Disentangling the Innovation – Internalization Process Through a Structural Equation Model

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Abstract: Innovation virtuously impacts on the degree of international growth, which in turn positively influences innovation activities and then firms' performance. Many authors have tried to identify and explain the relationship between these two phenomena at firm level. Only recently, few empirical studies investigate them at a more aggregate level. Moreover the literature focuses only on one direction of causality, while scant attention has been paid to inspect empirically innovation and internationalization together. This paper provides an empirical analysis of the mutual relationship of these two phenomena, taking into account various features of the regions themselves. The empirical study is based on a statistical analysis conducted on data concerning 20 Italian regions covering the period 1999-2008. To better understand the complex relationship between internationalization and innovation, we refer to the Structural Equation Models (SEM). These are multivariate regression type models, in which response variables could in turn act as dependent and predictor within a system of equations, and all variables are assumed to influence one-another reciprocally, either directly or through other variables as intermediaries.

1. INTRODUCTION

Many regions in advanced countries have been challenged in the past years by the processes of globalization and industrial restructuring. There is a strong imperative for firms to innovate (i.e., to renew their product structure, technology and organizational practices) as well as, to internationalize. Arguably, innovation and internationalization are the main engines and sources of sustainable and stable growth over the long term.

This paper provides an empirical analysis of relationship between internationalization and innovation and how they reinforce each other at regional level. To the best of our knowledge, there are currently very few studies addressing this issue. And, furthermore, such an investigation has not been undertaken at the European regional level and should permit us to answer two main questions: the eventual complementarities between innovation and internationalization;. The answer to this question have undeniably important implications with regard to industrial policy making.

To better understand the complex relationship between internationalization and innovation, we refer to the Structural Equation Models (SEM). These are multivariate regression type models, in which response variables could act as dependent and predictor within a system of equations, and all variables are assumed to influence one-another reciprocally, either directly or through other variables as intermediaries (BOLLEN, 1989; MC ADAM et al., 2010). The empirical study is based on a statistical analysis conducted on data concerning 20 Italian regions, covering the period 1999-2008. Italy, being a country with marked regional asymmetries, provides an appropriate setting to conduct the research. Within the European arena, the heterogeneity of socioeconomic conditions among the 20 Italian regions is a clear example of the kind of intra-border imbalances that are likely to affect internationalization and innovation prospects (BASILE et al., 2003).

The remainder of this paper is organized as follows. Section 2 reviews the literature and set up the conceptual model. Section 3 describes the empirical setting, the model and the data. Section 4 discusses the econometric findings, and the conclusion derives policy implications and suggestions for future research.

2. INNOVATION AND INTERNATIONALIZATION OF REGIONS

Innovation and internationalization are the main engines and sources of sustainable and stable growth over the long term. This idea led to argue that innovation and internationalization are the challenges for Europe in a changing World. An interesting question is whether innovation and internationalization activities are complementary or substitutive (Kyläkeiko et al., 2010)

2.1. Innovation and internationalization: mutual relationship

Innovation activities reflect the firm's endeavor to use unexploited opportunities by developing new products and business models, improving processes, or generating novelty by creating "new combinations" from existing components. Likewise, internationalization can be regarded as a strategy enabling the firm to exploit new profitable opportunities outside its domestic market.

Several authors have tried to identify and explain the determinants of innovation and the determinants of internationalization. These studies, which are mainly at firm level, suggest that innovation and internationalization affect each other in different ways. Innovation virtuously impacts on the degree of international growth, which in turn positively influences innovation activities and then firms' performance (FILIPESCU et al., 2009). Existing literature suggests that a circular relationship between the two phenomena seems to exist (KOTABE et al. 2002; KAFOUROS et al. 2008). However, very few authors study the bi-directional relationship between the two phenomena (FILIPPETI et al., 2009).

In this paper we examine the complex innovation-internationalization relationships and the internal causalities between them.

Internationalization - driving innovation

Innovation is related to the firm's ability to utilize its existing knowledge base and to acquire knowledge from external sources by means of imitation, licensing, partnerships or acquisitions. This perspective also facilitates examination of the complex innovation-internationalisation relationships and the internal causalities between them. Involvement in international business provides firms and agents from a region access to a wider range of resources for innovation. Specifically, from the presence in international markets firm can exploit knowledge from several countries (KAFOUROS, 2006). Furthermore, international investments enhance firm's knowledge about the environment and the competition in different countries. This knowledge will be very helpful in maintaining the competitive advantages and in creating others which in turn can generate more innovation. In this way, the internationalisation favors the accomplishment of innovative goals.

