UNCTAD/ITE/IIT/2005/5

VOLUME 14 NUMBER 2 AUGUST 2005

TRANSNATIONAL CORPORATIONS

Global technology: innovation strategies of foreign affiliates in Italy

by

Giovanni Balcet and Rinaldo Evangelista

United Nations
New York and Geneva, 2005
United Nations Conference on Trade and Development
Division on Investment, Technology and Enterprise Development

Global technology: innovation strategies of foreign affiliates in Italy

Giovanni Balcet and Rinaldo Evangelista*

The relevance, nature and economic effects of innovation activities of transnational corporations are highly debated topics in the current literature on the "globalization of technology". A controversial theme concerns the innovation strategies of foreign affiliates and the role they play in host countries. This article sheds new light on this topic by assessing the technological contribution of foreign affiliates in Italy; comparing the innovation performance and strategies of foreign affiliates and domestic firms; and qualifying the main patterns of innovative activities of transnational corporations. The empirical evidence presented shows that foreign affiliates and domestic firms differ from each other more in terms of type of innovation strategies pursued than in terms of innovation performance. However, innovation strategies of foreign affiliates reflect a high degree of heterogeneity, being affected by the technological characteristics of an industry, the specific technological assets of firms as well as by some peculiar features of the Italian innovation and production systems,

* Giovanni Balcet is professor of International Economics at University of Torino, Italy. Rinaldo Evangelista is a researcher at the National Research Council of Italy (CNR-IRPPS, Rome) and a Professor on contract of Political Economy at Univerità di Camerino and CNR-IRPPS, Roma. Contact: giovanni.balcet@unito.it or r.evangelista@irpps.cnr.it.
The firm-level data-set used for the empirical analysis presented in this article was generated through the merging of the ELIOS database developed by the University of Urbino and the CIS2 data provided by Istat. The authors are grateful to both Institutions and in particular to Antonello Zanfei and Davide Castellani of the University of Urbino and Giulio Perani of ISTAT for the access given to the micro-data. The authors are also grateful to three anonymous referees for their useful comments and suggestions. As usual the authors are solely responsible for the results presented and the views expressed in the article.

The views expressed in this article are those of the authors and do not necessarily reflect the views of the United Nations.

namely its specialization in traditional goods and mechanical engineering combined with its weakness in science-based industries. Three distinct innovation patterns of foreign affiliates were identified and labelled respectively as low-tech, adaptive and asset seeking. These patterns differ on the basis of the overall commitment of foreign affiliates to innovation, the sources and objectives of the technological activities undertaken and the nature, strength and geographical horizon of technological links established with the external environment. Among the three, the "adaptive" pattern is by far the dominant one, while foreign affiliates following an "asset seeking" strategy are rare, and they are surprisingly lacking in high-tech industries. The empirical findings reflect the structural features of Italian industry and innovation system and highlight some more general stylized features of innovation strategies of foreign affiliates.

Key words: technology, innovation, globalization, transnational corporations

1. Theoretical issues: the internationalization of technology by TNCs

The relevance, characteristics and economic effects of the internationalization of the innovation strategies of transnational corporations (TNCs), or technological globalization, are highly debated issues. There are three main dimensions of global technology (Archibugi and Michie, 1997):

- the exploitation and transfer of technological innovation in international markets;
- the international location of research and development (R&D) and innovative activities by TNCs; and
- international technological co-operation and networking.

Traditionally, the economic literature on TNCs considered the production of new technology to be heavily concentrated in their headquarters in the home countries, and then diffused internationally via foreign direct investment (FDI). The

international transfer of technology was at the core of the mechanism described, since the 1960s, by the well-known product-life-cycle model (Vernon, 1966). In this model, dynamic inter-relations between innovators and followers explain both the direction and evolution over time of international trade flows, as well as the crucial decision of innovative exporting firms to become transnational, via FDI.

The empirical evidence on trade patterns, FDI and patent distribution shows a positive correlation in most advanced countries between innovative intensity on the one hand, and export performance and international production on the other hand, while the pace of the product life cycle has been shortening over time in recent decades (Cantwell, 1997).

