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REGIONAL DIFFERENCIES OF INNOVATION: FIRMS' ORGANIZATION, REGIONAL INSTITUTIONS AND INNOVATIVE PERFORMANCE

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1. Introduction

This paper explores the possibility of explaining divergence in countries' economic growth through a system of innovation approach. A system of innovation approach adopts the idea that externalities and spill-over have a positive effect on firm and industry productivity and it focuses attention mainly on three types of interactions:
- co-operative and networks inter-firms relations;
- sector/region clusters;
- inter-institutional relations.

The paper tests the significance of organisational variables, externalities and public policy variables in explaining regional differences in firm innovation propensity, i.e. the propensity to introduce product innovation. The empirical application concerns the regional differences of innovation activities of firms in Italy. In this country there are strong differences between Northern and Southern firms in carrying out innovative projects. In order to develop a regional innovation policy tailored to suit varying local conditions, it is essential to understand how the innovation process takes place. That is to say, it is essential to understand which factors explain innovation behaviour of firms within each region.

The basic model used to explain firm's innovation performance is the 'classical' Schumpeterian equation, to which we add other variables on inter-

firm organisation, local spill-over and policy. The dependent variable is the propensity to introduce product innovations.

By using firm level data collected by Mediocredito Centrale, we test the role of these variables in affecting innovation behaviour of firms localised in three different geographical areas: the North West, the North-East-Centre (the, so-called, Third Italy) and the South (Mezzogiorno).

Since our ultimate interest is on regional development and growth, we begin by briefly reviewing some issues related to the role of innovation and technological change in affecting economic growth (section 2). Then, we turn to microeconomic issues related to innovation processes (section 3) emphasising the role of organisational strategies in shaping the creation of new knowledge by firms. From section 4 to section 6 we discuss some traditional issues related to the determinants of innovation: the role of firm size, market structures and technological opportunities (section 4 and 5). In section 6 we treat the role of knowledge spill-over and finally the potential role of public support to innovation (section 7). Then we turn to the empirical analysis. Section 8 introduces the sample, while section 9 describes the distribution of innovative firms within it. Based on the understanding of the most crucial and relevant contributions, a number of hypotheses on the determinants of innovation behaviour of firms are formulated in section 10. Section 11 reports the main findings of the econometric analysis. The last section concludes.

2. Catching up and national/local systems of innovation

Catching up theories introduce a specific conceptualisation of technological change for explaining differences in economic growth between countries. The basic assumption is that “the growth rate of productivity for a country over a period of time is negatively proportional to the level of productivity at the beginning of the period” (Gregersen and Johnson, 1997, p. 10). International movements of capital and transfer of technologies from high to low productivity countries are at the origin of this phenomenon.

Catching up processes, however, are not automatic, since they depend on the ability of countries to exploit technological gaps. Abramowitz (1994) introduces the concept of “social capabilities” as crucial, including country’s

organisational and institutional factors. This concept includes the ability of a country to imitate products realised abroad, as well as the ability to adapt imported technologies to the national context or the capability of importing suitable organisational and institutional forms from abroad. Moreover, catching up economies may show a rapid economic growth and structural change in a rather short period (if they are able to build absorptive/imitative capacity), but sooner or later they face the necessity of building up own indigenous science and technology bases[1].

The new growth theory esteems that investment in technological activities create opportunities for new investments and growth. Each firm learns as a result of own investment as well as of investments of other firms, through knowledge externalities and spill-over (Arrow, 1982). Some empirical studies have showed that knowledge spill-over are often spatially localised (Acs, Audretsch, Feldman, 1994; Jaffe, Trajtenberg and Henderson, 1993). These empirical results are important for understanding the lack of catching up processes among countries and regions. Externalities, referred to the systems in which firms operate, are important for understanding the differences in growth among countries (Stigliz '91).

New approaches for understanding the different results obtained by catching up economies in terms of growth and of specific patterns of development are now receiving growing attention. Among them, the National System of Innovation approach has a strong appeal.

The system of innovation approach does not accept the idea of an automatic and unlimited process of externalities creation. Its main contribution to the growth theory is that, adopting the idea that externalities and spill-over have a positive effect on the firm/industry productivity, the system of innovation approach underlines the relevance of interactions (firm agreement and networks) and of institutional context supporting externalities creation.

Firm behaviour is strongly influenced by "organised market structure", such as the user-producer relation (Lundvall 1988), the industrial cluster characterising a country (Carlsson and Jacobbson 1996), the social based rules and routines (Dosi, 1988).

The firm propensity and capacity of innovation depends on the systems of linkages in which it is embedded, the institutions regulating distribution and

access to knowledge, the organisation of different competencies and technologies combination. Linkages and interactions are a way through which firms change their opinion on the state of the world, opportunities from new combinations appear and the social value of knowledge increase.

3. Innovation systems and firm organisation

The interactions between different actors shapes national technological trajectories. It can be described at three levels: co-operative organisation among firms; cluster of economic agents at intermediary level; relation between knowledge infrastructures and firms. The capacity of exploiting and realising technological opportunities lays in these interactive patterns of knoweledge production:

- localised and firm specific knowledge, that is not only a technical knowledge, but it is mainly organisational. At this level it is important how firms integrate and co-ordinate an heterogeneous range of activities, internally and externally. Firms have not all the necessary competencies and they can have access and use knowledge from outside. The firm can import externally developed technical knowledge through different organisational modes. The purpose is generating a new body of collective knowledge out of the encounter of two or more existing bodies of organisational learning and two or more corporate culture;
- the industrial or sector generic knowledge base: a body of knowledge base and practices in principle available to all firms in an industry. In reality this knowledge is developed and disseminated by institutions and organisation of various kinds (technical infrastructure) and requires firms' internal resources to be absorbed. At this level it is important the analysis of intermediary structures (smaller than a national economy but larger than individual firms) such as cluster and networks, that can be geographically concentrated (Krugman 1991);
- another source of knowledge for firms come from general scientific bases, which are also internally differentiated and influenced by the relations with industry.

All these aspects (firms' external integration, clusters and relations with public scientific institutions) form highly specific national or regional innovation context for innovation.

Issues of organisation, management and strategy have not been jet well integrated in the innovation literature and have still a low prevision strength or they need more research for offering less ambiguous interpretation (Dosi, Marengo Fagiolo, 1996).

We treat these issues by referring to three lines of research:

- the firm competence base literature;
- the literature based on organisational learning;
- the literature on alliances and co-operation.

Transaction cost economics is less relevant, since it is not able to evaluate the relative importance of different forms of inter-firms relations for incentive to engage in innovation. It could be used in an "extended form", in the sense of including problems of conflicts and controls in the organisational analysis. However, as emphasised by Noteboom (1999), an agreement with high transaction costs and high flexibility can be more interesting for a firm than an agreement with low transaction costs and low flexibility.