KOTABE et al. 2002 and KAFOUROS et al. (2008) show that by acting in international markets, firms can better capitalize the exclusive rents of R&D expenditures. Multinational firms can offer products to a larger number of potential buyers, thereby enhancing profits from innovation efforts and spreading innovation costs. Internationalisation lowers the risk of R&D by avoiding fluctuations and business cycles specific to a single market or region. Moreover, internationalisation can

reduce costs associated with innovation because international firms have more opportunities to buy R&D inputs from the cheapest available sources.
Despite these positive effects, internationalisation may negatively contribute to innovation by increasing the risk of knowledge leakage (i.e. the costs of outgoing spillovers may even outweigh the benefits from incoming spillovers) and by increasing the costs that the coordination and control of a global network requires.
Taking this relationship to a more aggregate level, outward FDI may have positive effects upon the technological capacity of the economy of the internationalized firms (LIPSEY, 2002; KOKKO, 2006).
Consequently, regions where firms and other agents are more internationalized are also expected to be more strongly involved in international activities (FILIPPETI et al., 2009).

Innovation driving internationalization

Some scholars have emphasized the role of innovation and technological capabilities as determinants promoting firm internationalisation and performance. As international markets are characterized by a greater competitive pressure than national markets, innovation is a prerequisite to compete in the current globalised knowledge economy and to fulfill successful international investments. Technological capabilities may facilitate the creation of unique superior products that enable the incoming firm to overcome the indigenous advantages enjoyed by local firms. Hence, innovation gives rise to proprietary advantages, which enable firms to compete and grow abroad. Firms that invest in knowledge creation are also more likely to develop skills that are useful in realizing successful growth in foreign markets (KAFOUROS et al., 2008).
Consequently, regions where firms and other agents are more innovative are also expected to be more strongly involved in international activities (FILIPPETI et al., 2009).

2.2. Conceptual model

The determinants for the degree of regional innovation and internationalisation, and their mutual relationship can be expressed through the model in Figure 1.
It is to be expected that European regions differ quite strongly in their ability to innovate and internationalize. A number of factors may be responsible for this.
Along with the degree of internationalisation of firms from a region, its institutional setting is also highly relevant for the stimulation and implementation of innovations. This approach, which has been originally applied to the national level where industrial economists have demonstrated that in-

dustrial systems, institutions and technology paths within countries are strongly related. This system approach has been extended to a multilevel setting (LUNDVALL and BORRÁS, 1997; EDQUIST, 2001) where regional, national and the supranational (European) levels play a role.

Along these lines, important preconditions for innovation are the qualification of the labour force. These are related to the availability of educational institutions and of research organizations, which are tied to specific regions (and not very mobile) giving them an innovation advantage over others (TODTLING, 1992; SIMMONS, 1997).

Regional firms differ in their ability to innovate due to their sectorial specialization (TODTLING, 1992).. Regional firms differ in their propensity to interact depending on the existence of clusters and networks. Industrial regional structures with strong presence of high tech manufacturing offer higher technological opportunities and R&D capabilities. A favorable innovation infrastructure positively influences the region's capacity to innovate. Despite the fact that the process of innovation and internationalisation is dominated by the private sector, this does not exclude the public sector from the system. The public sector becomes another agent for innovation able to take action in favor of those projects deserving support by providing, in most cases, financial assistance (e.g. WALLSTEN, 2000; RUSSO, 2004; BERUBE and MOHNEN, 2009).

Otherwise, certain aspects of the region are determinants that directly affect the degree of internationalisation activities of the region. The scant literature that exists indicates that a firm's region's likelihood of achieving international success depends to a large extent on features of the regions themselves, which evolve slowly over time (FILIPPETTI et al. 2009, BASILE et al., 2003; MARIOTTI et al., 2008; MASCIARELLI et al., 2009).

The presence of leading multinational corporations may contribute to an overall increase in the level of outward internationalisation of the region (FEDERICO, 2006; MARIOTTI et al., 2008). International experience accumulated in a region over time creates conditions for its firms to undertake major commitments in foreign markets (GREENAWAY and KNELLER, 2007). It provides an opportunity to accumulate tacit and valuable knowledge about international business practices, increasing firms' propensity to undertake riskier choices. Infrastructure can also be important because can be seen as proxies for interaction between the region and the exterior. This idea is closed linked to the new economic geography framework as they link regional dynamics to spatial factors and transport facilities and costs.

