FDI and local capabilities in peripheral regions - The Etna Valley case

Grazia D. Santangelo*
(University of Catania)

Abstract – Due to the recent technological, economic and political events as well as to the latest theoretical developments, the location of foreign direct investment (FDI) has been a topical issue in international business literature. If the rediscovery of *space* as a crucial element in economic activity has drawn great interest into sub-national regions as territorial unit of analysis, scholars have mainly devoted their attention to core regions, neglecting the peripheral. Moreover, even the few studies investigating the activities of multinational corporations (MNCs) in peripheral regions have disregarded intra-regional disparities due to constrains of data availability.

The aim of the paper is to analyse the locational preference of MNCs activities across provinces (a sub-regional political and economic territorial unit) of Sicily (Italy) in 2001 controlling for incentives granted under the new regional development policy. Through a Poisson regression model it is shown that, unlike what is predicted by the current literature on FDI in peripheral regions, locational preferences of foreign firms are driven by local high skilled competencies (also reflected in high wages), high degrees of trade openness, low degrees of crimes, proximity to university and low information costs. The econometric results also suggest an agglomeration of foreign firms in electronics, and chemicals and pharmaceuticals in what has been named Etna Valley after the nearby volcano. However, while in chemicals and pharmaceuticals local productive (and indirectly technological competencies) have acted as a catalyst for foreign investments in the province, these competences were initially lacking in electronics.

JEL Classification: F23, L6, L52, O19, R3

Keywords: FDI, peripheral regions, local emerging clusters

* Facoltà di Scienze Politiche, Università degli Studi di Catania, Via Vittorio Emanuele 8, 95131 Catania, ITALY. Tel: +39.095.7462111. Fax: +39.095.7464193. Email: grsanta@unict.it

1. Introduction

Traditionally, studies of location of foreign direct investment (FDI) embracing a macroeconomic perspective have mainly adopted the nation State as unit of analysis. Recently, the issue has started to be analysed at a more detailed geographical level (Dunning, 2000) following some major theoretical developments which have re-discovered the role of *space* in economic activity. Despite some exceptions (e.g. Mariotti e Piscitello, 1995), the territorial unit of analysis of these more recent streams of research has been the sub-national region. Empirical analysis has been mainly concerned with foreign investments in production or technology localised in *higher* order centres disregarding peripheral sites (e.g. Cantwell and Iammarino, 2001). Few studies have been devoted to investigate the location of multinational corporations (MNCs) activities *in* or *within* peripheral regions (e.g. Amin *et al*. 1994), while a large literature investigates the determinants of the location of MNCs in developing countries (e.g. Dunning and Narula, 1996).

However, the understanding of the interplay between the global and local dimensions has become crucial for both corporate managers and local governments for the sake of global competitiveness and local development, respectively. On the one hand, the new role of the subsidiary within the corporate network and its greater interaction with the local environment (Birkinshaw, 1996) can be fully exploited if local geography is correctly appreciated. At intra-regional level, for instance, the agglomeration of potential local capabilities in peripheral centres may attract foreign investors and, then, shape corporate location strategies by diverting them from mere market-oriented motives. On the other hand, *vicious* cycles of local socio-economic

conditions can be inverted by attracting locally MNCs, which, in turn, act as an engine of local development. Inward investments are, indeed, an additional channel though which new ideas, working practises and technologies are sourced into the host economy (Barrell and Pain, 1999). If, in favour of peripheral locations, potential gains have risen from the decentralisation of corporate activities generated by new corporate organisation forms and by the emergence of information and communications technology (ICT), some sceptical views have been expressed on their long-run sustainability due to the immobile nature of knowledge (Camagni, 1992). As empirically shown elsewhere (Cantwell and Santangelo, 2002), far from reducing geographical differentials in terms of local capabilities the ICT revolution has enhanced spatial imbalances both across and within borders.

Within this theoretical framework, the mid-1990s upsurge of FDI in Sicily represents an emblematic case of foreign firms location in a region classified as peripheral both in the national and European context.[i] However, in evaluating this pattern, the implications of the implementation of the European Union (EU) regional policy should be taken into the right account. Due to the take-off of the EU regional policy, in Italy the development of depressed regions is nowadays mainly pursuit through attraction of production activities by means of incentives. Nonetheless, although the boom of FDI in high-tech sectors in the island may be attributed to the new incentive policy, within Sicily FDI may be unevenly distributed across provinces suggesting the presence of basic location determinants.

The aim of the paper is twofold: 1) to analyse the geographical and sectoral distribution of production activities carried out by MNCs across Sicilian provinces; 2) to explain locational preferences of foreign-owned firms across provinces and sectors

once foreign companies have chosen to sit their productive activities in Sicily. Within this framework, the study attempts to evaluate whether potential emerging areas of local expertise acting as catalysts for MNCs investments can be identified within the island. The analysis is carried out by combining territorial data (drawn from different sources) with inward-FDI data.[ii] The FDI data refer to 48 foreign-owned manufacturing plants located in the 9 Sicilian provinces (corresponding to level 3 of the Nomenclature of Territorial Units for Statistics (NUTS3) adopted by the European Commission[iii]) in May 2001.

The paper is articulated in 6 sections. Section 2 sets the theoretical scene. Section 3 sketches the situation of FDI in Sicily in the late 1990s in geographical and sectoral terms. In section 4, the variables and the models adopted are illustrated. Section 5 discusses the econometric results. A few brief conclusions and policy implications are drawn in section 6.

2. The renewed importance of the location advantage

The issue of FDI location is traditionally linked with the theoretical attempt to explain the existence of multinational corporations (MNCs).[iv] The more recent literature drawing on Hymer's (1970) work (i.e. new trade theory, and geography and trade) has emphasised the significance of imperfect market environment and imperfect industrial structure as primary conditions creating advantages for foreign investments. Imperfections of market environment allow multinational firms to obtain monopolistic advantages through FDI *vis-à-vis* host companies. Imperfect market structure enables

firms to become multinationals by obtaining intangible assets from their investments in advertising and R&D (Markusen, 1995). Conversely, internalisation theory (Buckley and Casson, 1976) has stressed the importance of asymmetric information in operations carried out in foreign countries, arguing that high information costs (and more general transaction costs) push firms to internalise rather than licensing foreign operations. A more comprehensive framework has been provided by Dunning (1993) eclectic paradigm, which, moving away from the predictive theories of MNCs, identifies the determinants of international production in ownership, location and internalisation (OLI) advantages. According to this framework, MNCs have competitive *ownership* (O) advantages by comparison to their competitors in terms of both intangible and productive assets. Ownership advantages can be utilised to establish production plants in sites that are attractive for their *location* (L) advantages. Across different locations, MNCs can enjoy *internalisation* (I) advantages rising from the ease of appropriating returns and from the exploitation of complementary assets within their integrated corporate structure. Great attention has been devoted to the study of I advantages in explaining the existence and growth of the multi-activity firms so far. Nonetheless, although firm-specific determinants of international economic activity is still a major topic of academic research, international business scholars have shown a renewed interest in the spatial aspect of FDI (Dunning, 1998).