During the 1990s, the internationalization of the production of new technologies within TNCs, including R&D projects, process and product innovation, design and patenting, has become more and more relevant (Patel, 1997), with the exception of Japan. Strong sectoral specificity, as well as path-dependency, have been observed in the international fragmentation of innovative activities (Narula, 2003).

A multiplicity of locations of innovation centres within TNCs results from these processes (Dunning, 1993; Cantwell, 1994). Not only has incremental R&D been decentralized in order to adapt products to local needs and requirements, but some TNCs have also located segments of basic research abroad, as discussed in the next section.

Foreign ownership affects innovation processes because foreign affiliates may be more (or less) innovative than domestic enterprises, because of the specific advantages of transnationality (positive effects of operating in various countries), and because TNCs have by definition the advantage of belonging to a group (Ietto-Gillies, 2002).

We must note, however, that the international spread of technological capabilities may not only be the result of explicit innovation strategies developed by TNCs, but also the indirect

outcome of international acquisitions of innovative firms, aimed at different goals, such as market penetration.

The international spread and decentralization of innovative activities is driven by the following factors:

- the need to adapt products to local conditions, local regulations and constraints;
- good scientific infrastructure and human capital in the host country;
- the size and growth rates of foreign markets;
- high R&D intensity of the industry;
- the strategies of international location of R&D and innovation activities by direct competitors;
- the capacity of TNCs to manage efficiently complex research systems and innovation networks;
- acquisitions of firms abroad with complementary or similar technological capabilities; and
- the high cost of research and the lack of scientific infrastructure in the home country.

The spread of inter-firm cooperative networks characterizes what has been called "alliance capitalism", where oligopolistic competition coexists with inter-firm cooperation (Dunning, 1997; Contractor and Lorange, 2002). The creation of international inter-firm R&D partnerships and research-oriented networks, developed since the 1960s (Hagedoorn, 2002), has been interpreted as a consequence of the shortening of the product life cycle (Cantwell, 1997). This trend was characterized by a new orientation of TNCs towards global asset-seeking strategies, which also implied a more active technological role of their foreign affiliates in host countries. The setting-up of linkages and relationships between foreign affiliates and local science and technological institutions has progressively become a characterising feature of this new strategy (UNCTAD, 2001).

A concentration of joint ventures and co-operation agreements has also been observed in new industries, such as information and communications technologies (ICTs) and

biotechnology. They involve both national firms and TNCs, as well as government agencies and academic centres. Partner firms may be vertically connected, or they may be operating in the same industry.

Technology-oriented joint ventures, international networks of alliances and co-operation agreements, while pushing ahead the international sharing of technological knowledge and practices, interact with the internationalization of innovative activities within TNCs, such as intra-muros R&D. A "learning-by-cooperating" effect has been observed in the case of Italian inter-firm cooperative agreements abroad (Balcet, 1988).

In several high-tech industries, such as telecommunications and software, network externalities are a primary source of competitiveness, and global technological standards shape the markets. Rival companies tend to cooperate in research, sharing their knowledge in strategic R&D intensive areas, while competing in final markets.

Governments and local administrations may deeply influence inter-firm alliances aiming to impose global standards, as a part of their strategic industrial policies (Narula, 1999; Hagedoorn, Link and Vonortas, 2000).

The innovation strategies and performance of foreign affiliates are therefore the result of various factors, the most important being the specific technological assets of TNCs that invest in a host country, the industry in which they operate and the technological attractiveness – i.e. localized context-specific factors – of the country/region hosting foreign affiliates (Dunning, 1997).

Technological knowledge and innovative capabilities may be embedded in a firm's organization, or localized in a given territory (Antonelli, 1995, 1999). How these two dimensions interact with each other is a major analytical issue that needs to be addressed. In fact, TNCs search for scientific and technological resources that are country-specific and localized, actively interacting with them, and internalizing new

technologies within their organizations (Narula, 2003). Path-dependency may result at the firm level, because innovative capabilities are embedded in its organization, human resources and routines. At the same time, they may be localized in a territory or district, where technological externalities and agglomeration phenomena are more likely to arise. The relationship between local and global dimensions of technology is therefore a crucial issue (Cantwell and Iammarino, 2003).