The level of internationalisation of a region firms' may also be related to public policy actions. Indeed, reflecting a recognition of the importance of internationally active firms and the barriers to do so (e.g., EUROPEAN COMMISSION 2007, 2008, 2010; OECD, 2009), there has been a rather well-established tradition by governments to support the internationalisation of their national firms,

and, consequently, of their regions. A variety of studies address the role of export promoting programs (e.g. SEREINGHAUS and ROSSON, 1989; LEONIDOU et al., 2010; WILKINSON and BROUTHERS, 2000; BERNARD and JENSEN, 2001; WRIGHT et al., 2007; BREWER, 2009). More recently governments launched measures to support more aggressive forms of internationalisation, but very few studies have empirically addressed these government programs designed explicitly to promote more demanding forms of internationalisation, such as outward investment (CUTS, 2003; DURAN and UBEDA, 2001; UNCTAD, 2001; MAESENEIRE and CLAEYS, 2007).). Only recently, few empirical studies investigate these them at a more aggregate level (see e.g. MARIOTTI et al., 2008; BANNÒ and MORANDI, 2010).

Hence, certain aspects of the region are determinants that directly affect the degree of innovative and internationalisation activities of the region. A number of aspects of the region (region international infrastructure) directly impact upon the degree and scale of international activities of the region, whilst other specificities (regional innovation infrastructure) frame directly the performance of the region in terms of innovation.

Several structural characteristics of the home region may play an important role in defining both firms' innovation and participation in international markets. Results from studies on home country's determinants of innovation and of outward FDI demonstrate that the market size at the home location and the degree of development of the home region may well affect its firms' degree of innovation and involvement in international markets. For example, according to the investment-development path model (DUNNING and NARULA, 1996), GDP, which represents the level of development, is a good predictor of the level of a region's outward FDI.

A region's sectorial composition is another structural aspect that may affect its innovation performance and its international presence through outward FDI. Technologically advanced sectors are not only more innovative but also generally reported in the literature as being more involved in internationalisation processes. Otherwise, some countries (e.g., Italy, with its Made in Italy sectors, textile, clothing, leather, footwear, wood and furniture) demonstrate an international comparative advantage in a number of traditional sectors (see MARIOTTI et al., 2008). Innovative and international experience accumulated in a region over time creates conditions for its firms to innovate more and also to undertake major commitments in foreign markets (GREENAWAY and KNELLER, 2007). It provides an opportunity to accumulate tacit and valuable knowledge about innovation and international business practices, increasing firms' propensity to undertake riskier choices.

The degree of a region's innovation and internationalisation is likely to depend on the presence of leading firms. Large firms may increase the likelihood that a region will expand in terms of innova-

tion and international involvement: first, these firms are more likely to innovate and to develop international production networks and implement multinational strategies, and second, the relationships between these firms and others in the region encourages exchanges of knowledge and information that contribute to generating innovation and capabilities. Finally, certain regions within a country are clearly more dynamic which impacts upon firms overall involvement in innovation and international activities (DIMITRATOS, 2002; VENCE et al., 2000; PACI and USAI, 2000).

Finally, if innovation and internationalisation affect each other, than the regional international infrastructure will affect indirectly the degree of innovation in the region, and the regional innovation infrastructure will affect indirectly the degree of involvement of the region in international activities.

In the next section we explore the determinants for region internationalisation and innovation taking in consideration the nexus internationalisation and innovation. Most of the literature focuses only on one direction of causality, while scant attention has been paid to inspect empirically innovation and internationalisation together (FILIPESCU et al., 2009).

Moreover, we address also a timely concern related to evaluating public policy (WOLLMAN, 2007) specifically incentives for innovation and internationalisation. This issue is pertinent insofar as the existing evidence is ambiguous regarding the effectiveness of financial incentives in promoting additional investment (BEGG and MCDOWALL, 1987; AIVAZIAN AND SANTOR, 2008). Moreover, the extensive existing research on the efficiency of government export promotion programs raises doubts about the effectiveness of these incentives to promote additional investment or levels of internationalisation, either at the firm or more aggregate levels. The influence of financial incentives on regional investment and employment growth on a plant's final choice of locality (WALKER and GREENSTREET, 1991), on firms' performance (BLASIO, 2006; GABE and KRAYBILL, 2002; HARRIS and TRAINOR 2005; SKURAS and TZELEPIS, 2004), investment decisions, and on attraction of inward foreign investment (e.g., GUISINGER, 1992), indicate positive, albeit minimal, effects.