The firm competence base literature focuses on internal firm specific capabilities. The competitive force of a business enterprise is seen in its collection of difficult to imitate resources and capabilities. But firms do not innovate in isolation, as the innovation system approach suggests. The competence base theory studies organisation in terms of firm boundaries: **internalisation/decentralisation** of intangible assets, choice of making or buy. The competence perspective, which looks at industrial structure "as reflecting efficiency outcomes rather than market power" (Foss 1993) is part of the strategy management literature. But the strategy literature doesn't give an adequate treatment of the collective organisational learning.

One of the scope of inter-firm organisation is generating a new body of collective knowledge out of the encounter of two or more existing corporate cultures. The literature based on organisational learning (which is part of the evolutionary economics) looks at inter-firm relationships in terms of pure co-ordination, without considering conflicts among agents and bargaining power aspects. Four features are relevant in this cognitive approach (Lazaric and Marengo, 1994):

- identifying the connection between integration and performance. The co-ordination is related to communication and problem solving activities among agents with different models of the world;
- communication involves a problem of capacity of communication and knowledge absorption; learning as problem-solving activity involves a question of diversity among partners;
- in order to occur, learning needs some commitments in tangible and intangible investments (social conventions), for co-ordinating diversity of knowledge and for creating some irreversibility which give stability to the inter-firms relation;
- social conventions and collective knowledge emerge and are shaped by the organisational structure. The organisational structure influences how actors process knowledge (Kogut and Zander, 1992). The organisational structure is examined in terms of **centralisation-decentralisation** (top-down or bottom-up) of two types of processes: observation, forecasting and modification of the state of the world, co-ordination of actions.

Organisational design in the organisational learning approach concerns the balance between coherence of the organisation (centralisation) and possibility of exploring new possibilities (decentralised learning). The choice is a function of the uncertainty of the environment: radical change; continuos change according to regular patterns; continuos but unpredictable change. The result concerns the characters of the new knowledge and in particular its general or specific character, tacit or codified and the potentiality of being easily distributed or recombined.

The literature on collaboration and networks looks at them as specific organisational forms and try to explore their potentiality of resources and value creation. Sales and acquisition of capabilities are difficult to organise, since the same strength that enables a firm to extract a rent from its resources makes it difficult for the firm to transfer them to new use (Mowery, 1993). Market channels cannot be the best way for acquiring new capabilities: some assets are not quickly tradable (tacit know how) and firms may stand to gain little when purchasing an asset. The extent to which inter-firm organisation create collective resources depends on its capacity of producing mutual advantages and shaping trust and reciprocity.

Langlois and Robertson (1995) have studied the relations between different types of external integration of firms and innovation and offered a way of predicting how firms will behave. Their methods is useful for at least three reasons:

- they allow to characterise different types of inter-firm organisation on the basis of two axis: ownership integration and co-ordination integration;
- they make a distinction between different types of technological change, that is also a way of considering different degree of uncertainty (parametric, strategic, structural) and associate organisational forms to type of technical change;
- they introduce an element of dynamics, since they assume that the character of technological change evolves during a sort of learning life cycle, therefore also the criteria of organising inter-firm relations evolve, taking into account the necessity of shifting from exploration strategies to exploitation and *viceversa*.

Following them, co-ordination integration (such as in Third Italy industrial districts) is more appropriate when:

- change has a parametric character: change of known variables in known framework;
- innovation is related to a small range of uses (scope is reduced);
- the firm is in a fluid stage of innovation;
- there are external local channels helping firms to communicate or establishing conventional rules and common services.

Co-ordination with ownership integration (Chandler firm and Japanese networks) is more appropriated when:

- there is uncertainty asking for a rearranging of capabilities, but within known boundaries;
- an innovation has acquired a stable design and entered market;

These vertical integration put power problems under control.

Ownership integration (such as in venture capital networks) is more appropriated when:

- the change is radical;
- the scope of innovation is wide;
- the firm is entering a phase of structural change.

When innovation and change have not a parametric nature, ownership co-ordination is necessary, accompanied or not by co-ordination integration. The explication of why is based on the concept of “dynamic transaction costs”. Langlois and Robertson explain it in the following way: most of the theory of firm boundaries is static, since it take the circumstances of production as given; but economic change and innovation can bring the problem of lack of the necessary capabilities. In presence of uncertainty and divergence of expectations, arm’s length arrangement can be costly. “Unpredictable change makes it costly to specify contractual provision, implying the need for expanded residual rights” (Langlois and Robertson 1995 p. 37). They find an accordance with Silver (1984 p. 17) “the costs of co-ordination in a regime of change are the costs of transmitting information that is new in a qualitative sense”. The innovator is motivated to integrate by a desire of appropriating the rent of innovation, but he does so not so much for preventing others from getting the rents, but in order to create rents that otherwise would not exist or would not be great.

4. Schumpeter hypotheses on innovation

Schumpeter conjectured that product market structure coupled with firm size should facilitate the firms’ propensity to innovate, because it could facilitate the retention of rents. Empirical tests on this hypothesis have given controversial results. The schumpeterian determinants of innovation make reference to a tradition in industrial economics where firms conduct derives from industrial structure. The ambiguity of prediction is caused by the fact that there is an unequal distribution of incentive and of capacity to innovate between firms and industries (Coombs, 1988). The market structure seems not to be the primary determinants of pattern of innovation behaviour.

Scherer (1967) arrived to these results studying inter-industrial differences in R/D investments and patenting. He suggested that the most important determinant were the scientific and technological opportunities, which varies largely among industries. Several studies have confirmed this result (Kamien and Schwarz, 1982; Stoneman, 1983). A recent review on empirical studies on innovation (Cohen, 1995 p. 231) has found that "there is

a movement among empirical scholars from a narrow concern with the role of firm size and market structure toward a broader consideration of the determinants of technical change in industry". This wider concern includes some determinants of innovative activities (technological opportunity, appropriability conditions) that have influence on the inter-industry differences in innovative activity over long period. To day, market structure variables are used in studies on the determinants of firm propensity to innovate as complementary to other variables such as managerial efficiency (Bughin and Jacques, 1994) or firms organisation (Veugelers and Cassiman, 1998)

Basically, firms' innovative behaviour and market structure have a two-way relationship influenced by a multiple set of contingencies. In particular, co-operative agreements for innovation facilitate innovation, even when the product market structure could theoretically reduce incentives to innovate (Kay). This is because co-operative mechanisms can free the direction of an innovative activity from the constraints of a market structure.

5. Technological regime and innovation

The importance of inter-industry differences, in terms of sources of knowledge and technological opportunities, as incentive to innovate has been underlined by evolutionary economics. This theory has established a causal relation from the rate and the characteristics of technological change and ease or difficult to imitate innovation to market structure (Nelson and Winter, 1982). Where the rate of technological change is fast and imitation difficult, the tendency towards concentration is stronger.

In a recent paper, Nelson and Wolff (1998) have recognised that behind cross industry differences in technical progress are mainly technological opportunities ("other things being equal the richer the technological opportunities, the more R/D is profitable for firms to fund"), while the appropriability aspect, which is based on the assumption of a maximising firm behaviour, at industrial level doesn't represent an R/D or innovating incentive. In fact what is loose in terms of firm appropriability is gained in terms of externalities among firms. Spillovers from other firms may have the effect of stimulating a firm's R/D or innovative activity, partly

offsetting the disincentive of firm's own imperfect ability of appropriating results (Jaffe, 1988; Cohen and Levinthal, 1990). From the firm point of view intra-industry spillovers enhance technological opportunities.