This article seeks to shed light on these issues, investigating the intensity and the main features of the innovative activities carried out by foreign affiliates in Italy. Its basic questions are:

- What are the technological activities, innovation strategies and performance of foreign affiliates in Italy, compared to those of domestic firms?
- What are the main patterns of technological internationalisation of TNCs?
- How to assess the contribution of foreign affiliates to the creation of endogenous technological capabilities?

In answering these questions, we mean to contribute to the debate on the effects of technological globalization and, in particular, on the issue of the impact of TNCs on host countries. The list of questions above serves to exemplify the complexity and multidimensionality of the matter, which needs to be explored with robust data-sets and sound empirical evidence.

In order to investigate the qualitative and strategic aspects of these innovation strategies, it is crucial to identify some basic patterns of the innovative activities of TNCs, characterizing their behaviour and strategies. These ex-ante patterns are presented in the next section; they are the base for shedding light on the empirical evidence presented, based on the Italian case. Section 3 highlights some essential features of the pattern of "transnationalization" of Italian industry, relevant for analyzing the innovation strategies of foreign affiliates. Section 4 contains the empirical part of the article, presenting a description of the database. Section 5 provides a systematic comparison between

the innovative activities and performance of domestic firms and foreign affiliates, while the main typologies of innovative patterns of foreign affiliates are identified in Section 6. The concluding section brings together the main results presented in this article and draws some policy implications.

2. Patterns of innovative activities by foreign affiliates: low-technology, adaptive and asset-seeking strategies

A vast amount of literature suggests that a variety of patterns of technological globalization are likely to coexist, depending on the specific technological characteristics of industries, as well as on the basic technological and economic features of host countries and regions. Based on Christian Le Bas and Christophe Sierra (2002), we can identify *ex ante* three different types of strategies and innovative behaviours of foreign affiliates:

Low technology foreign affiliates

Foreign affiliates characterized by weak internal knowledge assets and poor innovation performances comprise a first category.

This pattern may fit well with the first stage of the already mentioned traditional product-life-cycle scheme, and with Raymond Vernon's (1966) hypothesis of unidirectional centre-periphery technology flows. Foreign affiliates produce innovative goods designed and developed abroad, mainly in the home country of TNCs. Their main missions are the production and distribution of commodities. They can be either export-oriented or local-market oriented. In the first case, their export performance is not explained by competitive advantages based on innovation, but rather by other types of competitive factors such as economies of scale, skills, brands, marketing capabilities and organization. In the second case, they serve the domestic market without any significant adaptation of the product to local needs, regulations and market conditions.

This pattern is associated with strategies of internationalization of production with little commitment to innovation. The propensity to introduce innovation is likely to be very low, with process innovation playing a dominant role. R&D activities (both internal and external) are expected to be absent or very limited, with most of the innovative efforts being focussed on the acquisition of machinery and new equipment. We can expect that both the import of innovations developed elsewhere (especially by the parent company) and investment in new machinery represent a large share of total innovation costs. Technological interactions and knowledge flows with the external environment are expected to be very low or absent.

Domestic market oriented strategies and adaptive innovative activities

In this second pattern, innovative activities abroad are mainly meant to adapt products or processes to the specific features of local demand and regulations. R&D is mainly contextual to local production, and is expected to be incremental and limited to product development, not including the generation of general-purpose technologies and basic research. It may correspond to a second evolutionary stage of the product life cycle, building on the previous simple transfer of technology from the centre to the periphery.

The main motivation of TNCs in this case is access to domestic markets, through acquisitions or greenfield FDI, and the exploitation of innovative advantages created abroad and transferred from the home country or from other affiliates of the group. Therefore, this pattern represents the first step of a process of the internationalization of innovation.

The existing empirical literature also suggests that the customization and adaptation of existing products and technologies is the most frequent motivation of TNCs – and the main driver – of the internationalization of innovation.