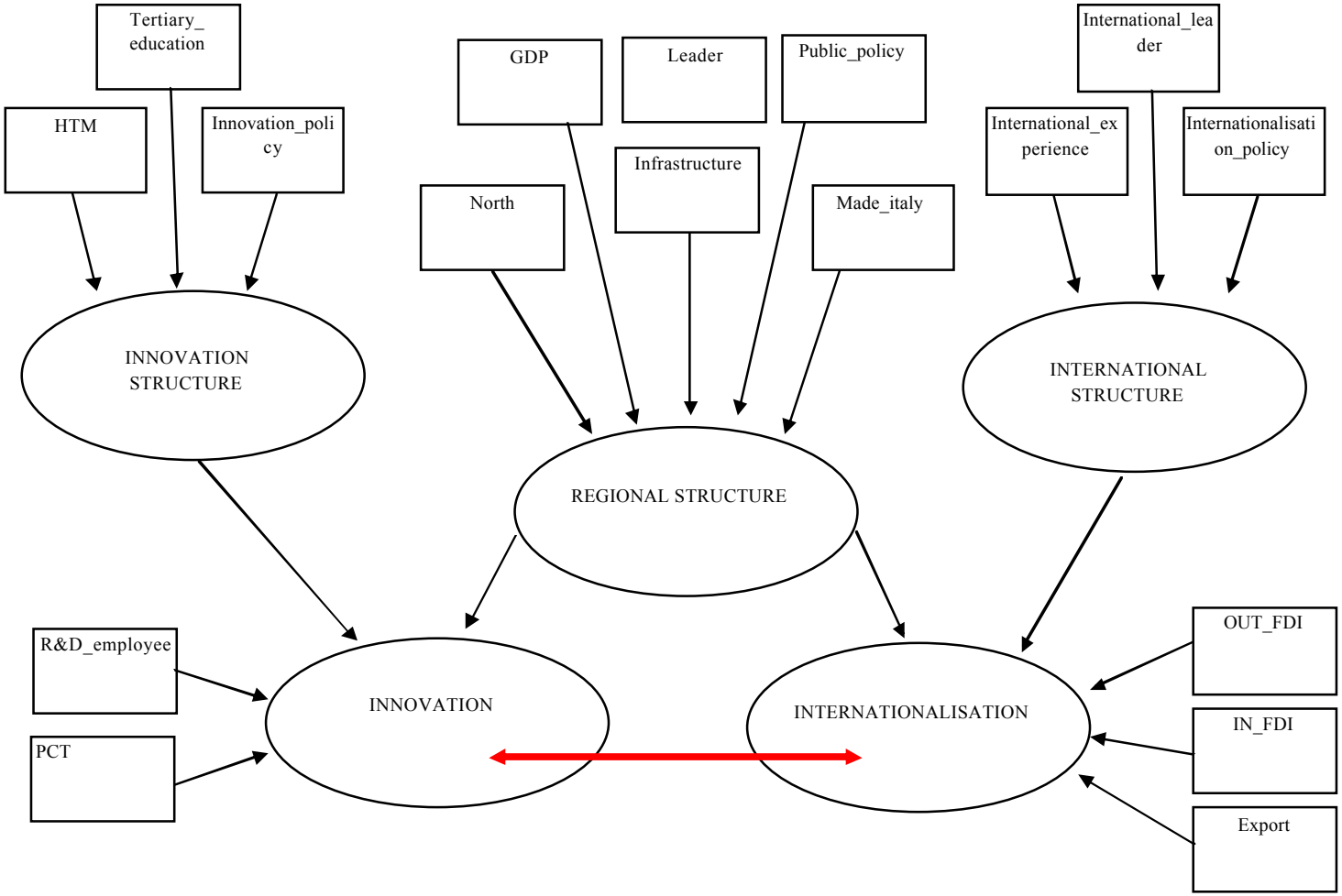

Figure 1: Conceptual model: internationalization and innovation nexus

3. EMPIRICAL SETTINGS

3.1. Methodology

To better understand the complex relationship between internationalization and innovation, we refer to the Structural Equation Models (SEM). These are multivariate regression type models, in which response variables could in turn act as dependent and predictor within a system of equations, and all variables are assumed to influence one-another reciprocally, either directly or through other variables as intermediaries (BOLLEN, 1989). Through the SEM the relationships are expressed by a set of parameters which explain the magnitude of the effect (direct or indirect) between independent (either observed or latent) and dependent variables. Such an approach is then a methodological alternative which is particularly well suited for our purpose. Indeed, internationalization and innovation could act as both dependent and predictor which measurement could be difficult then suggesting the use of latent variables (i.e., variables that cannot be observed and measured directly), and where the system of indicators is complex enough to lead at a model specified through two-way relations intrinsically connected. Using SEM approach we are able to specify flexible models dealing with non-standard relations stylized along panel data structure, in which spatial and temporal dimensions do matter. Our statistical procedure will help explain and verify the series of casual relations looking at both what the theory and what the data could tell us, translating our findings into a clear understanding of relevant dependencies between and within the linkage *internationalization-innovation*.