As to the relation between technological opportunities and market structures, while causalities flowing from the first to the second ones are recognised (the market structure will respond adaptively to technological opportunities through the behaviour of firms), there will be differentiated answers within an industry at product level. In sum it is not easy to read off a set of industrial structure characters directly from a diagnosis of technological opportunities, since the sources of technological opportunities and the mechanisms through which they are applied are complex.

6. Local spill over and linkages : the system level analysis

In the modern innovation theory firm opportunities depend on the "sectoral support system" (Nelson 1996 p. 610). These systems includes strong input suppliers and demanding customers, firms which compete with each other for customer, but also co-operate, for instance establishing standards or collective supporting institutions of trading, brokerage and so on. Clusters and networks of this type allow technological trajectories to become visible and relevant at macro-level (regions or nations).

Such extended industrial nexus can be analysed in terms of linkages or in terms of spill over. In the first case the focus is on the architecture of the clusters. This is studied in terms of connectivity of the constituent parts, concentration, number and types of actors. In the second case the focus is on geographical proximity. These structures are moulded by national institutions, but at a large extent they develop on their track. Networks, such as alliances or firms' external integration have a relevant role since they can compensate for limitations in the firm's search space (bounded rationality and bounded vision) (Jacobbson and Carlsson 1996). They provide a wider set of options and opportunities for a firm, they influence the rate and direction of firms search activities; moreover they provide to diffuse knowledge. Networks and clusters give rise to significant externalities, which are not market mediated and increase return to scale (Dosi et al 1990; Carlsson and Jacobbson 1993); they lie at the hearth of the process of innovation. An initial specialisation

tends in this way to be reproduced and strengthened, resulting in specific local (regional/national) technological development. If the linkages among firms and technologies within an industry or also a group of industries are strong they become the "development block" of a region/nation.

7. The role of public support

The system of innovation approach allows to include non economic factors among the determinants of innovation, i.e. institutional, organisational, social and political factors. There is now a growing literature on public policy and innovation systems and studies on technological catch up patterns recognise in the State intervention one of the key elements co-operating to the result. The State intervention promoting industrialisation (credit allocation and protection of domestic markets) has sustained the large vertically integrated firm model characterising Korea; the Taiwan model, based on the relation between small and medium firms and large public research institute, has been sustained by the State intervention in technology diffusion, promotion of product consortia, standardisation and procurement (Wong, 1999).

It is now largely accepted that the effectiveness of public policies on innovation depends on the capacity of policy makers of a comprehension of innovation as system. The linear approach was based mainly on scientific research funding; this is still fundamental, but many other tools are necessary. Redesigning organisations, institutions and their relations can be a more important policy instruments than subsidies and other financial incentives (Edquist, 1999). Smith (1999) suggests some main failures (different from market failures) as point of departure for policy intervention: failure in infra-structural provision and investments; transition failures or the necessity of pushing technological opportunities and markets in new areas; lock-in failures or change in integrated technologies; institutional failures: for instance the legal system regulating contracts or property rights.

Public intervention in Europe and in Italy is still mainly based on financial incentives to industry and one way of studying its impact has been looking at its differential effects on more and less advanced situation: small and medium firms, the Southern regions. For instance this policy in Italy has not significantly modified the vicious circle of low dynamic geographical systems.

Policy intervention on linkages (connections among complementary activities; among university and industry), competence enhancing activities, public procurement can be more important determinants of industrial propensity to innovate than financial incentives and market structure (Malerba, 1999).

8. The sample

The empirical objective of this paper is to assess regional differences of innovation behaviour of firms in Italy. The work draws on a rich data set of firm level observations collected by Mediocredito Centrale (1995) for the period 1992-1994. This survey covered a sample of about 4,400 manufacturing firms operating in Italy with more than 10 employees and all firms with more than 500 employees. The sample is random and stratified according to the size of the firm, in terms of number of employees, and the sector. Furthermore, the sample is representative at a regional level.

The distribution of the sample by region, sector and size class confirms the well known characteristics of the industrial structure in Italy (Sapelli, 1992). The North West area is characterised by the presence of a small core of oligopolistic firms operating in heavy industries and scale production, which, through their demand of capital equipment, sustain the development of capital goods producers. In the recent past, this kind of industrial development was driven by two main factors: 1) a process of corporate diversification in large firms; 2) the development of mechanical competencies specifically biased towards capital equipment production, with a learning-by- interacting trajectory guided by user-suppliers relationships. This virtuous circle of growth fostered also the birth of a new wave of firms in traditional sectors (textile, wood products, leather and shoes).

In the Third Italy (North-East-Centre regions) the specialisation in traditional sectors and in small size classes has followed a specific path: the flexible specialisation model. This type of industrial development has been characterised by an autonomous entrepreneurial development and by the presence of systematic factors fostering the opportunity of reaching and maintaining small scale productions (Barca and Magnani, 1989). Small firms have been organised in local systems, different from the Marshallian industrial districts, since they shared a common culture and created collective institutions, which allowed a co-ordination of activities and the possibility of exploiting scale economies through collaborations. Such a model of industrial development has been based on three types of interactions: among competitors, with capital goods suppliers and with users. The limit of this model stays in its strong inertia: it tends to reproduce itself along the same paths. Some scholars sustain that this model of development, that offers still a competitive advantage at international level, is reaching its limit of growth (Varaldo, Bellini, Bonaccorsi, Riccaboni, 1998). It seems to need some organisational innovation, from small-family managed firms to the organisation of groups with a leader enterprise and larger industrial size.

The South (Mezzogiorno) has experimented a dualistic industrial development: on the one side the heavy, large scale industries sustained by the State, on the other side small sized firms specialised in traditional sectors. The two main limits of this pattern of industrial development are: the low presence of specialised suppliers and the very low number and isolation of systems of small firms. Some scholars have built a sort of demography of industrial districts in Italy (Brusco and Paba, 1997, p. 286). According to these studies, systems of small firms, which were present in the 1951 Census in the South, disappeared in the next one, probably as consequence of competition from the North and Third Italy firms on their local market. But new systems of small firms were registered at the 1991 Census, concentrated in two Southern regions: Puglia and Molise. Moreover, a process of learning by interacting seems to operate in the South through the diffusion of subcontracting agreements. However, this kind of subcontracting agreements are quite different from those operating in the North of the country, since they do not imply externalisation of research, design and engineering and are

characterised by low levels of autonomy. However, subcontracting from large firms remain an important means of knowledge transfer even in the South.

