (CRAFT projects)	51	82,6	58,68	192,28
D	2. Autonomous - non governmental research institutions or foundations	43	47,4	53,72	144,12
D	3. Business Innovation Centres (BIC) and Innovation Relay Centres (IRC)	59	75,8	64,76	199,56
D	4. TT centres of industry associations and chambers of commerce	50	68	63,76	181,76
D	5. Local incubators of innovative firms	50	74,2	61,32	185,52
D	6. Regional/local development agencies	46	58,4	66,4	170,8
D	7. Local stakeholders coordination tables	47	56	58,68	161,68
D	8. RIS - regional innovation system	62	84,8	59,44	206,24
D	9. Territorial knowledge management (TKM)	62	77	48,56	187,56
D	10.Regional innovative start-up funds	51	65,6	57,92	174,52

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