3.2 Structural Equation Model in a nutshell

Structural equation modeling represents the hybrid of two separated statistical traditions. The first is the factor analysis developed in the disciplines of psychology and psychometrics. The second is the simultaneous equation modeling developed in econometrics.

The factor analysis and the path analysis merged into a comprehensive statistical methodology. In a preliminary work, WRIGHT (1918) have shown how the correlations among variables could be related to the parameters of a model as represented by a path diagram. WRIGHT showed also how the model equations could be used to estimate direct effects, indirect effects and total effects.

As regards to the simultaneous equation modeling, HAAVELMO (1943) modeled the interdependence among economic variables using the following system of simultaneous equation

$$\mathbf{y} = \mathbf{B}\mathbf{y} + \boldsymbol{\Gamma}\mathbf{x} + \boldsymbol{\zeta}$$

where $\mathbf{y}$ is the vector of the endogenous variables that the model is specified to explain, $\mathbf{x}$ is the vector of exogenous variables that are supposed to explain $\mathbf{y}$ but whose behavior is not explained, $\boldsymbol{\zeta}$ is a vector of disturbance terms, and $\mathbf{B}$ and $\boldsymbol{\Gamma}$ are coefficients matrices.

The combination of these methodologies into a coherent and analytic framework was based on the works of JORESKOG (1973), KEESLING (1972) and WILEY (1973). In particular, JORESKOG (1973) stated that the structural equation model consists of two part: (*i*) the measurement part, linking observed variables to latent variables via a confirmatory factor model, and (*ii*) the structural part, linking latent variables to each other via systems of simultaneous equations. The estimation of the model parameters relies to the maximum likelihood estimation.

When the phenomenon under study is dynamic (i.e. change over the time) it may be a matter of interest adopting a dynamic perspective and asking how the variable under scrutiny change over time and how those changes are influenced by time invariant and time varying features of the system. To this end we will considered the growth curve modeling, expressed in the following form:

$$y_{ji} = \pi_{0j} + \pi_{1j} t_i + \varepsilon_{ji}$$

where y_{ji} is the dependent variable for unit j at time i, π_{0j} represents the initial status at time $t = 0$, π_{1j} is the growth trajectory, t_i is a temporal dimension, and ε_{ji} is the disturbance term.

MUTHEN (1991) and WILLET and SAYER (1994) have shown how the general growth model can be incorporated into a structural equation modeling framework. In particular they insert the growth model in the measurement model

$$\mathbf{y} = \boldsymbol{\tau}_y + \boldsymbol{\Lambda}_y \boldsymbol{\eta} + \boldsymbol{\varepsilon}$$

where $\boldsymbol{y}$ is a vector representing the empirical growth record for unit j, $\boldsymbol{\Lambda}_y$ is a fixed matrix containing a column of ones and a column of constant time values. The matrix $\boldsymbol{\eta}$ contains the initial status and growth rate parameter denoted as π_{0j} and π_{1j}, and the vector $\boldsymbol{\varepsilon}$ contains measurement errors, where $cov(\boldsymbol{\varepsilon})$ is assumed to be a diagonal matrix of constant measurement error variances. Since this specification results in the initial status and growth parameters being absorbed into the latent variable vector $\boldsymbol{\eta}$, this model is referred to as a latent variable growth model. The standard structural model specification can be also used to handle the components of the growth model. An important feature of this particular type of structural equation model is its flexibility in handling structured er-

rors. More precisely, the assumption of independent and homoskedastic errors can be relaxed allowing for heteroskedasticity and autocorrelation. In particular, heteroskedasticity can be incorporated by relaxing the equality constraints among error variances.