9. The distribution of innovative firms

As proxy of innovation activity, we use the propensity of firms to introduce product innovations. Mediocredito survey asks firms whether they introduced a) only a product innovation, b) only a process innovation, c) both, or d) no type of innovation during the period 1992-1994. As well known, changes in product and processes imply different risks and uncertainties for the firm. Process innovations concern changes in the production techniques and the uncertainty is related to the engineering dimension. Product innovations concern new or improved products that face uncertainties of market acceptance and identify a more complex innovation strategy (Archibugi and Evangeslista), including problems of building up new capabilities. Product and process innovations are nevertheless often closely intertwined and difficult to be separated. In particular, product innovations are rarely introduced without a process innovation. The results of Mediocredito survey confirm this empirical regularity. Thus, we classified as "innovative" those firms belonging to the intersection of the sets a) and c).

About 40% of firms have introduced a product innovation during the period of the survey. The distribution by sector suggests that innovative firms are more diffused within science based and specialised suppliers industries rather than within traditional and scale intensive sectors. The distribution by size class shows a higher presence of innovative firms in central size classes (51-250 and 251-500). Such a result suggests the presence of a non-linear (U-shaped) relationship between size and innovation, instead of the strong linear relationship found by Barbieri and Rapiti (1995) using information from the 1990-92 Cis survey. The asymmetric result may be due to the different proxy of innovation used: we focus on product innovations, while Barbieri and Rapiti considered both product and process innovators.

Turning to the distribution of innovative firms within each region, we generally find a higher presence of innovators within NEC regions (Third Italy), rather than in the other geographical areas. A notable exception concerns the medium sized class (251-500) in the South, where we find a percentage of innovating firms higher than the national average.

10. Hypotheses and variables

Different groups of variables are found to be important in innovation decisions. Firstly, we investigate the role of "*firm specific*" factors, focusing on organisational strategies. More precisely, following Robertson and Langlois (1995), as well as other recent contributions to the literature on the relationship between innovation and organisation (Malerba and Orsenigo, 1996), we consider different strategies of external growth (or integration in external networks) which are potentially conductive to innovative activities: acquisitions and group belonging (*ownership strategies*), on the one side, and co-operation (*co-ordination strategies*), on the other, as well as different combinations of them. We call the relative hypotheses as "*organisational theory*" hypotheses.

Other firm specific factors are those suggested by the so called *Schumpeterian hypotheses* on firm size and market structure and other factors which capture specific competencies of firms. Furthermore, we take control of sector specific effects, as suggested by the "*technological regime*" hypothesis (see, for example, Malerba and Orsenigo, 1992; Pavitt, 1984).

Secondly, we analyse the role of factors external to the firm but specific to the province (sub-regional entity) in which it is localised (*region specific* o *environmental* factors). In particular, we investigate the issue of localised technological spill over from public research and agglomeration of innovative firms. We call the relative hypotheses as "*New growth theory*" hypotheses.

Finally, we consider the effect of public support to innovative activities as an important determinant of the probability to innovate. This kind of factor might capture both the ability of the firm to use policy incentives (by this point of view it should be interpreted as a *firm specific variable*) and the efficiency of local institutions in the promotion of the use of these incentives (by this different point of view it should be interpreted as a *regional specific variable*).

In synthesis, our model of innovation is specified as follows:

$$INNOVATION^*_{ij} = \alpha + \beta SIZE_{ij} + \gamma MARKET\ INCENTIVES_{ij} + \delta TECHNOLOGICAL\ REGIME_{ij} + \varepsilon ORGANISATION_{ij} + \zeta SPILLOVERS_j + \eta PUBLIC\ R\&D_j + \theta PUBLIB\ SUPPORT_{ij}$$

Where the subscript *i* indicates the firm (*i = 1…4,431*) and *j* indicates the province (*j = 1 … 95*).

By estimating separate regressions within regions - e.g. one regression for North - Western firms, one for Third Italy (North-East-Centre) firms, and one for Southern firms -, we automatically estimate region-specific effects.

a) "Schumpeterian" hypotheses

As discussed in section 4, Schumpeterian hypotheses concern the role of firm size and market structure in affecting firms' propensity to innovate. This approach maintains that innovative activities are explained by economic incentives and that such incentives are a function of the industrial structure.

Kamien and Schwarz (1982) and Cohen and Levin (1989) and Cohen (1995) have observed the lack of empirical regularities of the role of firm size and market structure for innovative success in econometric tests. Other factors play a relevant role: some latent sectorally specific technological opportunity; local components of techological opportunity, depending on spill-over and externalities effect, firm knowledge absorbing capacity. According to Nelson and Wolff, size and market concentration loose statistical significance after including in the regression some measure of technological opportunity and appropriability. Malerba and Orsenigo (1995, 1997) found that the two Schumpeterian models (Mark 1 and Mark 2) - the first characterised by small firms and concurrence while the second by large firms and oligopoly - correspond to two different groups of sectors. According to these scholars, inter-industry differences in technological regime absorb inter-industry differences in market structure.

In our model the natural logarithm of total number of employees (lnEMP) is used to measure the size. Its quadratic term (lnEMP2) is also included in order to test the presence for non-linearity in the relationship between innovation and size.

Generally, a concentration index (e.g. Herfindhal index) is used as a proxy of the market structure. This is an industry level variable. We claim that there is strong heterogeneity within each industry in the type of competition. Thus, we use the respondent's perception of the intensity of competition within the industry, that is the localisation of competitors (same province: SAMEPRO; European Union countries: EUCOUNTR), as proxy of competitive environment. These are categorical variables defined in an ordinal scale (from zero to four). Our hypothesis is that international competitiveness (and in particular competitiveness within Europe) is based more on research and innovation rather than on price. Hence, it is expected that competitive pressure from foreign firms is more likely to positively affect innovation, than local competition by domestic firms.

b) Technological regime

Malerba and Orsenigo (1995,1997) define a technological regime in terms of technological opportunities (potential for innovation of each technology), appropriability conditions (ability to protect innovation rents), cumulativeness[2] (stability of innovators as to non innovators), and properties of the knoweldge basis (various characters of the knowledge involved in innovation: codified versus tacit; specialised vs. pervasive; simple vs. complex).

In our model we refer to sectors as determinant of the propensity of firms to innovate mainly in the meaning of high/low opportunities, taking into account the sector main sources of knowledge, as indicated in Pavitt (1984) taxonomy. In our opinion, this meaning of opportunity is not absolute, since it changes in different geographical contexts in relation to different strategies of competence development by actors (public research institutes, user demand, supplier competencies) and to the character of their interrelations.

c) Creative/absorptive capacity and quality of internal skills

Firms' propensity to innovate is strongly related to the investment in R/D activity, that, after capital investment, represents the more relevant firms'

expenditure for innovation (1997 Isrds Databook, Elaboration on Cis data). Internal R/D is an internal source of knowledge, but it is also fundamental for identifying, selecting, adopting and transforming external sources of knowledge. In other words, there is a complementary relation between internal and external sources of knowledge (Cohen and Levinthal, 1989; Cassiman and Veugelers, 1998).