This pattern has been defined in terms of "asset-exploiting R&D" (Dunning and Narula, 1995), "home-base exploiting"

innovative activities abroad (Kuemmerle, 1999), or "exploitation, refinement and extension" of existing technologies and competencies (March, 1991).

We can expect that foreign affiliates following this strategic orientation are characterized by relevant intra-group technology inflows, and that the innovation intensity itself may vary; it can be relevant in some cases, but is expected to be, on average, lower than in the "global" pattern defined below.

The adaptive pattern is characterized by innovation strategies that are not meant to be "radical". The innovation output is likely to be made up of a mixture of product and process innovations, with some of these developed by the head of the enterprise group and transferred to foreign affiliates. Accordingly, compared to the asset-seeking profile, R&D activities play a less crucial role in this innovation pattern. In this case, foreign affiliates are more likely to rely upon external R&D services (acquired from headquarters) and incremental knowledge sources (such as design, trial production).

With the exception of intra-group linkages, knowledge flows with the external environment (both local and global) are expected to be limited. Both production and innovation activities of foreign affiliates aim at adapting to local markets products and technologies developed within a group. As a consequence, the export propensity of foreign affiliates is expected to be rather low.

Global technology: asset-seeking innovative activities

In this pattern, innovative activities are carried out within international research networks, in order to develop distinctive knowledge assets and technological capabilities. Innovative activities are integrated within macro-regional or global transnational networks in which foreign affiliates share a good deal of general purpose knowledge and technology.

In several high-tech industries, an increasing proportion of FDI has been motivated by the acquisition of new technologies

and the setting-up of networks for the international sourcing of scientific and technological resources. The role of external actors and institutions for developing new knowledge is important in this strategy, giving rise to technological alliances (section 1).

The proximity of technological districts, universities and research institutions, as well as the availability of highly qualified human resources, strongly supports this strategy, developed through the acquisition of existing R&D units or through greenfield R&D investments. Agglomeration phenomena and technological clusters generate locational advantages for these foreign affiliates. For example, Paul Almeida (1996) has provided extensive evidence on the case of FDI in the semiconductor industry in Silicon Valley, where technology-seeking foreign affiliates have been rather effective for enhancing the catching-up of transnational newcomers and followers (Kim, 1997).

As a consequence, foreign affiliates pursuing an asset-seeking strategy are also capable of exporting technologies, patents and new components and products, in particular within their corporate group. Moreover, we can expect that, in this case, an important share of the production of foreign affiliates will be export oriented.

This pattern was envisaged in one of his late works by Raymond Vernon (1979) who defined highly developed TNCs as "global scanners" and suggested an active role of foreign affiliates in the creation of new products. In the most recent literature, "strategic asset-seeking activities" (Dunning and Narula, 1995) have also been defined in terms of "knowledge-based FDI" (Frost, 2001), "home-based augmenting activities" (Kuemmerle, 1999) or "exploration and experimentation" strategies (March, 1991).

Firms following an asset-seeking pattern are expected to show a heavy commitment to innovation activities, with a high propensity to introduce product innovation developed internally and large resources devoted to (internal) R&D. The radical

nature of technological activities carried out by foreign affiliates should lead to some patent activity, significant intra-group technology outflows and the establishment of systematic relationships with universities and R&D centres. The geographical horizon of these knowledge interactions, and in particular cooperation, should not be confined to intra-group linkages but should go beyond the region where foreign affiliates operate. High export propensity is also likely to be associated with such a pattern.

The characterizing features of the three innovation patterns described above are synthesized in table 1 and will be used as *ex-ante* typologies to be explored and empirically tested in section 6. It should also be stressed that these patterns are stylized typologies. In fact, mixed forms, intermediate strategies and, more interesting, evolutions from pattern B to pattern C can be frequently observed. Technological competencies in R&D units abroad in a first stage are often created to cope with local adaptation needs; but in a second stage the same units may develop autonomous technological capabilities and also transfer technologies within the transnational network they belong to. This trend has been observed in the case of German TNCs (Wortmann, 1990), as well as in the automotive industry (Balcet and Enrietti, 2002).