Due to the drastic technological, economic and political changes of the past two decades as well as to the theoretical attempts (i.e. new trade theory, economic geography, and international political economy) to further analyse and integrate this aspect into mainstream research, L advantages have gained increasing relevance in academic investigation. Among the changes that have geared the rethinking of L

advantages, the emergence of knowledge as a crucial asset and the technological revolution starting in the late 1960 have doubtless played a major role. These two aspects have, indeed, generated concurrent centripetal and centrifugal forces in the sense that, if technological advantage has eased the transfer of knowledge across and within borders, the production of knowledge is still locally embedded. Thus, contrary to what is sometimes alleged, globalisation and national/regional specialisation are complementary parts of a common process, and not conflicting trends (Archibugi and Michie, 1997). Along these lines, it has been stressed that MNCs arise "not out of the failure of markets for the buying and selling of knowledge, but out of its superior efficiency as an organisational vehicle by which to transfer this knowledge across borders" (Kogut and Zander, 1993, 625). Besides FDI motives dictated by adaptation to host markets (i.e. home-base exploiting (HBE) motives (Kuemmerle, 1996)), MNCs' decisions on foreign production units are increasingly geared by the need to tap into local capabilities (i.e. home-base augmenting (HBA) motives (*Ibid.*)). The recent growth of the strategic asset-seeking FDI and consequently the more embedded ties of foreign subsidiaries with the local environment bear testament to this view. Accordingly, empirical evidence on FDI as a strategy to source abroad knowledge-intensive assets (Dunning and Lundan, 1998) as well as to acquire know-how reinforcing the strengths or complementing the weakness of investors (Chen and Chen, 1998) has been gathered. Therefore, MNCs are increasing looking for high-value capabilities in order to complement their core competencies, with the due exceptions for some labour and resource investments in developing countries.

This new techno-socio-economic situation raises two orders of implications. The first order concerns corporate organisation: at inter-firm level, a relational, collective

and collaborative form of capitalism - named "alliance capitalism" (Dunning, 1995) - has emerged; at intra-firm level, MNCs are increasingly coordinating their internal networks through heterarchical (as opposite to hierarchical) organisational forms. The active interaction of affiliates with the local environment, which results from broad mandates granted by the parent company, enables the whole corporate structure to tap into locally specific and differentiated streams of innovation in each site, and reinforces local strengths. The second order of implications refers to the paradox of "sticky places within slippery regions" (Markusen, 1996) resulting from the more pronounced geographical concentration of production and technology within countries and regions. FDI may, indeed, lead to the establishment of local industrial sectors (Markusen and Venables, 1999).

The growing significance of knowledge-related infrastructures and the theoretical stream of research started by Krugman's (1991) work have drawn attention on sub-national spatial units (mainly sub-national regions) based on the idea that increasing returns are essentially a regional and local phenomenon arising from regional economic agglomeration and specialisation.[v] This implies that location factors attracting MNCs can be analysed at local level since local environments are "the product of historical processes that are not easily imitated or alterated" (Saxenian, 1994, 162). Unlike classical location theory (Lösch, 1954) explaining agglomeration economies mainly in terms of reduction of transaction costs and cheap labour, the theoretical developments which have taken place since the 1980s have, therefore, underlined the importance of localised higher value-added and its cumulative and path-dependent nature in explaining economic agglomeration and performance.[vi]

However, economic agglomerations may show a more specific spatial pattern as a result of intra-regional disparities. Agglomerations rise from the immobile nature of knowledge, which may further feed intra-regional disparities. Cantwell and Piscitello (2002), for instance, show the significance of potential intra- and inter-industry knowledge spillovers as crucial location determinants of foreign-owned research. In turn, MNCs can play a role as flagship firms in the establishment of new high-tech clusters (Arora *et al*. 2000), where cascading effects due to the observation of other investors can reinforce this process (Mody and Srinivasan, 1998). Thus, countries/regions engage international tournaments to attract FDI in order to improve their location advantages and local firms ownership advantages through spillovers and linkages generated by MNCs activities (Cantwell and Narula, 2001). However, the impact of MNCs' activities on host economies greatly depends on the local subsidiary type, its technical capabilities (relative to the corporate network), the scale of its innovative activity, as well as on the position advantage of the home and host location in the field in which the subsidiary operates (Frost, 2001). As argued by Beaudry and Breachi (2000), clustering *per se* is not sufficient to explain firm's innovative performance since it needs to be complemented by innovative persistence and accumulated stock of knowledge. Thus, in the emergence of high-tech clusters, the *coevolution* of emergent and guided processes should be accounted for. As far as the former is concerned, the unintentional actions of firms, for instance, on the creation of location advantage are the relevant factors. Conversely guided processes are the intentional results of institutional actors (i.e. governments) aiming at contributing to the development of L advantages.

The findings concerning incentives to favour FDI location are controversial despite of the recognised role of governments in promoting FDI-assisted growth (Dunning and Narula, 1996) and the worthwhile participation of governments in location tournaments (Mudambi, 1995). If evidence has been provided on the irrelevance of incentives in attracting foreign investors in Italy in the 1980s (Mariotti and Piscitello, 1995), it has also been shown that there is not single recipe as far as incentive are concerned since different kinds of incentives attract different kinds of investments (Rolfe *et al*. 1993). Accordingly, at a more theoretical level it has been argued that the impact of incentives seems to be more effective in R&D intensive sectors (Sanna-Randaccio, 2002). The Irish case appeared to be explicative in this respect due to the successful attraction of FDI in high-tech sectors in the 1990s through a policy of trade liberalisation and location incentives (Barry and Bradley, 1997). However, this model seems to have provided only a short-term solution to the development issue, given the recent intention of some major MNCs to move outside Ireland. This suggests a structural weakness of the local system in absorbing foreign capabilities and feeding them locally in order to invert the vicious cycle. Local absorptive capacity is a key factor in order for local firms to benefit from optimal potential spillovers and linkages, which are the outcome of the "right kind" of FDI. In fact, if local technological capabilities are weak in the sector of MNCs' activity, FDI may drive out local competition and further reduce local technological expertise (Cantwell, 1987). Conversely, strong local capabilities are reinforced by the dynamic interaction with foreign investors. Thus, the success of incentive to high quality inward investments requires the host location to have a rich resource base (Cantwell and Mudambi, 2000).

The debate on the role of incentives in enhancing L advantages of depressed regions through the attraction of FDI and, consequently, that of MNCs in the take-off of local high-tech clusters gains particular momentum in the case of Sicily for two orders of reasons. First of all, the early 1990s (with effect from the mid-1990s) radical changes in the governmental policy towards depressed regions - stimulated by the take-off of the EU regional policy[vii] - has transferred the right to implement economic policies to local regional governments. Within this new political approach, incentives have been granted for the establishment of productive activities in depressed Italian regions. Secondly, in the mid-1990s massive FDI flows into Southern regions as compared to the rest of the country were recorded (Mariotti and Mutinelli, 1999). Moreover, inward-FDI flows targeted especially high-tech sectors and Sicily.

Given that the new kinds of incentives are available for all Sicilian provinces our aim is to investigate whether there are specific drivers to location decisions of MNCs once multinationals have decided to sit their production plants in the island in order to investigate whether some provinces show greater agglomerations of FDI than others. International, national and local press as well as some major consulting companies (e.g. KPMG, 2002) have increasingly claimed that a phenomenon of agglomeration in high-tech sectors (such as electronics, and chemicals and pharmaceuticals) appears to be at work in the Sicilian province of Catania, wishfully labelled Etna Valley after the nearby volcano. Thus, this may suggest that locational preferences of foreign firms may be driven by local capabilities and embedded value-added.

3. The geography and sectoral structure of inward-FDI in Sicily

Before evaluating the magnitude of different determinants of the decisions of foreign investors, the geography and sectoral structure of inward-FDI in Sicily are briefly analysed.