We consider institutionalised R/D activities (number of employees to research function, RDINT) and skilled or highly educated (SKILL) human resources as indicators of the firm general capacity of innovating.

d) Organisational strategies

Different organisational strategies may be pursued by the firm in order to innovate. They correspond to different external sources of knowledge, as well as to different external growth strategies: 1) acquisition of other firms; 2) group belonging; 3) licensing; 4) technological and commercial collaborations; 5) subcontracting alliances.

Mediocredito survey allows us to consider all these strategies. Therefore, different dummy variables have been considered:

1. *Acquisition*: 1 if the firm purchased another firm;
2. *Group:* 1 if the firm belongs to a business group;
3. *Licencing*: 1 if the firm acquired technology through licensing;
4. *Technological collaboration*: 1 if the firm acquired technology through technological alliances with other firms within the country and/or abroad;
5. *Commercial collaboration*: 1 if the firm established a commercial collaboration with other firms within the country and/or abroad;
6. *Subcontracting alliances*: 1 if the firm established subcontracting alliances.

Then, following Robertson and Langlois (1995), we classified acquisition and group belonging as *ownership integration strategies*, while licencing, technological, commercial, and subcontracting alliances as *co-ordination integration strategies*. Thus, firms have been classified in four different groups:

a) Co-ordination integrated firms;
b) Ownership integrated firms;
c) Both co-ordination and ownership integrated firms;

d) “Isolated firms” (the reference category).

A simple analysis of Mediocredito data suggests that product innovation is mainly a collective process. In all geographical areas, isolated firms innovate less than firms with external growth opportunities. Interestingly, the South is characterised by a higher presence of isolated firms. This is coherent with the economic development of the South: autonomous firms are rarely organised in systems or districts.

Co-ordination integration strategies, both alone and in combination with ownership strategies, seem to be the dominant organisational patterns among innovative firms, although some regional differences are evident: “only co-ordination integration” strategies prevail among innovative firms localised in the North West as well as in the Third Italy, while “combined strategies” (both co-ordination and ownership integration) prevail among innovative firms localised in the South.

Ownership integration strategies by themselves do not show a strong relation with innovation behaviour. Moreover, ownership strategies are less represented among innovating than among non-innovating firms. This may indicate that ownership strategies by themselves are mainly motivated by reasons different from innovation, such as the opportunity to export, the accessibility to financing sources, the accessibility to public supports (Barbetta, Viga, Vivarelli, 1996, p. 61). Indeed, business groups are a very diffused form of organisation in Italy. According to Barca et al. 1994, about 51% of firms with more than 50 employees belongs to a business group. In our sample, 31,7% of firms belong to a group and about the same percentage in the traditional and specialised suppliers sector.

e) “New growth theory” hypotheses: spill over from public research and agglomeration of innovative firms

Competitiveness has a systemic dimension: it depends not only on firm capacity and strategy but also on the interaction between firms and the capabilities of the external environment. These can be observed in terms of linkages with principal education-research institutions and with other firms or, as we do, in terms of spill over, deriving from agglomeration of innovative

firms and of research institutions. This type of externality contributes to speed up learning processes and technological diffusion.

Our measure of technological spill over is given by the number of innovative firms on total number of firms ratio and by the number of public research institutions (university departments plus CNR institutes) localised within the province where the firm operates.

e) Public support

As discussed in section 7, public financial support may have a strong impact on the probability to introduce an innovation. In Italy there are different financial instruments by which the State support innovative activities of firms. First, one of the most important form is a public support to investment in industrial machinery for small and medium sized firms (L. Sabatini 1329/65). A second important public intervention (L. 317/91) includes a set of instruments aimed at promoting development, competitiveness and innovation of small and medium sized firms. A third public instrument (L. 46/82), is aimed at financing either applied research or technological innovations. Mediocredito collected information on the use of these instruments: dummy variables indicate whether the firms has used the Lex Sabatini (*INSABATI*), the Lex 317/91 (*IN317*), or the Lex 46/82 either for applied research (*INL4682A*) or for technological innovations (*INL4682B*).

11. Econometric results

Firstly we introduce the results of the hypothesis testing for the country as a whole ; it is also a benchmark for the regional comparison.

Using a 'from specific to general' strategy, we present four different nested models. The baseline case (column 1) introduces only "size, competitive environment and technological regime" as well as regional dummy control variables (the reference category is NEC: the firm localised in a Norh-East-Centre region). This model sum up the specification generally used in the so-called Schumpeterian literature. The advantage of beginning with a specification that is similar to others employed in the literature is that we can first check if there are peculiarities in our sample of Italian

manufacturing data, resulting in different estimated effects for regressors that have been found previously. Moreover, starting from a common framework, we can determine the contribution that other variables bring to the estimates.

The following three columns list the coefficients when organisational variables (column 2), spill over and public R&D variables (column 3) and public innovation support variables (column 4) are added sequentially. First note that the inclusion of these different groups of variables improves the fit of the model: the log likelihood starts at –2,578 in the baseline case and improves in each successive column (especially in the third one), ultimately reaching –2,485.

Turning to the coefficient estimates, in the baseline model (**column 1**) both SIZE and SIZE2 are significant and have opposite signs. These results confirm the presence of a non linear (U shaped) relationship between the likelihood to innovate and firm size. The hypothesis that firms competing in oligopolistic markets are more likely to innovate (the second Schumpeterian hypothesis) is also confirmed (EUROP is positive and highly significant, while SAMEPRO is not significant).

Moreover a higher presence of skilled workers and workers devoted to R&D activity within the firm strongly affects the probability of introducing new products.

The three sector dummy variables (TRADITIONAL, SCALE INTENSIVE, and SPECIALISED SUPPLIER), which approximate different technological regime, are all significantly negative (the reference category is SCIENCE BASED).

It is important to underline that, differently from the results of Nelson and Wolf and Malerba and Orsenigo (1995, 1997), the two Schumpeterian hypotheses are confirmed even controlling for technological regime.

As far as organisational strategies are concerned (**column 2**), the results suggest that co-ordination strategies and combinations of ownership and co-ordination strategies are both conductive to innovation, while ownership strategies by themselves have no impact on the probability to introduce new products.

Spill over from other firms localised in the same province are very important sources of knowledge, while being localised near either a university department or a CNR institute is not relevant for the innovation performance

of the firm (**column 3**). The last result does not mean, however, that public research is not important for the innovative success of private manufacturing firms. Indeed, it is reasonable to think at the public research output as highly codified, so that this new knowledge may be easily transferred far away from its creating source. In other words, spill over from public research are not localised and geographical proximity is not relevant.

Finally, public support is a very important factor for product innovation of Italian firms. Particularly important are Lex 46a and Lex 46b, financing industrial applied research and development activity.

Now, we turn to the estimation results for each region. The best way to discuss them is, probably, by comparing the coefficient estimates for each variable or group of variables. First note that size and market structure variables act at the regional level as they do for the country as a whole (column 2). Thus, a U-shaped relationship between size and product innovation is confirmed for each geographical area; and the coefficient of EUROP is always positive. The only slight difference concerns the level of significance of this variable for the South ($p<0.05$ instead of 0.01).

All the other following variables help in discriminating among regions and their different propensity to innovate.