3. The sectoral patterns of employment in foreign affiliates in Italy: the role of science-based industries

As mentioned, the innovative behaviour of foreign affiliates is explored empirically in the following sections, looking at the case of Italy. It is therefore important to start to address our empirical agenda by providing some preliminary evidence on the pattern of the transnationalization of Italian industry, especially with reference to its sectoral characterization. Even a simple sectoral breakdown of the data on inward FDI over the past 15 years can provide indirect indications of the technological attractiveness of the Italian innovation system.

Table 1. Innovation patterns of foreign affiliates: hypotheses and expected results

Variable	Innovation patterns of foreign affiliates		
	Low tech	Adaptive	Asset seeking
Type of innovation	Process	Product (incremental)	Product (radical)
Internal capability to generate innovation	Low	Medium	High
Innovation intensity (resources devoted to innovation & R&D)	Low	Medium	High
Dominant type of innovation activity	Adoption of new equipment and machinery	R&D (external) & design contextual to local production	R&D (internal) & patenting
Innovation strategy (objectives of innovation)	Lowering cost	Incremental (Improve quality, fulfil regulations and standards)	Radical (Substitute products, enter new markets)
Cooperation			
- with universities, R&D centres, clients, suppliers	Very low	Low	High
- within the group	Low	Medium	High
- within the group only	High	Medium	Absent
- world-wide cooperation	Absent	Low	High
Other external linkages (with universities, R&D centres, suppliers)	Very low	Low	High
Export propensity	-	Low	High

Source: the authors.

Table 2 shows that most employment in foreign affiliates is concentrated, as expected, in scale-intensive industries. It is well known that these industries, as well as the science-based industries, are dominated by large corporations operating on an international scale. Their share has grown from 44.3% in 1985 to 51.8% in 2003.

It is interesting to note, for our purposes, that, in 1985, science-based industries represented 31.5% of foreign affiliates' total employment, but this share has been continuously decreasing since then, reaching 26.0% in 1995 and 22.7% in 2003. Such a trend may be interpreted as the result of a decreasing attractiveness of Italy in high-tech industries, which could be due to decreasing investment, both private and public, in innovation, R&D, technological infrastructures and higher education (Fagerberg *et al.*, 1999).

An international comparative analysis of the Italian pattern of transnationalization can be done by looking at the role played by foreign affiliates (in terms of output shares) in the most innovative industries in different countries (OECD, 2001). In a group of highly technologically-attractive countries such as the United States, the United Kingdom, France, Germany, Sweden, Finland, and the Czech Republic, foreign affiliates are concentrated in the most innovative industries; a share between 50% and 70% of their production belongs to "high technology"

Table 2. Employment in foreign manufacturing affiliates in Italy and in foreign affiliates of Italian firms, by macro-sectors (at year end)

Type of industry	1985	Per cent	1995	Per cent	2003	Per cent
Scale-intensive	206 172	44.3	255 490	48.8	318 573	51.8
Science & technology-based	146 644	31.5	136 030	26	139 693	22.7
Specialized suppliers	86 156	18.5	101 458	19.4	117 665	19.2
Traditional	30 866	6.6	30 057	5.7	38 496	6.3
Total industry	465 143	100	523 035	100	614 427	100

Source: Mariotti and Mutinelli, 2004.

or to "medium-high-technology" groups of industries.[1] The Italian case seems more similar to that of the Netherlands, Poland and Norway, where foreign affiliates are concentrated in less technology-intensive industries. However, the share of employment of foreign affiliates in science-based industries is still higher than the share of domestic Italian firms in the same industries; this is a result of the well known weaknesses of the Italian innovation system and in particular of its R&D-intensive industries (Malerba, 1993; OECD, 2004; Ferrari et al., 2004). These weaknesses are confirmed also by the limited presence of Italian TNCs abroad, especially in the science-based industries. These industries account for less than 10% of the total employment of Italian foreign affiliates abroad. Therefore, the pattern of international production is converging with the pattern of international trade, especially in the case of traditional and specialized mechanical engineering industries, which account for a high share of Italian exports[2] (Balcet, 1997).