The upsurge of FDI in the island has been fed by different countries to different extents. As shown in Table 1, US firms hold by far the greatest share of foreign-owned plants (more than 40%), followed by French companies which account for almost 23%. German and UK investments are definitely more contained - each national group has a share of slightly more than 6% on the total number of FDI -, although they are more present than other European firms (such as Swedish and Swiss companies), whose shares equal those of Canadian and Japanese multinationals. If this suggests that geographical distance does not matter for US firms and, to a lesser extent, for Canadian and Japanese, it does for European companies showing small investments shares in the region – with the exception of French multinationals. These disparities may be due to different degrees of experience across national groups of firms (Davidson, 1980). Firms with extensive experience (such as US multinationals) exhibit less preference for near and similar markets. Conversely, less experienced firms (e.g. European companies) may perceive Sicily as less attractive because of high uncertainty due to the lack of an inward-FDI story. However, international trends should be also borne in mind when reading these figures since the 1990s have witnessed a rise in US FDI showing a peak in the years 1996-97 (UNCTAD, 1997). It is also worth noting the presence, although contained, of Swedish investors who traditionally prefer high-income locations (Blomström *et al.*, 1997).

The idea of an uneven distribution of foreign presence across the 9 Sicilian provinces gathers support from a two-way ANOVA analysis – grouping foreign-owned plants according to province and sector – which aims at identifying significant main effects of specific factors (namely, PROVINCE and SECTOR) on the distribution of FDI. The results of the analysis reported in Table 2 show that the factor PROVINCE is statistically significant ($p < 0.05$) while the factor SECTOR is not, thus confirming the uneven distribution of foreign-owned plants across the Sicilian provinces, but not across sectors. These results have been further plotted in Figure 1, where Catania is by far the province hosting the highest number of foreign-owned plants, followed by Syracuse. Although the ANOVA analysis does not enable us to identified a statistically significant difference in the distribution of foreign firms across the 10 sectors considered, Table 3 shows that "mechanical equipment and metal products" (which in our database mainly concerns electronics), "chemicals and pharmaceuticals", and "oil and energetic products" host all together (to different extents) almost 80% of the total number of foreign-owned manufacturing plants located in the island.[viii] However, if the significance of the later sector in terms of foreign-owned plants is understandable due to the availability of natural resources[ix], the location of multinationals in the former two high-tech sectors is surprising given the socio-economic conditions of the region.

4. The econometric models and the specification of the variables

The phenomenon under investigation is the location preferences of foreign-owned firms as between alternative provinces once companies have decided to locate their

technological activities in Sicily. The dependent variable concerns the number of foreign-owned plants located in each province *i* and industrial sector *j*, which is specified as follows:

$FPLANT_{ij}$ = number of foreign-owned plants in province *i* and sector *j* in May 2001: i = 1, 2, …, 9 and j = 1, 2, …, 10.

A Poisson regression model was fitted to the data when considering a series of covariates which account for factors impacting on the location preference of foreign-owned activity across provinces and sectors.[x] Since the phenomenon under analysis is the location preferences of foreign–owned plants sited in Sicily in 2001, the independent variables have been calculated over the period 1996-1998, when the incentives policy took place. It should be highlighted that the variables considered do not intend to be comprehensive due to constrains of data availability at the adopted detailed level of geographical disaggregation. The variables used and the relative sources are reported in Table A1.

The first set of variables considered refers to traditional location factors such as manpower availability and market size. If availability of manpower potentially may attract FDI by lowering labour costs (Markusen and Venables, 1998), it also reveals the backwardness of the province. This factor has been proxied for each province *i*, by the average percentage of unemployed people over the period 1996-1998 ($UNEMP_i$). Similarly, the size of the local market may be a crucial variable in the location decision of foreign firms since the larger the local market, the greater the opportunities of adapting and customising MNCs production locally without incurring in further costs (*Ibid*.). Thus, for each province (*i*), the indicator adopted for the size of the local market is the average *per capita* value-added calculated over the period considered **(**$MSIZE_i$**)**.

A second set of variables concern variables related to local competences and intangible assets. Quality of the labour force is a recognised factor of attraction of foreign activity looking for highly skilled manpower (Audretsch and Feldman, 1996). For each province *i* in each sector *j*, we considered the average percentage of managers and white-collar components to the total employees on the manufacturing industry ($SKILL_{ij}$). Similarly, high quality competencies may be also reflected in high wages. Thus, for each province *i* in each sector *j* the weighted average of the annual average retribution of managers and white collars components over the period under analysis ($WAGE_{ij}$) is taken into account. Innovative capabilities are proxied by the share of patents granted to residents in province (*i*) relative to the total region patenting activity (PAT_i).[xi] The presence of a university in the province should also act as a factor of attraction in terms of potential access to the production of local basic research and knowledge as well as of source of skilled labour. Therefore, for each province (*i*) the variable considered is a dummy variable (UNI_i) equal to 1 if in the province there is a University, equal to 0 otherwise. The commitment to higher education may be seen as a potential local source of knowledge by foreign investors. In order to capture this aspect, for each province (*i*) the average number of full-time students enrolled in secondary education (EDU_i) over the period 1996-1998 is considered. Local productive (and indirectly technological) competencies have, instead, been included in the analysis by calculating the average of the reveal comparative advantage index (RCA_{ij}) calculated for each province (*i*) in each sector (*j*) over the period 1996-1998.[xii] The breath of local productive (and technological) competencies (DIV_{ij}) has been considered for each province (*i*) in each sector (*j*) as the average of the inverse of the coefficient of variation of the RCA distribution.[xiii] [xiv]

A variable related to the economic policy, which can influence FDI location, is the presence of incentives. For each province (i) the proxy used is a dummy variable ($INCE_i$) equal to 1 if any of the foreign companies located in province (i) and operating in sector (j) has been granted incentives to locate their productive activity there over the period under analysis, and 0 otherwise.[xv]

A third set of variables accounts for the information costs MNCs face when sitting production plants abroad. Firstly, the degree of trade openness (TOP_{ij}) of each province (i) in each sector (j) may lower information costs of foreign firms as provinces more active in the international trade arena display a trade history for multinationals interested in selecting local production sites. TOP_{ij} is defined as the average of the following index over the period of time under analysis:

$$top_{ij} = (X_{ij} + M_{ij})/VA_i \qquad (2)$$

where X_{ij} are the exports of province (i) in sector (j), M_{ij} are the imports of province (i) in the same sector, and VA_i is the province's value added in manufacturing. Uncertainty will be also lower in provinces where large companies are already operating, insuring diffusion of information within the international business community. For each province (i) it has been considered the number of firms with 500 or more employees normalised with the total number of manufacturing firms in 1996 ($F{>}500_i$).

Variables related to the socio-economic context can play a role in the location decision of foreign companies. Given the characteristics of Sicily, a variable accounting for the presence of crime, which may obviously act as a deterrent for the location of economic activities (Gastanga *et al*., 1998), has been included in the analysis. This variable ($CRIME_i$) has been defined for each province (i) by the average number of illegal acts per inhabitant over the years 1996-1998. Moreover, the turnover of local

firms has been considered as a deterrent to FDI location since it reveals instability of the local market. The variable ($FTURNOVER_{ij}$) included is given for each province (i) in each sector (j) by the average of the following index over the period considered:

$$fturnover_{ij} = (R_{ij} + C_{ij})/A_{ij} \quad (1)$$

where R_{ij} is the number of firms registered at the Chamber of Commerce of province (i) in sector (j), C_{ij} and A_{ij} are the number of firms which have closed down and the number of active firms in that province and sector, respectively.

A final variable is related to transport infrastructures, which may be determinant in the location of foreign activities. Given the geography of Sicily, in this study the presence of airports in the Sicilian provinces is taken into account. For each province (i), a dummy variable ($AIRP_i$) is considered equal to 1 if in the province under consideration there is an airport, equal to 0 otherwise.

The summary statistics of the variables and the correlation matrix are reported in Table 4 and 5 respectively.[xvi]

5. The results

The results of the econometric analysis are reported in Table 6.[xvii] In order to assess whether foreign companies show location preferences for the province of Catania (which is the province hosting the largest number of foreign-owned plants, as illustrated in Figure 1) in electronics, and chemicals and pharmaceuticals (which are the sectors where the greatest proportions of foreign firms operate, as show in Table 3), a variable

controlling for the interaction effect of Catania and electronics ($CTel_i$), and Catania and chemicals and pharmaceuticals ($CTch_i$) are included in the model.