Skilled and R&D workers seem to play a determinant role only for the North Western firms. In the "Third Italy" sub-sample the coefficient of SKILL looses significance when organisational variables are introduced. In the case of Southern firms, neither SKILL nor R&DEMP enter significantly in the probit estimation.

As to sector, interestingly the coefficient of Specialised Supplier is not significantly different from zero for the North West and the Third Italy, while it is still negative for the South, confirming the lack of machine-tool producers within this area. Moreover, Southern firms operating in traditional and scale intensive sectors are not less likely to innovate than Southern firms operating in science based sectors.

As far as organisational variables are concerned (column 3), we observe some important results. In synthesis:

- firstly, coherently with national average results, in all geographical areas ownership strategies by themselves seem not to play any significant role for innovation success;

- secondly, in the North West co-ordination strategies by themselves are slightly more conductive to innovation than combined (co-ordination and ownership) strategies;
- thirdly, in the North East Centre as well as in Southern regions we find the opposite, i.e. combined strategies are slightly more conductive to innovation than only co-ordination strategies;
- finally, for the South, organisational variables loose significance after the introduction of SPILLOVERS and PUBLIC R&D variables.

Other important regional differences concern the specific role of various public support to innovation. While in the North West the Lex 46/82b (financing industrial R/D activity) seems to be more important, in the Third Italy the Lex Sabatini (financing investments) plays a more relevant role for innovation performance. However, the most important result concerns the South: there is no significant effect of public support on the innovation success of firms operating in Southern regions. This evidence may be interpreted in a dual way: first, Southern firms are not able to exploit public incentive for innovation; second, local institutions do not efficiently promote the use of the innovation incentive system.

12. Discussion and Conclusions

In this paper we have tried to understand which factors affect innovation behaviour of firms localised in three different geographical areas in Italy: the North West, the North-East-Centre (the so-called, Third Italy), and the South (Mezzogiorno). We started from the baseline “Schumpeterian” model, which stress the role of i) firm size and ii) market structure in determining innovation performance of firms. These hypotheses have been confirmed for all three areas: i) everywhere, a non-linear (U-shaped) relationship between innovation and firm size seems to occur; and ii) competing with foreign (European) firms, rather than with firms localised within the same region, is always a strong market incentive to innovate.

Other variables have been found to help in discriminating innovation behaviour of firms localised in different regions. Firstly, we found that the relationship between innovation and firm organisation (i.e. firm strategies of external growth) differ among regions. In the North West, external integration

through co-operation (or co-ordination) strategies is the organisational form most conductive to innovation success; in the Third Italy and in the South, combined strategies, that is strategies of both co-operation and ownership integration, are the most related to innovation performance.

As far as the sector is concerned, we found that while in the North firms operating in traditional and scale intensive sectors are less innovative than other firms, in the South the so-called specialised suppliers are less innovative.

Other factors which have been found to have a different role in different regions are related to the public innovation support system. Indeed , comparing the North West and the North-East-Centre, we observed that innovative firm operating in each of the two areas use a different public support instrument. Finally we found that no public innovation support system plays a significant role in the determination of the innovative success of firms localised in the Southern regions.

Table 1 – Sample: Distribution of firms by region, sector and size

	Traditional	***Scale Intensive***	***Specialised Suppliers***	***Science Based***	***Total***
	ITALY				
11-50	951	655	286	59	1951
	48,7	*33,6*	*14,7*	*3,0*	*100,0*
	48,1	*42,8*	*39,2*	*30,4*	*44,0*
51-250	802	579	323	58	1762
	45,5	*32,9*	*18,3*	*3,3*	*100,0*
	40,6	*37,8*	*44,3*	*29,9*	*39,8*
251-500	117	106	60	29	312
	37,5	*34,0*	*19,2*	*9,3*	*100,0*
	5,9	*6,9*	*8,2*	*14,9*	*7,0*
more than 500	106	192	60	48	406
	26,1	*47,3*	*14,8*	*11,8*	*100,0*
	5,4	*12,5*	*8,2*	*24,7*	*9,2*
Total	1976	1532	729	194	4431

	44,6	*34,6*	*16,5*	*4,4*	*100,0*
	NORTH WEST				
11-50	317	252	116	24	709
	44,7	*35,5*	*16,4*	*3,4*	*100,0*
	40,1	*38,9*	*35,5*	*27,9*	*38,3*
51-250	358	240	150	23	771
	46,4	*31,1*	*19,5*	*3,0*	*100,0*
	45,3	*37,0*	*45,9*	*26,7*	*41,6*
251-500	60	46	34	11	151
	39,7	*30,5*	*22,5*	*7,3*	*100,0*
	7,6	*7,1*	*10,4*	*12,8*	*8,2*
more than 500	56	110	27	28	221
	25,3	*49,8*	*12,2*	*12,7*	*100,0*
	7,1	*17,0*	*8,3*	*32,6*	*11,9*
Total	791	648	327	86	1852
	42,7	*35,0*	*17,7*	*4,6*	*100,0*

	Traditional	***Scale Intensive***	***Specialised Suppliers***	***Science Based***	***Total***
	THIRD ITALY				
11-50	525	308	144	20	997
	52,7	*30,9*	*14,4*	*2,0*	*100,0*
	53,6	*43,6*	*40,8*	*26,7*	*47,2*
51-250	368	279	155	25	827
	44,5	*33,7*	*18,7*	*3,0*	*100,0*
	37,6	*39,5*	*43,9*	*33,3*	*39,1*
251-500	45	52	23	14	134
	33,6	*38,8*	*17,2*	*10,4*	*100,0*
	4,6	*7,4*	*6,5*	*18,7*	*6,3*
more than 500	41	68	31	16	156
	26,3	*43,6*	*19,9*	*10,3*	*100,0*
	4,2	*9,6*	*8,8*	*21,3*	*7,4*
Total	979	707	353	75	2114
	46,3	*33,4*	*16,7*	*3,5*	*100,0*
	SOUTH				
11-50	102	83	23	6	214
	47,7	*38,8*	*10,7*	*2,8*	*100,0*
	52,3	*51,6*	*53,5*	*28,6*	*51,0*
51-250	73	58	15	10	156
	46,8	*37,2*	*9,6*	*6,4*	*100,0*

	37,4	*36,0*	*34,9*	*47,6*	*37,1*
251-500	11	7	3	2	23
	47,8	*30,4*	*13,0*	*8,7*	*100,0*
	5,6	*4,3*	*7,0*	*9,5*	*5,5*
more than 500	9	13	2	3	27
	33,3	*48,1*	*7,4*	*11,1*	*100,0*
	4,6	*8,1*	*4,7*	*14,3*	*6,4*
Total	195	161	43	21	420
	46,4	*38,3*	*10,2*	*5,0*	*100,0*