3.3 The model

The estimates of the panel data are conducted using a structural equation model. The latent variables for the measurement model are defined as following:

F4: Innovation → R&D_emplyee; PCT
F5: Internationalisation → Outward_FDI; Inward_FDI; Export
F1: Innovation structure → Tertiary_education; KIS; HTM; Innovation_policy
F3: Internationalisation structure → Intern_leader; Intern_experience; Internationalisation_policy
F2: Regional structure → North; GDP; Population; Leader; Made_italy; Infrastructure; Policy

The observable variables for the first latent variable (i.e. Innovation) are the number of Patent Cooperation Treaty (PCT) application and the number of R&D employee. PCT was concluded in 1970 and instruments of ratification or accession must be deposited with the Director General of WIPO. The Treaty makes it possible to seek patent protection for an invention simultaneously in each of a large number of countries by filing an international patent application.
The observable variables for the second latent variable (i.e. Internationalisation) is the level of internationalization of the region, with a focus on outward FDI, inward FDI and export. This second latent variable represents part of a more general strategy for internationalization of production, and has often been acknowledged as a complement of rather than a substitute for other forms of internationalization. Then, for each Italian region, it is measured the stock of both inward and outward FDI projects in terms of the number of foreign investments and the amount of export in the same year.
The evaluation of the mutual relationship between innovation and internationalisation level of a region requires a model that links the two latent target variables, taking into account also the general characteristics, the innovation and the internationalisation structure of a region. To this end, the present analysis considers in the structural model other three latent variables: the regional structure, the innovation structure and the internationalisation structure likely to affect both the internationalisation and innovation. The innovation structure of a region is measured by the level of human capital in terms of tertiary education, the number of employee in knowledge intensive sector and in high and medium high-technology manufacturing industries and by the amount of public policy for in-

novation. In turn, the internationalisation structure of a region is measured by the presence of large foreign-owned multinational corporations, by the international experience and by the amount of public policy for internationalisation. The regional structure refers to the regional characteristics described in the previous section. In particular measures include the localization of regions in northern Italy, a measure for economic development, the number of population, the presence of large firms within the region, the sectorial composition of industries in the region, the infrastructure measured by the number of fly routes in the region and finally also policy-related measures are included. For a detailed description of the variables see Table 2.

Variable	**Description**
PCT $_{r,t}$	Total number of Patent Cooperation Treaty (PCT), in region *r* and year *t*
R&D_employee $_{r,t-1}$	Number of R&D employee in region *r* in year *t-1*
Outward_FDI $_{r,t}$	Total number of outward FDI, in region *r* and year *t*
Inward_FDI $_{r,t}$	Total number of outward FDI, in region *r* and year *t*
Export $_{r,t-1}$	Total amount (euro) of export in year *t*-1 and region *r*
Tertiary_education $_{r,t-1}$	Tertiary education (number of people) in region *r* in year *t-1*
KIS $_{r,t}$	Number of employee in knowledge intensive services in region *r* and year *t*
$HTM_{r,t}$	Number of employee in high and medium high-technology manufacturing industries (i.e., machinery and equipment, electrical apparatus and electronics, precision instruments) in region *r* and year *t*
Innovation_policy $_{r,t-2}$	Total amount (euro) of public policy for innovation in year *t*-2 and region *r*
$International\_leader_r$	Ratio of the number of employees in foreign affiliates of firms with over 250 employees in region *r* in year *t* and the number of employees in the leader firms located in the same region in 2001
International_experience	Number of years elapsing from when region *r* reached 50% of the number of employees engaged in foreign activities, as recorded at the beginning of 2000.
Internationalisation_policy $_{r,t-1}$	Total amount (euro) of public policy for internationalisation in year *t*-1 and region *r*
$GDPpc_{r,t-1}$	Gross domestic product per capita (euro) in region *r* and year *t*-1
$North_r$	Dummy variable equal to 1 if the region *r* is located in the north of Italy
Population	Number of population in year *t* and region *r*
$Leader_r$	Number of firms with more than 250 employees in the region *r* in 2001
$Made\_italy_r$	Number of firms in made in Italy industries (i.e., textile, clothing, leather, footwear, wood and furniture) in region *r* in 2001
$Infrastructure_{r,t}$	Number of fly routes in region *r* and year *t*
$Public\_policy_{r,t-1}$	Total amount (euro) of industrial public policy in year *t*-1 and region *r*

Table 2: Description of dependent and independent variables

Referring to the conceptual model (Figure 1), the identified relationship for the structural model are:

F1 Innovation structure → F4 Innovation

F2 Regional structure → F4 Innovation

F2 Regional structure → F5 Internationalisation

F3 Internationalisation structure → F5 Internationalisation

F4 Innovation ↔ F5 Internationalisation

In particular the level of innovation of a region (i.e. latent variable Innovation) is expected to depend on the degree of internationalisation of the region (latent variable internationalisation) and vice versa. As discussed in section 2.2., the latent variable for innovation and internationalisation structure are included because they are expected to impact directly upon region innovation and internationalisation, respectively. The present analysis considers as additional explanatory variable the regional structure likely to affect both the internationalisation and innovation.