The overall picture provided by table 2 does not allow us to assess what is the dominant driver of innovation activities by TNCs in Italy and, in particular, what is the dominant one between strategies aimed at:

- manufacturing in the country on the basis of imported technologies, in order to penetrate the large domestic market and/or to export to other European Union countries; and
- decentralizing a substantial part of their technological activities to foreign affiliates located in Italy in the context of an asset-seeking strategy. In this case, foreign affiliates are expected to create linkages and to contribute to the development of the country's national innovation system.

[1] Japan and Ireland also show very high values, but their cases are very peculiar, for opposite reasons: the very low penetration of TNCs in the former, and the very high penetration in the latter.

[2] In the specialized suppliers industries, Italian companies (usually small in size) show a limited but growing propensity to invest abroad, although they are highly export oriented. The share of foreign production in traditional industries grew significantly during the 1990s, thanks to a process of relocation of production capacity to low wage areas such as Eastern Europe.

The limited empirical evidence available on this topic shows that both types of strategies can be observed. In some cases, R&D-intensive Italian firms have been acquired by their foreign competitors (e.g. the pharmaceutical industry), which have integrated Italian R&D divisions into their international networks, coordinated by regional or global headquarters.

An exploratory study, based on the information provided by the first Community Innovation Survey (CIS) for the year 1992, estimated that foreign affiliates accounted for 23.1% of total industrial R&D expenditure in Italy (Balcet and Cornaglia, 2001).

Most of the crucial questions raised in section 1 concerning the relevance and impact of technological spillovers from foreign affiliates and the innovation strategies and performance of foreign affiliates are still open in the case of Italy. Further investigation is therefore needed.

4. Data and methodology

The empirical analysis presented in this article is based on the use of data provided by the Italian innovation survey (part of the second CIS), carried out in 1997 and covering to the period 1994 through 1996. The CIS provides a wide range of information on the specific innovation strategies and performance of firms and also on their ownership structure. Firms are in fact asked whether they are part of an enterprise group and, if so, to indicate the nationality of the head office. This piece of information is however based on a rather loose definition of "ownership" and may be unreliable regarding who is the ultimate beneficial owner of firms. More reliable information on the true nationality of firms, considering the whole chain of control, has therefore been drawn from the ELIOS database (European Linkages, International Operations and Ownership Structure) developed by the University of Urbino. The latter is a Pan-European data-set based on Bureau Van Dijck "Amadeus" and Dun and Bradstreet "Who Owns Whom" databases (Castellani and Zanfei, 2002, 2003a, 2003b).

The firm-level data-set used for the empirical analysis presented in the following two sections is the result of the merging (at the firm level) of the Italian CIS2 data-set and the ELIOS database. The outcome is a data-set (hereafter called CIS2-ELIOS) of 1,115 observations, containing all CIS2 variables and the "Who Owns Whom" information on the transnationality of firms.[3]

In the empirical analysis, we focus on selected variables contained in the CIS2-ELIOS database, namely those providing information on the following: the ownership/transnationality of the firm (domestic/foreign and nationality of the head office) and its export propensity; the presence of innovation activities and the type of innovation introduced (product/process); the type of innovation inputs used (R&D, investment and other inputs) and the amount of resources devoted to such activities (both per employee and as a share of total innovation costs); the technological linkages and interactions with the external environment (degree of importance) and the presence, scope and geographical horizon of cooperation (see table 4 for a detailed description of the indicators used in the empirical analysis).

The structure and sectoral coverage of both the Italian CIS2 sample (representative of all Italian manufacturing firms with more than 19 employees) and the CIS2-ELIOS data-set are shown in table 3. The comparison between the two data-sets reveals that the CIS2-ELIOS database is somewhat biased towards large firms. While in the CIS2 data-set the first firm

[3] As mentioned, the CIS-ELIOS data-set refers to the 1994-1996 period. This is a clear limitation. The merging at the micro level of CIS 2 data with other information sources (i.e. the ELIOS database) required solving a series of complex methodological problems and following time consuming administrative procedures. This means that updating our empirical exercise would have required a substantial delay in the circulation and publication of the results.