The estimates obtained illustrate the significance of local high skilled competences ($SKILL_{ij}$ is significant at $p < 0.05$ and $p < 0.01$) as a determinant of locational choice of foreign-owned productive activities across provinces. As already highlighted in some studies investigating location determinants of FDI in Southern Italy (e.g. Dell'Aringa *et al*., 1999), quality of labour appears to be a major strength of Southern Italian regions. Contrary to the predictions of more traditional theory on FDI location (Markusen and Venables, 1998), the results of the econometric analysis also suggest that high costs of labour affect positively the location decisions of foreign investors ($WAGE_{ij}$ is significant at $p < 0.01$). In line with a more heterodox stream of theory (Audretsch, 2000; Cantwell and Piscitello, 2002), since high skilled competencies usually reflect high wages, this result may suggest that foreign firms seem to rely on a competitiveness based upon tacit competencies rather than low production costs. Accordingly, proximity to universities seems to act as a factor of attraction (UNI_i is significant at $p < 0.05$) as it allows potential access to the production of local basic scientific research and knowledge (Anselin *et al*. 1997) as well as to skilled labour (Bresnahan *et al*., 2000). The significance of quality of labour, wages and university in the location decisions of multinationals also reveals a great interaction between local environment and foreign subsidiaries, which, being sensitive to these factors, are likely to be competence-creating type of affiliates looking for assets-seeking types of investments (Kuemmerle, 1996; Cantwell and Narula, 2001) rather than mere market-oriented – coherently, market size and manpower availability do not appear to be determinants of foreign location preferences. Thus, these results confirm that different

locations can attract high quality foreign investments by means of skilled labour and innovative capacity (O'Donnel and Blumentritt, 1999).

Like in previous studies (Mariotti and Piscitello, 1995), information costs come out as relevant factors in shaping location decisions of foreign companies. The degree of trade openness seems to positively affect the location preferences of foreign firms (TOP_{ij} is significant at $p < 0.05$ and $p < 0.01$), consistently with findings at country-level (Narula and Wakelin, 1998). This may suggest that foreign investors are more akin towards locations which are already active in the international trade scenario, when deciding to geographically disperse their operations abroad. Provinces which are heavily trading internationally lower information costs for MNCs potentially interested in investing locally due to the existence of past international trade records. This result also suggests that FDI may not be substitute to export-oriented strategies, as alleged by new trade theory (Markusen, 1995; Baldwin and Ottaviano, 2001). Conversely, the two strategic approaches seem to be complementary (Guerrieri and Manzocchi, 1996) as argued in Dunning's (1997a, 1997b) analysis of the formation of the Common Market and the Single Market Programme, where FDI flows complemented rather than displaced trade flows. Similarly, foreign investors appear to be sensitive to the presence of large companies already operating locally ($F>500_i$ is significant at $p < 0.10$) since it lowers uncertainty by insuring diffusion of information within the international business community.

The socio-economic context also seems to be relevant to FDI location as high degrees of crime ($CRIME_i$ is significant at $p < 0.10$) deter foreign companies to sit their production plants locally.

The incentives granted under the new subsidies policy do not drive the locational preferences of foreign-owned firms once they have decided to locate their production plants in Sicily, given that incentives are available to all provinces. By linking this result with the others discussed above, locations showing high-skilled labour, relative high wages, high degrees of trade openness, low degrees of crime and hosting universities and large companies seem to be able to attract investments even though all locations considered use subsidies to attract FDI (Haaparanta, 1996), thus implying the significance of local value-added embedded.

As illustrated by the two-way ANOVA results, which, plotted in Figure 1, show that Catania is by far the province hosting more foreign-owned plants, foreign firms do discriminate across provinces when sitting their production plants. Although on the grounds of the ANOVA analysis sectoral differences do not seem to matter, the positive and significant sign of $CTel_i$ ($p < 0.05$) and $CTch_i$ ($p < 0.01$) bears testament to the fact that foreign firms do seem to show a statistically significant preference in locating their production plants in Catania as far as electronics, and chemicals and pharmaceuticals are concerned. This result is fairly remarkable when considering the context-dependent and tacit nature of these science-based sectors characterised by a greater geographical concentration in centres of excellence (Cantwell and Santangelo, 2000). Nonetheless, Bresnahan *et al*. (2000) argue that highly skilled labour is a precondition for the growth of ICT-based entrepreneurial clusters as shown, for instance, by the Silicon Valley story. Accordingly, strong University traditions are widely recognised factors of attraction in high-tech clusters (*Ibid*.) as well as in peripheral regions – as illustrated in Scotland (UK), for instance (Santangelo, 2002) - due to the more localised nature of academic knowledge spillovers (Adams, 2001). Both factors seem to be present in

Catania hosting the Etna Valley agglomeration, where the active cooperation between the University, research laboratories and high-tech firms on one side, and foreign companies on the other may have initiated a process aiming to turn a marginal area into a high-tech district. Established research collaborations between Catania University and some major foreign multinationals operating in the province (e.g. ST-Microelectronics) have led to several US patents in high-tech sectors and to join graduate training programmes.

However, the econometric results point out that in Catania differences exist as far as local productive (and indirectly technological) competencies are concerned. While foreign-owned companies are sensitive to sit their production plants in Catania in chemicals and pharmaceuticals as a result of local capabilities ($CTch_i$ is significant at $p < 0.05$ and RCA_{ij} is significant at $p < 0.01$), in electronics local expertises seemed to lack in the middle-1990s ($CTel_i$ is not significant and RCA_{ij} is significant at $p < 0.10$). Therefore, in chemicals and pharmaceuticals Catania was targeted by foreign companies because of local capabilities, which may have developed further through dynamic interaction with world's corporate leaders (e.g. Arch Chemicals and Wyeth Lederle). Like in the formation of the Israeli Silicon Wadi (de Fontenay and Carmel, 2000), in the Etna Valley case comparative advantage forces in this sector seem to have acted as a catalyst for MNCs ensuring a critical mass of absorptive capacity for future local development. Conversely, like in Ireland (Barry and Bradley, 1997) and in Bangalore (India) (Arora *et al*., 2000), in Catania MNCs (such as IBM and ST-Microelectronics) have targeted sectors (such as electronics) lacking local comparative advantage. Nonetheless, if the mushrooming of local firms operating in information technology and related sectors active in Catania and registered to the local Chamber of Commerce

between 1996 and 2001 (see Figure 2) can be attributed to the fast-rising nature of the underlying technologies, the presence of electronic multinationals (e.g. Nokia and IBM), may have also played a role, as in the Silicon Valley case (Moore and Davis, 2000).

Having said so, it should be borne in mind that, as acknowledged by the Cambridge high-tech cluster story, new firms formation and university-industry links do not necessarily ensure the same degree of globalisation as in Silicon Valley (Athrey, 2000). For this purpose, "right" linkages creation with indigenous firms are needed to promote local development and clusters formation through technology and knowledge spillovers (Zanfei, 2000). In turn, positive effects of FDI are likely to increase with the level of local capabilities, which can be enhanced through spillovers and linkages to MNCs' operations (Blomström and Kokko, 1998). If local capabilities were present in chemicals and pharmaceuticals already in the mid-1990s, they might have developed in electronics in the meanwhile as signalled by the mushrooming of the local firms operating in information technology and related sectors. However, the phenomenon of agglomeration of multinational companies in the province of Catania (i.e. Etna Valley) is still in a gestation period as *backward* and *forward* linkages generated by MNCs on the local economy (Rodriguez-Claire, 1996) have not yet been fully displayed their results. As far as the former are concerned, the increase in the demand for specific inputs may not have been yet able to generate positive externalities to other potential firms without relying on the incentive-based attraction policy. In the case of forward linkages, although the number of firms operating in ICT-related sectors has experienced a massive growth, the local network of specialised producers supplying more complex goods at competitive costs is heavily dependent on the existing multinationals localised

in the province. This scenario implies that, although promising, Etna Valley cannot still be considered a high-tech cluster due to the cumulative and self-reinforcing nature of clustering phenomena (Arthur, 1990).