3.4 Data description

The dataset employed in the empirical analysis combines several sources of data (Table 3).

	Source	**Years**
PCT	REPRINT Database	1998-2007
R&D_employee	ISTAT Annual Data	1998-2007
Outward_FDI	REPRINT Database	2000-2008
Inward_FDI	REPRINT Database	2000-2008
Export	ISTAT Annual Data	2000-2007
Tertiary_education	OECD Database	2001-2008
KIS	OECD Database	1998-2008
HTM	OECD Database	1998-2008
Innovation_policy	MET, Ministry of Economic Development	1999-2006
International_leader	REPRINT Database	2000-2008
International_experience	REPRINT Database	2000-2008
Internationalisation_policy	MET, Ministry of Economic Development	2000-2007
GDP	ISTAT Annual Data	1999-2008
North	--	--
Population	OECD Database	1999-2008
Leader	ISTAT Census Data	2001
Made_italy	ISTAT Census Data	2001
Infrastructure	INNOVATA	2000-2008
Public_policy	MET, Ministry of Economic Development	2000-2007

Table 3: Sources and time of data for dependent and explanatory variables

An initial empirical investigation is carried out, taking into account the regional level of internationalization and the level of innovation in 2007 (Figure 2) thanks to two measures (i.e. the number of outward FDI and the number of PCT application of a region in 2007).

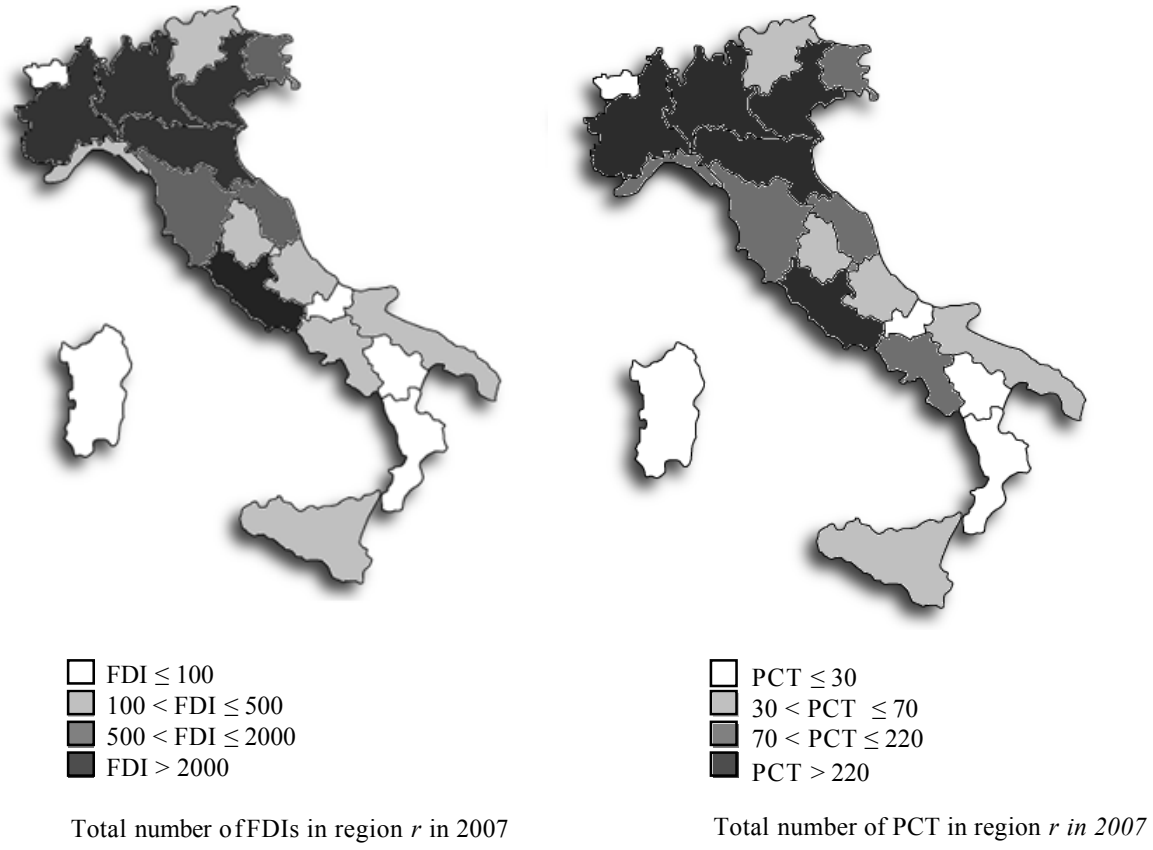

Figure 2: Number of outward FDI and number of PCT applications in 2007

Descriptive evidence shows that the degree of internationalisation is much more significant for regions in the North of Italy than in the South. A similar picture is found for the distribution of PCT applications: the level is highest in Lombardia and Emilia Romagna (884 and 512 applications per year, respectively); Lombardia also show the highest degrees of internationalisation (with 7,820 FDI). Notice also that the insignificant values of patents in Valle d'Aosta, Molise, Basilicata, Calabria and Sardegna correspond to a very low degree of regional internationalisation. In conclusion, regions that are characterized by a high level of innovation are also characterized by a high level of internationalisation, and vice versa.