Table 2 –Distribution of innovative firms by region, sector and size

	Traditional	***Scale Intensive***	***Specialised Suppliers***	***Science Based***	***Total***
	ITALY				
11-50	*29,2*	*29,6*	*39,9*	*61,0*	*31,9*
51-250	*42,8*	*48,0*	*60,1*	*63,8*	*48,4*
251-500	*39,3*	*48,1*	*58,3*	*51,7*	*47,1*
more than 500	*31,1*	*32,3*	*33,3*	*45,8*	*33,7*
Total	*35,4*	*38,2*	*49,8*	*56,7*	*39,7*
	NORTH WEST				
11-50	*28,7*	*30,6*	*40,5*	*58,3*	*32,3*
51-250	*41,9*	*42,5*	*57,3*	*69,6*	*32,9*
251-500	*30,0*	*56,5*	*50,0*	*54,5*	*44,4*
more than 500	*30,4*	*30,9*	*25,9*	*28,6*	*29,9*
Total	*34,9*	*36,9*	*48,0*	*51,2*	*38,7*
	THIRD ITALY				
11-50	*31,2*	*30,5*	*43,1*	*60,0*	*33,3*
51-250	*44,0*	*54,5*	*68,4*	*60,0*	*52,6*

251-500	*48,9*	*40,4*	*65,2*	*50,0*	*48,5*
more than 500	*29,3*	*38,2*	*38,7*	*68,8*	*39,1*
Total	*36,8*	*41,4*	*55,2*	*60,0*	*42,2*
	SOUTH				
11-50	*20,6*	*25,3*	*17,4*	*66,7*	*23,4*
51-250	*39,7*	*39,7*	*13,3*	*60,0*	*38,5*
251-500	*54,5*	*57,1*	*100,0*	*50,0*	*60,9*
more than 500	*44,4*	*15,4*	*50,0*	*66,7*	*33,3*
Total	*30,8*	*31,1*	*23,3*	*42,9*	*31,7*

Table – Distribution of firms by region and organisational strategy

	Isolated firms	**Only co_ordination**	**Only ownership**	**Co_ordination and Ownership**
Italy	*37,2*	*26,4*	*19,1*	*17,4*
North West	*35,7*	*25,6*	*21,3*	*17,3*
Third Italy	*36,6*	*28,4*	*17,1*	*17,9*
South	*48,6*	*17,4*	*20,0*	*14,0*

Table – Distribution of innovative firms by region and organisational strategy

	Isolated firms	**Only co_ordination**	**Only ownership**	**Co_ordination and Ownership**
Italy	*30,3*	*29,5*	*14,8*	*25,4*
North West	*28,8*	*30,9*	*15,9*	*24,4*
Third Italy	*31,0*	*29,1*	*13,9*	*26,0*
South	*35,3*	*23,3*	*15,8*	*25,6*

Table – Public support: distribution of firms by region and use of innovation public support (*percentages*)

	Legge Sabatini 1329/65	**Legge 317/91**	**Legge 4682A**	**Legge 4682A**
Italy	*19.1*	*7.4*	*2.5*	*4.8*
North West	*22.1*	*6.9*	*2.3*	*5.9*
Third Italy	*19.5*	*8.5*	*2.9*	*4.4*
South	*3.8*	*1.7*	*1.2*	*1.7*

Table – Public support: distribution of innovative firms by region and use of innovation public support (*percentages*)

	Legge Sabatini 1329/65	**Legge 317/91**	**Legge 4682A**	**Legge 4682A**
Italy	*22.2*	*9.4*	*5.0*	*8.4*
North West	*23,2*	*10,1*	*4,6*	*10,6*
Third Italy	*24.2*	*10.0*	*5.5*	*7.3*
South	*3,0*	*2,3*	*3,8*	*3,8*

Table - Variables

Variable	Description
Size, competitive environment and technological trajectories	
LnEMP	
LnEMP2	
SKILL	
R&DEMP	
SAMEPRO	
EUROP	
NORTH WEST	
SOUTH	
TRADITIONAL	
SCALE INTENSIVE	

SPECIALISE SUPPLIER	
Organisational variables	
ONLY_COORDINATION	
ONLY_OWNERSHIP	
COORD.&OWNERSHIP	
Spillovers and public R&D	
SPILLOVERS	
PUBLIC R&D	
Public support	
INCENTIVE_L.SABATINI	
INCENTIVE_L.317	
INCENTIVE_L.4682A	
INCENTIVE_L.4682B	

Table - Italy: Determinants of the probability to innovate

(marginal effects and t values in parenthesis)

Variable	(1)	(2)	(3)	(4)
Size, competitive environment and technological trajectories				

LnEMP	+0.280*** (6.65)	+0.280*** (6.63)	+0.270*** (6.44)	+0.260*** (6.07)
LnEMP2	-0.025*** (-5.35)	-0.025*** (5.40)	-0.024*** (-5.27)	-0.024*** (-5.05)
SKILL	+0.005*** (3.17)	+0.004*** (2.78)	+0.004*** (2.64)	+0.004*** (2.67)
R&DEMP	+0.002*** (4.20)	+0.002*** (4.00)	+0.002*** (4.13)	+0.002*** (3.01)
SAMEPRO	0.003 (0.42)	0.001 (0.10)	-0.001 (-0.06)	-0.002 (-0.30)
EUROP	+0.053*** (6.44)	+0.049*** (5.93)	+0.048*** (5.68)	+0.046*** (5.52)
SOUTH	-0.069*** (-2.48)	-0.060*** (-2.15)	+0.001 (0.77)	+0.035 (1.15)

TRADITIONAL	-0.180*** (-4.12)	-0.169*** (-3.81)	-0.164*** (-3.55)	-0.162*** (-3.50)
SCALE INTENSIVE	-0.162*** (-3.69)	-0.151*** (-3.42)	-0.150*** (-3.26)	-0.153*** (-3.32)
SPECIALISE SUPPLIER	-0.078* (-1.72)	-0.078* (-1.70)	-0.08* (-1.68)	-0.089* (-1.85)
Organisational variables				
ONLY_COORDINATION		+0.092*** (4.62)	+0.094*** (4.65)	+0.09*** (4.50)
ONLY_OWNERSHIP		-0.022 (-0.86)	-0.023 (-0.88)	-0.021 (-0.85)
COORD.&OWNERSHIP		+0.100*** (3.85)	+0.095*** (3.63)	+0.086*** (3.25)
Spillovers and public R&D				
SPILLOVERS			+0.008*** (7.90)	+0.009*** (7.92)

PUBLIC R&D			-0.007 (-1.58)	-0.007 (-1.59)
Public support				
L.SABATINI				+0.039* (1.86)
L.317				+0.035 (1.16)
L.4682A				+0.181*** (2.96)
L.4682B				+0.109*** (2.65)
% of correct predictions	0.64	0.65	0.65	0.65
Log likelihood	-2,582	-2,562	-2,500	-2,486

Table - North West: Determinants of the probability to innovate

(marginal effects and t values in parenthesis)

Variable	(1)	(2)	(3)	(4)
Size, competitive environment and technological trajectories				
LnEMP	+0.20*** (3.35)	+0.20*** (3.28)	+0.189*** (3.05)	+0.177*** (2.80)