6. Conclusions and policy implications

Recently, research in economics has rediscovered *space* as a crucial factor in economic activity. Due to recent theoretical developments as well as to the technological, economic and political events of the past two decades, the rediscovery of *space* has pushed investigation on FDI location to look at the host locations in greater geographical details in order to better understand the interplay between the *local* and the *global*. The result has been the flourishing of studies overcoming the country as unit of analysis by focusing on sub-national regions. So far, great attention has been devoted to successful regions in order to understand the elements of their socio-economic performance. Conversely, despite the large literature on FDI in developing countries, peripheral regions have been neglected. The few exceptions have mainly treated regions has homogeneous entities without analysing them *within* their borders. However, nowadays this issue is of particular interest when considering the interplay between location and ownership advantages of the host site, and ownership and internalisation advantages of the multinationals. On the one hand, territorial units can increase their location advantage and, consequently, the ownership advantage of local firms by benefiting from knowledge spillovers stemming from the local activity of multinationals. On the other hand, MNCs can enhance their ownership advantage by

choosing appropriate locations where sourcing local value-added into the corporate network through the benefits coming from their internalisation advantage. If this is obvious in the case of *core* regions, it can be less clear if considering peripheral regions as a whole without discriminating *within* them, where centres of excellence may potentially flourish.

In this context, the mid-1990s upsurge of FDI in Sicily can be attributed to basic location factors attracting major multinationals operating in cutting-edge sectors. The econometric results gathered in our analysis show that foreign firm location decisions are driven by local high skilled competencies (also reflected in high wages), high degrees of trade openness, low degrees of crimes, and proximity to university and large companies. Therefore, once multinationals have decided to locate their production plants in the island, they are sensitive to basic factors, which dominate MNCs' location preferences, while investment incentives may upgrade the role of local affiliates in their international network by granting them strategic mandates (Cantwell and Mudambi, 2000). Similarly, multinationals appear to discriminate across provinces and sectors as shown by their preference for locating their activity in the province of Catania and particularly in electronics, and chemicals and pharmaceuticals generating the Etna Valley agglomeration. However, while in chemicals and pharmaceuticals local productive (and indirectly technological competencies) have acted as a catalyst for foreign investments in the province, these competences initially lacked in electronics.

These results bear some relevant policy implications. First of all, factors involving local valued-added should be enhanced in order to make each province competitive in the national and international arena when the subsidies policy will came to an end. On the grounds of the econometric exercise, this means targeting sectors of

productive (and technological) specialisation, promoting labour training programmes, boosting university research and teaching, and encouraging international trade. Secondly, care should be taken of the phenomenon of Etna Valley since the fortunate agglomeration of multinationals in science-based sectors and the flourishing of complementary local enterprises may, if correctly looked after, generate a district in the sector in question as already happened in Silicon Valley (Arora *et al*., 2000). Following Mudambi's findings (1998), this should be pursuit by seeking to keep in the province multinationals with current operations, rather than attempting to attract new investors due to FDI duration dependency. MNCs which have existing investments in the province are the firms with the highest probabilities of making new investments locally. Thirdly, attempts should also make to fill the gap between the more dynamic provinces and the laggards to achieve a more balanced intra-regional development. Nonetheless, although this point should not be disregarded in the medium-long run, a balanced intra-regional development may not be a priority for the time being. At this stage, balanced intra-regional development may be risky in the sense that it can divert resources from the most promising areas. Conversely, resources should be addressed to the more dynamic sites of the island which may act as an engine for the others in the future.

References

Adams, J. *D.* (2001) "Comparative localisation of academic and industrial spillovers". *NBER Working Paper* No. 8292.

Amin, A. Bradley, D., Howells, Tomaney, J., and Gentle, C. (1994): "Regional incentives and the quality of mobile investment in the less favoured regions of the EC". *Progress in Planning*, 41(1).

Anselin, L. Varga, A. and Acs, Z. (1997) "Entrepreneurship, geographic spillovers and university research: a spatial econometric analysis". *ESRC Centre for Business Research, University of Cambridge Working Papers*, No. 59.

Archibugi, D. and Michie, J. (1997) "Technological globalisation and national systems of innovation: an introduction", in Archibugi, D. and J. Michie (eds.) *Technology, Globalisation and Economic Performance*. Cambridge and New York: Cambridge University Press.

Arora, A. Gambardella, A. and Torrisi, S. (2000) "In the footsteps of Silicon Valley? Indian and Irish software in the international division of labour". *SIEPR Discussion Paper* No. 00-41.

Arthur, W. B. (1990) "Silicon Valley locational clusters: do increasing returns imply monopoly?". *Mathematical Social Sciences*, 19: 235-251.

Athrey, S. (2000) "Agglomeration and growth: a study of the Cambridge high-tech cluster". *SIEPR Discussion Paper* No. 00-042.

Audretsch, D. B. (2000): "Knowledge, globalisation and regions", in Dunning, J. H. (ed.): *Regions, Globalization and the Knowledge Based Economy*. Oxford: Oxford University Press.

Audretsch, D. B. and Feldman, M. (1996) "R&D spillovers and the geography of innovation and production". *American Economic Review*, 86(3): 630-640.

Beaudry, C. and Breschi, S. (2000) "Does "clustering" really help firms Innovative activity?". *Manchester Business School Working Paper* No. 412.

Baldwin, R. E. and Ottaviano, G. I. P. (2001) "Multiproduct multinationals and reciprocal FDI dumping". *Journal of International Economics*, 54: 429-448.

Barrell, R. and Pain, N. (1999) "Domestic institutions, agglomerations and foreign direct investment in Europe". *European Economic Review*, 43: 925-934.

Barry, F. and Bradley, J. (1997) "FDI and trade: the Irish host-country experience". *The Economic Journal*, 107: 1798-1811.

Birkinshaw, J. M. (1996) "How multinational subsidiary mandates are gained and lost" *Journal of International Business Studies*, 27(3): 467-495.

Blomström, M., Fors, G. and Lipsey, R. E. (1997) "Foreign direct investment and employment: home country experience in the United States and Sweden". *Economic Journal*, 107: 1787-1797.

Blomström, M. and Kokko, A. (1998) "Multinational corporations and spillovers" *Journal of Economic Surveys*, 2(2): 1-31.

Bresnahan, T., Gambardella, A. and Saxenian A. (2000) ""Old economy" inputs for "new economy" outcomes: cluster information in the new Silicon Valleys". *Stanford University Discussion Papers*, No. 00-043.

Buckley, P. J. and Casson, M. C. (1976) *The Future of Multinational Enterprise*. London: Macmillan.

Camagni, R. (1992) "Nuovo paradigma tecnologico e mutamento nei modelli localizzativi", in Del Monte, A. Imbruni, C. and Viganoni, L. (eds.) *Sviluppo Regionale e Attività innovative Esperienze a Confronto*. Milano: FrancoAngeli.

Cantwell, J. A. (1987) "The reorganisation of European industries after integration: selected evidence on the role of multinational enterprise activities". *Journal of Common Market Studies*, Vol. XXVI, (2): 127-151.

Cantwell, J. A. and Iammarino, S. (2001): "EU Regions and Multinational Corporations: Change, Stability and Strengthening of Technological Comparative Advantages*". Industrial and Corporate Change,* 10(4): 1007-37.