4. ECONOMETRIC FINDINGS

This section presents the estimates of the proposed structural models for the degree of Italian regions' internationalization and innovation from 1999 to 2008 (Table 4).

As far as the measurement model is concerned, our result confirm the positive impact of all the observable variables. The number of PCT patent application and the R&D employee contribute positively to the definition of the latent variable Innovation (F4). In turn, both inward, outward and export contribute positively to the definition of the latent variable Internationalisation (F5).

Measurement MODEL		*Structural MODEL*	
F1 by		*F4 on*	
Tertiary_education	1.00	F1	155.68
KIS	0.77	F2	-263.073
HTM	0.82		
Innovation_policy	0.79		
F2 by		*F5 on*	
North	1.00	F2	0.34
GDP	1.32	F3	1.04
Population	1.27		
Made_italy	1.43		
Infrastructure	1.59		
Public_policy	1.01		
F3 by		*F4 with*	
International_leader	1.00	F5	0.01
International_experience	0.30		
Internationalisation_policy	0.67		
F4 by		*F2 with*	
PCT	1.00	F1	0.21
R&D_employee	1.17		
F5 by		*F3 with*	
OUT_FDI	1.00	F1	0.30
IN_FDI	1.02	F2	0.18
Export	0.76		

Table 4: Results of the structural equations model (preliminary findings)

The number of employee in knowledge intensive services, in high and medium high-technology manufacturing industries, the level of education and the amount of policy for innovation contribute positively in determining the innovation structure of a region (F1). The presence of large multinational firms, the international experience and the amount of public policy for internationalisation af-

fects positively the measurement of the internationalisation structure of a region (F3). As far as the regions' features are concerned, the location of a region in the northern Italy, the economic development, the population, the presence of leading firms, the sectorial composition of the industry, the number of fly routes and the industrial policy gave all the same contribution on the definition of the last latent variable (F2).

As far as the simultaneous equations model is concerned, our results confirm that a mutual relationship between the regional level of innovation and internationalisation exists. The latent variables for internationalisation and innovation show in fact a positive covariance. Also the other relationship are confirmed, the degree of a region's innovation and internationalisation is likely to depend respectively on the regional innovation and internationalization structure.

5. CONCLUSION AND POLICY IMPLICATIONS

Existing studies are elucidating separately regarding the regional characteristics likely to affect regional level of internationalisation and innovation. Research concerning the simultaneous relationship between innovation and internationalisation phenomena at sub-national level appears to be rather limited. Our results contribute to this set of literature, accounting simultaneously for innovation and internationalisation variables.

Concluding, innovation virtuously impacts on the degree of international activities of firms of a region which in turn positively influences innovation activities. This interdependence between innovation and internationalisation suggests that policy makers should plan policy taking into account the circular relationship between the two phenomena. In fact, even if each policy has as target specific issues, there is a substantial overlapping of effects among them at local level. Although the complementarities among different programs nowadays each measure operates in isolation, and the evaluation of the different incentives does not take into account their relationship. Both innovation and internationalisation measures granted in the same area can generate positive externalities: this justifies the integration of different incentive schemes in the same region. Therefore, there is a need of a better understanding of the effectiveness and interaction of these two types of measures that aim at correcting for market and coordination failures, pushing country development. This research will also contribute to a broader gap that relates to the lack of studies that evaluate the impact of policies (MOSSELMAN and PRINCE, 2004; STOREY and POTTER, 2008).

Bearing in mind the novelty of the subject, the results should nonetheless be taken in context, and future agenda could expand the analysis. First of all, the relationship can, and does, vary from industry to industry, therefore future research should take into account inter-industry differences. The

study reveals the asymmetries between regions regarding both the international and innovation activities of their firm. In conclusion, the findings of this paper seem to justify broader research efforts in the area of determinants for regions' level of both innovation and internationalisation, and there is ample scope for further research on measuring and assessing the relationship of both phenomena.

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