LnEMP2	-0.016*** (-2.41)	-0.016*** (-2.38)	-0.014*** (-2.18)	-0.014*** (-2.08)
SKILL	+0.004* (1.62)	+0.004* (1.43)	+0.004* (1.51)	+0.004* (1.56)
R&DEMP	+0.001** (2.18)	+0.001** (2.06)	+0.001** (2.06)	+0.001 (1.32)
SAMEPRO	0.018 (1.56)	0.018 (1.51)	0.017 (1.50)	0.017 (1.45)
EUROP	+0.051*** (4.17)	+0.046*** (3.69)	+0.045*** (3.59)	+0.045*** (3.48)
TRADITIONAL	-0.20*** (-2.95)	-0.19*** (-2.80)	-0.19*** (-2.76)	-0.184*** (-2.64)
SCALE INTENSIVE	-0.17** (-2.48)	-0.17** (-2.42)	-0.16** (-2.31)	-0.16** (-2.28)
SPECIALISE SUPPLIER	-0.097 (-1.38)	-0.100 (-1.42)	-0.100 (-1.34)	-0.102 (-1.42)

Organisational variables				
ONLY_COORDINATION		+0.136*** (4.39)	+0.143*** (4.57)	+0.135*** (4.28)
ONLY_OWNERSHIP		+0.024 (0.61)	+0.032 (0.79)	+0.038 (0.95)
COORD.&OWNERSHIP		+0.095** (2.39)	+0.103*** (2.56)	+0.090*** (2.23)
Spillovers and public R&D				
SPILLOVERS			+0.10** (2.70)	+0.010** (2.91)
PUBLIC R&D			-0.001* (-1.89)	-0.001* (-1.95)
Public support				
L.SABATINI				+0.028 (0.89)
L.317				+0.070 (1.45)
L.4682A				+0.158* (1.71)

L.4682B				+0.156*** (2.79)
% of correct predictions	0.63	0.64	0.64	0.65
Log likelihood	-1,074	-1,063	-1,059	-1,050

Table - Third Italy: Determinants of the probability to innovate
(marginal effects and t values in parenthesis)

Variable	(1)	(2)	(3)	(4)
Size, competitive environment and technological trajectories				
LnEMP	+0.375*** (5.76)	+0.379*** (5.80)	+0.383*** (5.80)	+0.364*** (5.44)
LnEMP2	-0.037*** (-4.99)	-0.037*** (-5.07)	-0.038*** (-5.14)	-0.037*** (-4.86)
SKILL	+0.004* (1.70)	+0.003 (1.45)	+0.003 (1.26)	+0.003 (1.33)
R&DEMP	+0.005*** (3.98)	+0.005*** (3.96)	+0.005*** (4.13)	+0.004*** (3.39)

SAMEPRO	-0.013 (-1.23)	-0.015 (-1.38)	-0.019* (-1.70)	-0.021* (-1.89)
EUROP	+0.057*** (4.81)	+0.056*** (4.67)	+0.051*** (4.28)	+0.051*** (4.21)
TRADITIONAL	-0.156** (-2.23)	-0.146** (-2.07)	-0.140** (-1.95)	-0.140** (-1.95)
SCALE INTENSIVE	-0.147** (-2.09)	-0.137** (-1.92)	-0.143** (-1.98)	-0.149** (-2.07)
SPECIALISE SUPPLIER	-0.021 (-0.28)	-0.022 (-0.31)	-0.038 (-0.51)	-0.048 (-0.64)
Organisational variables				
ONLY_COORDINATION		+0.050* (1.75)	+0.051* (1.77)	+0.051* (1.74)
ONLY_OWNERSHIP		-0.053 (-1.39)	-0.062 (-1.59)	-0.061 (-1.56)

COORD.&OWNERSHIP		+0.084** (2.21)	+0.084** (2.17)	+0.077** (2.00)
Spillovers and public R&D				
SPILLOVERS			+0.008*** (6.06)	+0.008*** (5.95)
PUBLIC R&D			+0.000 (0.05)	+0.000 (0.01)
Public support				
L.SABATINI				+0.057** (1.92)
L.317				+0.009 (0.22)
L.4682A				+0.163* (1.85)
L.4682B				+0.049 (0.75)
% of correct predictions	0.64	0.64	0.64	0.64
Log likelihood	-1,237	-1,230	-1,211	-1,206

Table - South: Determinants of the probability to innovate
(marginal effects and t values in parenthesis)

Variable	(1)	(2)	(3)	(4)

Size, competitive environment and technological trajectories				
LnEMP	+0.406*** (2.66)	+0.426*** (2.72)	+0.437*** (2.80)	+0.447*** (2.85)
LnEMP2	-0.038** (2.19)	-0.041** (2.34)	-0.043** (2.47)	-0.044** (2.51)
SKILL	+0.008 (1.48)	+0.008 (1.38)	+0.008 (1.54)	+0.008 (1.52)
R&DEMP	+0.004 (1.31)	+0.004 (1.09)	+0.005 (1.46)	+0.005 (1.49)
SAMEPRO	+0.018 (0.65)	+0.018 (0.65)	+0.004 (0.16)	+0.007 (0.26)
EUROP	+0.063** (2.03)	+0.061** (1.93)	+0.069** (2.18)	+0.070** (2.13)
TRADITIONAL	-0.147 (-1.23)	-0.125 (-1.03)	-0.136 (-1.12)	-0.139 (-1.12)
SCALE INTENSIVE	-0.112 (-0.93)	-0.086 (-0.71)	-0.101 (-0.84)	-0.102 (-0.83)

SPECIALISE SUPPLIER	-0.301** (-2.21)	-0.294** (-2.14)	-0.315** (-2.29)	-0.323** (-2.28)
Organisational variables				
ONLY_COORDINATION		+0.133** (2.01)	+0.104 (1.56)	+0.102 (1.51)
ONLY_OWNERSHIP		-0.074 (-0.99)	-0.056 (-0.76)	-0.058 (-0.77)
COORD.&OWNERSHIP		+0.163** (1.95)	+0.132 (1.56)	+0.128 (1.50)
Spillovers and public R&D				
SPILLOVERS			+0.011*** (3.91)	+0.011*** (3.89)
PUBLIC R&D			-0.000 (-0.26)	-0.000 (-0.28)
Public support				
L.SABATINI				-0.111 (-0.83)

L.317				-0.086 (-0.43)
L.4682B				-0.059 (-0.26)
% of correct predictions	0.70	0.72	0.74	0.74
Log likelihood	-223	-217	-207	-206

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[1] This is summarised in a recent Oecd (1997) progress report on National innovation systems in catching up economies: "The growth trajectory in the past has been mainly determined by the import of technology in various forms. It seems that the conditions under which the inflows of technology can be exploited have been changed and increasingly need matching efforts on the side of the recipient countries; that the potential to exploit this type of growth trajectory itself has reached some limits and warrants change towards more genuine innovation efforts".

[2] It is based on the possibilities that new innovations are built on the past ones. At industrial level it is based on the existence of spillovers, imitation and co-operation and it allows that firms in sectors with low opportunities be innovators (Malerba and Orsenigo, 1990).