Cantwell, J. and Narula, R. (2001) "The eclectic paradigm in the global economy". *International Journal of the Economics of Business*, 8(2): 155-172.

Cantwell, J. A. and Mudambi, R. (2000) "The Location of MNE R&D activity: the role of investment incentives". *Management International Review*, 40(1): 127-148.

Cantwell, J. and Piscitello, L. (2002) "The location of technological activities of MNCs in European regions: the role spillovers and local competencies". *Journal of International Management*, 8: 69-96.

Cantwell, J.A. and Santangelo, G.D. (2000): "Capitalism, profits and innovation in the new techno-economic paradigm". *Journal of Evolutionary Economics*, 10(1-2): 131-157.

Cantwell, J.A. and Santangelo, G. D. (2002), "The new geography of corporate research in information and communications technology (ICT)". *Journal of Evolutionary Economics*, 12: 163-197.

Castells, M. and Hall, P. (1994): *Technopoles of the World*. London and New York: Routledge.

Chen, H. and Chen, T-J. (1998) "Network linkages and location choice in the foreign direct investment". *Journal of International Business Studies*, 29(3): 445-468.

Davidson, W. H. (1980) "The location of foreign direct investment activity: country characteristics and experience effects". *Journal of International Business Studies*, 11(2): 9-22.

Dell'Aringa, C. Origo, F. and Lodovici, M. S. (1999) "Il mercato del lavoro nel Mezzogiorno: il ruolo del costo e della flessibilità del lavoro". *L'Industria*, 2: 251-262.

de Fontenay, C. and Carmel, E. (2000) "Israeli's Silicon Wadi : the forces behind cluster formation". *SIEPR Discussion Paper* No. 00-40.

Dunning, J. H. (1993) *Multinational Enterprises and the Global Economy*. Wokingham: Addison-Wesley Publishers Ltd.

Dunning, J. H. (1995) "Reappraising the eclectic paradigm in an age of alliance capitalism". *Journal of International Business Studies*, 26(3): 461-491.

Dunning, J. H. (1997a) "The European internal market programme and inbound foreign direct investment" (Part I). *Journal of Common Market Studies*, 35(1): 1-30.

Dunning, J. H. (1997b) "The European internal market programme and inbound foreign direct investment" (Part II). *Journal of Common Market Studies*, 35(2): 1-30.

Dunning, J.H. (1998) "Location and the Multinational Enterprise: a neglected factors?". *Journal of International Business Studies*, 29(1): 45-66.

Dunning, J. H. (2000) (ed.) *Regions, Globalization and the Knowledge Based Economy*. Oxford: Oxford University Press.

Dunning, J.H. and Lundan, S.M. (1998) "The geographical sources of competitiveness of multinational enterprises: an econometric analysis". *International Business, Review*, 7(2): 115-133.

Dunning, J. H. and Narula, R. (1996) *Foreign Direct Investment and Governments: Catalysts for Economic Restructuring.* London: Routledge.

Eurostat (1995) *Nomenclature of Territorial Units Statistics*. Luxembourg.

Frost, T. S. (2001) "The geographic sources of foreign subsidiaries' innovations". *Strategic Management Journal*, 22: 101-123.

Gastanga, V. M., Nugent, J. F. and Pashamova, B. (1998) "Host country reforms and FDI inflows: how much difference do they make?". *World Development*, 26: 1299-1314.

Green, W.H. (2000) *Econometric Analysis*. (London; Prentice Hall International).

Guerrieri, P. and Manzocchi, S. (1996) "Patterns of trade and foreign direct investments in European manufacturing: "convergence" or "polarisation"?". *Rivista Italiana degli Economisti*, No. 2, pp. 213-232.

Haaparanta, P. (1996) "Competition for foreign direct investments". *Journal of Public Economics*, 63: 141-153.

Hymer, S. H. (1970) "The efficiency /contradiction) of multinational corporations". *American Economic Review*, 60(2): 441-448.

Ietto-Gilles, G. (1992) *International Production*. Cambridge: Polity Press.

Kogut, B. and Zander, U. (1993) "Knowledge of the firm and the evolutionary theory of the multinational corporation". *Journal of International Business Studies*, 24(4): 625-645.

KPMG (2002) *Competitive Alternatives. Comparing Business in North America, Europe and Japan*. (KPMG LLP).

Krugman, P. (1991): *Geography and Trade*. (Cambridge Mass.; The MIT Press).

Kuemmerle, W. (1996) "The drivers of foreign direct investments into research and development: an empirical investigation". *Journal of International Business Studies*, 30(1): 1-24.

Kumar, N. (2001) "Determinants of location of overseas R&D activity of multinational enterprises: the case of US and Japanese corporations". *Research Policy*, 30: 159-174.

Lösch, A. (1954) *The Economics of Location*. (New Haven; Yale University Press).

Maillat, D. (1995) "Territorial dynamic, innovative milieus and regional policies". *Enterpreneurship & Regional Development*, 7: 157-165.

Mariotti, S. and Piscitello, L. (1995) "Information costs and location FDI within the host country: empirical evidence from Italy". *Journal of International Business Studies*, 26(4): 815-842.

Mariotti, S. and Mutinelli, M. (1999) "Gli investimenti diretti esteri nel Mezzogiorno: il passato e le tendenze attuali". *L'Industria*, 2: 263-274.

Markusen, A. (1996) "Sticky placed in slippery space: a typology of industrial districts". *Economic Geography*, 72(3): 293-313.

Markusen, J. R. (1995) "The boundaries of multinational enterprises and the theory of international trade". *The Journal of Economic Perspectives*, 9(2): 169-189.

Markusen, J. R. and Venables, A. J. (1998) "Multinational firms and the new trade theory". *Journal of International Economics*, 4(46): 183-203.

Markusen, J. R. and Venables, A. J. (1999) "Foreign Direct Investment as a catalyst for industrial development" *European Economic Review*, 43: 335-356.

Mody, A. and Srinivasan, K. (1998) "Japanese and US firms as foreign investors: do they march to the same tune?". *The Canadian Journal of Economics*, 31(4): 778-779.

Moore, G. and Davis, K. (2000) "Learning the Silicon Valley way". *SIEPR Discussion Paper* No. 00-45.

Mudambi, R. (1995) "The MNE investment location decision: some empirical evidence". *Managerial and Decision Economics*, 6(3): 249-257.

Mudambi, R. (1998) "The role of duration in multinational investment strategies". *Journal of International Business Studies*, 29(2): 239-262.

Narula, R. and Wakelin, K. (1998) "Technological competitiveness, trade and foreign direct investment". *Structural Change and Economic Dynamics*, 9: 373-387.

O'Donnel, S. and Blumentritt, T. (1999) "The contribution of foreign subsidiaries to host country national competitiveness". *Journal of International Management*, 5: 187-206.

Ottaviano, G.I.P. and Puga, D. “Agglomeration in the global economy a survey of the “new economic geography””, CEPR *mimeo*.

Pavitt, K. L. R. (1985) “Patent statistics as indicators of innovative activity: possibilities and problems”. *Scientometrics*, 7(1-2): 77-99.

Piore, M. J. and Sabel, C. F. (1984) *The Second Industrial Divide*. (NewYork; Basic).

Rogriguez-Clare, A. (1996) “Multinationals, linkages and economic development”. *American Economic Review*, 86(4): 852-873.

Rolfe, R. J., Ricks, D. A., Pointer, M. M. and McCarty, M. (1993) “Determinants of FDI incentive preferences of MNEs”. *Journal of International Business Studies*, 24(2): 335-355.

Sanna-Randaccio, F. (2002) “The impact of foreign direct investment on home and host countries with endogenous R&D”. *Review of International Economics*, 10(2): 278-298.

Santangelo, G.D. (2002) “The Regional Geography of Corporate Patenting in Information and Communications Technology (ICT): Domestic And Foreign Dimension”. *Regional Studies*, 36(5): 495-514.

Saxenian, A. (1994): *Regional Advantage*. Cambridge Mass.: Harvard University Press.

UNCTAD (1997) *World Investment Report – Transnational Corporations, Market Structure and Competition Policy*. New York and Geneva: United Nations.

Zanfei, A. (2000) “L’impatto delle multinazionali sui paesi ospiti: il problema della creazione di legami a monte e a valle con le economie locali”. *Economia e Politica Industriale*, 5: 133-162.

[i] Sicily is classified as an Objective 1 region within the European Union regional policy.

[ii] The data are the results of the updating of the 1998 Reprint (Cnel-R&P-Politecnico of Milan) database up to May 2001. The updating has been conducting by consulting the local and national press as well as by interviewing local agencies involved in local development. Consistently with the Reprint (Cnel-R&P-Politecnico of Milan) database and in line with the 1997 criteria of the International Monetary Fund, FDI is defined as concerning corporate acquisitions of control or (minority or priority) long-term interests embodying a certain degree of involvement of the investor in the direction and management of the company.

[iii] For a comprehensive description of the NUTS classification see Eurostat (1995).

[iv] For a review on international production theories see e.g. Ietto-Gilles (1992).

[v] For a survey on the new economic geography see e.g. Ottaviano and Puga (1997).

[vi] These theoretical lines can be summarised in the neo-Marshallian model of industrial districts and local production systems (concerning mainly the studies on the "Third Italy"); the development of the evolutionary theory and the notion of 'innovative milieu' (Maillat, 1995) and 'technopole' (Castells and Hall, 1994); and the extension of work on the organisation of industrial production (Piore and Sabel, 1984).

[vii] Up to then, the issue of Italian Mezzogiorno was tackled through a national policy inspired to a model of basic industrialisation targeting the development of depressed regions by locating here public companies operating in energy sectors in order to boost the local economies. Given the weakness of the industrial structure of southern regions (mainly based upon traditional manufacturing sectors), this policy had the effect of further hampering their economic development .

[viii] We are aware of the drawback of the aggregate sectoral level. However we had to accept a trade-off between the detailed geographical unit of analysis adopted and the sectoral disaggregation available at this spatial level.

[ix] Syracuse is a major national pole of oil extraction.

[x] Although the theory prescribes a negative binomial model to deal with the overdipsersion generated by the count-data nature of the dependent variable (Green, 2000), the test of overdispersion was not statistically significant. Conversely, the test of goodness of fit of the Poisson regression model insures robust results.

[xi] Following an established stream of literature (e.g. Pavitt, 1985), patents are adopted as alternative indirect measures of knowledge creation as they capture the generation of new knowledge and, accordingly, provide some indirect evidence on the establishment of tacit capabilities, which make such knowledge operational (*Ibid*.).

[xii] RCA is the average of the following index calculated over the period considered:

$rca_{ij} = (X_{ij}/\Sigma_j X_{ij})/(\Sigma_i X_{ij}/\Sigma_{ij} X_{ij})$

where X_{ij} is the total export of province (i) in sector (j). Therefore, the nominator is the share of exports of province (i) in sector (j) relative to all other sectors, while the denominator is the share of exports of all provinces in that sector relative to the regional total in all sectors. Values greater (lower) than 1 denote specialisation (despecialisation) of province i in sector j.

[xiii] DIV_i can be formalised as the average of the following index:

$div_i = \mu_{RCAij}/\sigma_{RCAij}$

where μ_{RCAij} and σ_{RCAij} are the mean and the standard deviation of the RCA_{ij} distribution, respectively.

[xiv] The drawbacks of using these indicators based on exports to proxy technological capabilities should be acknowledged (Kumar, 2001): firstly, a province may be able to export a particular good by serving as export-platform for foreign MNCs as a result of imported knowledge and, therefore, it has not the corresponding local technological competencies in that particular sector; secondly, local technological capabilities in certain sectors may not be adequately reflected by exports behaviour because of relocation away from home base by local enterprises.

[xv] The incentives considered refer to incentives granted to the multinationals in the sample under law 488/92 for production investments in each of the Sicilian province from 1997 to the year 2000.

[xvi] Given the high correlation between UNI_i, and PAT_i and EDU_i (0.94 and 0.87, respectively), and between PAT_i and EDU_i (0.94), only UNI_i has been considered in the econometric exercise.

[xvii] In order to solve the problem of odd-ratio interpretation due to the log-linear nature of the poisson model, the coefficients have been transformed into incident-rate ratio (IRR), which are directly interpretable as elasticities (Green, 2000).

Table 1 - Share of foreign-owned plants located in Sicily, by firm national group

Parent Nationality	
Canada	4.17%
Finland	2.08%
France	22.92%
Germany	6.25%
Japan	4.17%
Kwait	2.08%
Netherlands	2.08%
Sweden	4.17%
Switzerland	4.17%
UK	6.25%
USA	41.67%
European Total	47.92%
North American Total	45.83%
Asian Total	6.25%
Total	**100.00%**

Table 2 - two-way ANOVA results§

		Sum of Square	df	Mean Square	F	
Main Effects	(Combined)	93.02	17	5.472	1.83	**
	PROVINCE	52.40	8	6.55	2.19	**
	SECTOR	40.62	9	4.514	1.51	
Model		93.02	17	5.472	1.83	**
Residual		215.38	72	2.99		
Total		308.40	89	3.47		

[§]Unique method: all effects entered simultaneously

** significant at $p < 0.05$

Table 3 - Share of foreign-owned plants located in Sicily, by sector

Sector	
Food, drink and tobacco	6.25%
Textiles, clothing and leather products	0.00%
Wood, rubber and other manufacturing	6.25%
Paper and publishing	4.17%
Chemicals and pharmaceuticals	25.00%
Oil and other energetic products	10.42%
Non-metallic ores*	4.17%
Metallic ores	0.00%
Mechanical equipment and metal products	41.67%
Vehicles and other means of transport	2.08%
Total	100.00%

Table 4 - Summary statistics

Dependent Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
$FPLANT_{ij}$	0.53	1.86	0	15
Independent Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
$UNEMP_{i}$	0.24	0.05	0.13	0.31
$MSIZE_{i}$	30.05	28.73	8.06	105.02
$SKILL_{ij}$	0.24	0.46	0.00	3.64
$WAGE_{ij}$	71512146	147725332	0	732744730
PAT_{i}	0.11	0.11	0.01	0.31
UNI_{i}	0.33	0.47	0.00	1.00
EDU_{i}	29023	18192	9394	63836
RCA_{ij}	2.46	3.53	0.01	20.18
DIV_{ij}	2.24	2.59	0.58	17.37
$INCE_{i}$	0.06	0.23	0.00	1.00
TOP_{ij}	0.17	0.71	0.00	6.13
$F{>}500_{i}$	0.00	0.00	0.00	0.00
$CRIME_{i}$	0.03	0.01	0.01	0.05
$FTURNOVER_{ij}$	0.12	0.06	0.00	0.33
$AIRP_{i}$	0.33	0.47	0.00	1.00

Table 5 – Correlation matrix

	$UNEMP_i$	$MSIZE_i$	$SKILL_{ij}$	$WAGE_{ij}$	PAT_i	UNI_i	EDU_i	RCA_{ij}	DIV_{ij}	$INCE_i$	TOP_{ij}	$F{>}500_i$	$CRIME_i$	$FTURNOVER_{ij}$	$AIRP_i$
$UNEMP_i$	1.00														
$MSIZE_i$	-0.82	1.00													
$SKILL_{ij}$	-0.09	0.28	1.00												
$WAGE_{ij}$	-0.25	0.02	0.11	1.00											
PAT_i	-0.77	0.78	-0.05	0.44	1.00										
UNI_i	-0.61	0.72	-0.09	0.42	0.94	1.00									
EDU_i	-0.665	0.80	-0.02	0.45	0.94	0.87	1.00								
RCA_{ij}	0.13	-0.08	0.02	0.02	-0.07	-0.05	-0.07	1.00							
DIV_{ij}	0.16	-0.18	0.05	0.99	-0.20	-0.19	-0.16	0.20	1.00						
$INCE_i$	0.01	-0.03	0.34	0.32	0.12	0.14	0.10	-0.02	0.06	1.00					
TOP_{ij}	0.01	-0.02	-0.01	-0.01	-0.06	-0.06	-0.04	-0.03	0.10	0.11	1.00				
$F{>}500_i$	-0.10	-0.28	0.08	-0.14	-0.20	-0.43	-0.30	-0.09	0.02	-0.04	0.02	1.00			
$CRIME_i$	-0.34	0.15	0.31	0.27	0.35	0.29	0.27	-0.26	-0.10	0.20	0.20	0.15	1.00		
$FTURNOVER_{ij}$	0.01	-0.15	-0.12	-0.06	-0.04	-0.10	-0.06	-0.08	0.01	-0.05	-0.14	0.35	-0.02	1.00	
$AIRP_i$	-0.43	0.51	-0.03	0.31	0.63	0.50	0.73	-0.05	-0.13	0.03	-0.04	0.21	0.07	0.08	1.00

Table 6 – Poisson estimation results

Variables	***Model 1***			***Model 2***			***Model 3***			***Model 4***		
	IRR	Z-ratio		IRR	Z-ratio		IRR	Z-ratio		IRR	Z-ratio	
Traditional location factors												
$UNEMP_i$	3.44E+08	0.88										
$MSIZE_i$	1.007271	0.22										
Local competences and intangible assets												
SKILL*ij*	13.8727	3.08	***	4.706789	4.40	***	3.478478	5.48	***	3.408532	5.54	***
$WAGE_{ij}$	1	2.64	**	1	2.53	**	1	6.63	***	1	4.27	***
UNI_i	860.1346	2.56	**	10.10247	3.14	***	5.890946	3.1	***	6.332297	3.3	***
RCA_{ij}	1.029693	0.32					1.15593	2.68	***	1.118984	1.72	*
DIV_{ij}	1.100253	0.77										
Economic policy												
$INCE_i$	0.3639957	-0.76										
Information costs												
TOP_{ij}	3.456622	3.27	***	2.473	4.20	***	2.10822	5.94	***	2.02708	5.33	***
$F{>}500_i$	.	1.93	*	.	1.75	*						
Socio-economic context												
$CRIME_i$	7.81E-50	-1.79	*	4.81E-22	-1.32							
$FTURNOVER_{ij}$	0.00189	-0.92										
Transport infrastructures												
$AIRP_i$	0.1858278	-1.23										
Control Variables												
CTel	3.865831	0.94		4.585332	2.14	**				1.641479	0.83	
CTch	4.842492	1.27		4.549687	2.7	***	2.499972	2.15	**			
No of obs.	90			90			90			90		
Log likelihood	-45.086			-47.946			-51.809			-53.370		
	LR chi2(15)	158.09	***	LR chi2(8)	152.37	***	LR chi2(6)	144.64	***	LR chi2(6)	141.52	***
	chi2(74)	45.057	***	chi2(83)	50.776	***	chi2(83)	58.503	**	chi2(83)	61.625	**

**** Significant at $p < 0.01$
** Significant at $p < 0.05$
* Significant at $p < 0.10$

Table A1 - List of variables and relative description, time consistency and source

Variable	Description	Period	Source
Dependent			
$FPLANT_{ij}$	number of plants acquired by foreign investors and located in Sicilian provinces	2001	Author's updating on 1998 Reprint, Cnel-R&P-Politecnico di Milano database
Independent			
Traditional location factors			
$UNEMP_i$	number of people on the unemployment lists per inhabitant (%)	average 1996-1998	Confindustria Istituto Guglielmo Tagliacarne
$MSIZE_i$	per capite value-added (Lit. billions)	average 1996-1998	
Local competences and intangible assets			
$SKILL_{ij}$	managerial and white collar components to total employees on the manufactory industry (%)	average 1996-1998	INPS
$WAGE_{ij}$	annual average retribution (Lit. thousand)	weighted average 1996-1998	INPS
PAT_i	share of patents relative to the regional total patenting activity (%)	1995	ISTAT
UNI_i	Dummy variable equals 1 if the province hosts a University, and 0 otherwise.		
EDU_i	number of full-time students enrolled in secondary educations	average 1996-1998	ISTAT
RCA_{ij}	degree of export specialisation (Lit. millions)	average 1996-1998	ISTAT
DIV_{ij}	degree of export diversification	average 1996-1998	ISTAT
Economic policy			
$INCE_i$	Dummy variable equals 1 if any firm in province ($_i$) and sector ($_j$) has been granted an incentive, and 0 otherwise	1996-2000	Ministry of Industry Trade and Craft
Information costs			
TOP_{ij}	trade openness (Lit. millions)	average 1996-1998	ISTAT
$F{>}500_i$	number of firms with 500 or more employees (normalised with the total number of manufacturing firms) (%)	1996	Census ISTAT
Socio-economic context			
$CRIME_i$	number of illegal acts per inhabitant (%)	average 1996-1998	ISTAT
$FTURNOVER_{ij}$	turnover of active firms (%)	average 1996-1998	Unioncamere
Transport infrastructures			
$AIRP_i$	Dummy variable equals 1 if the province hosts an airport, and 0 otherwise.		

Figure 1 - Means of firms, by province

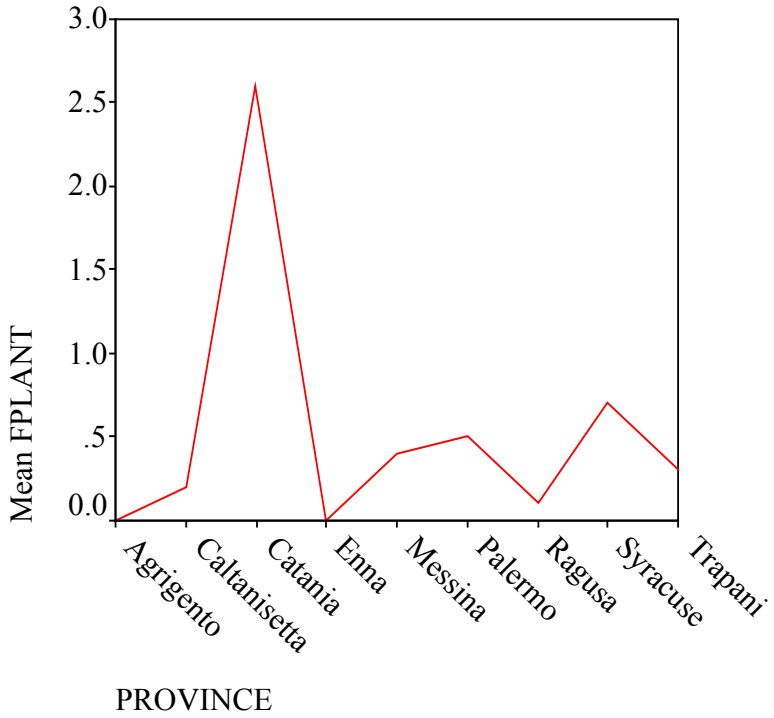

Figure 2 - Number of firms operating in "information technology and related activities" and located in the province of Catania, 1996-2001