However, it is reasonable to argue that the innovative patterns of foreign affiliates identified in the following sections are rather structural, as it reflects innovative behaviour and performance, as well as the presence of contextual factors, which are not expected to change substantially in a short time.

size class (20-99 employees) accounts for 88% of total manufacturing firms and 41% of total employees, in the case of the CIS2-ELIOS sample, the same size class accounts for a much lower share of firms and employees (22% and 2%, respectively). The sectoral coverage of CIS2-ELIOS is much more balanced and closely mirrors that of CIS2. This guarantees a reasonably good sectoral representativeness of our data-set. More than one third of firms in the CIS2-ELIOS sample are foreign affiliates of TNCs whose head office is located outside Italy. The remaining observations are either Italian independent firms or firms owned by an Italian head office.

The industrial break-down presented in table 3 corresponds roughly to a two digit NACE Rev1 classification. In some cases, industries have been pulled together in order to reach a minimum number (three at least) of foreign affiliates in each industrial group. The industrial and firm size breakdowns presented in table 3 are used to control for the presence of fixed factors in the econometric estimates presented in the following sections.

5. A comparison between foreign affiliates and domestic firms

In this section we start exploiting the information contained in the CIS2-ELIOS database by assessing the technological contribution of foreign affiliates in a host country such as Italy. This exercise is carried out by comparing the innovation performance and strategies of foreign affiliates (abbreviated as FAs) and those characterizing domestic firms (DOM). The questions we try to answer are the following:

- Are foreign affiliates more innovative than domestic firms?
- Are the innovation strategies of foreign affiliates different from the ones characterizing domestic firms?
- Do foreign affiliates rely on different types of knowledge sources?
- What kind of technological links do foreign affiliates establish with the local environment?
- Are differences in the innovation performance of foreign affiliates and domestic firms industry specific?

Table 3. CIS2-ELIOS sample

Item	CIS2 universe				CIS2-ELIOS sample							
					Total sample				Foreign affiliates			
	No. of firms	Per cent	No. of employees	Per cent	No. of firms	Per cent	No. of employees	Per cent	No. of firms	Per cent	No. of employees	Per cent
Sectors												
Oil, gas, metal estraction	733	2	202 927	7	37	3	125 076	15	13	4	3 093	1
Food, beverage and tobacco	2 744	7	234 765	8	65	6	51 212	6	21	6	28 943	13
Textile, footware, wood, furniture	10 422	26	539 271	17	138	12	57 998	7	15	5	5 474	3
Paper and printing	2 054	5	147 654	5	76	7	34 576	4	17	5	7 017	3
Chemical products	972	2	128 750	4	78	7	48 438	6	38	11	22 940	11
Pharamceutical products	267	1	62 152	2	39	3	28 000	3	21	6	16 673	8
Rubber and plastic	2 127	5	135 311	4	64	6	29 140	4	21	6	14 794	7
Metals	3 160	8	279 570	9	124	11	81 499	10	24	7	14 994	7
Metal products	5 641	14	259 461	8	74	7	16 582	2	21	6	4 800	2
Mech. machinery	4 851	12	400 167	13	179	16	100 232	12	54	16	39 327	18
Office machinery, elctr. equip. products	3 109	8	308 878	10	138	12	82 846	10	51	15	43 099	20
Automobile components	486	1	67 308	2	29	3	20 783	3	23	7	9 448	4
Other transport	638	2	209 670	7	32	3	120 945	15	3	1	1 181	1
Other industries	2 700	7	134 647	4	42	4	12 887	2	9	3	4 437	2
Firm size classes (number of employees)												
20-99	34 941	88	1279 903	41	243	22	13 341	2	62	19	3 491	2
100-499	4 415	11	833 831	27	579	52	157 679	19	158	48	43 813	20
500 and over	548	1	996 798	32	293	26	639 194	79	111	34	168 916	78
Total	39 904	100	3110 531	100	1 115	100	810 214	100	331	100	216 220	100

Source: the authors.

Table 4 provides a comprehensive picture of the results of the comparisons between foreign affiliates and domestic firms in the CIS2-ELIOS sample, using a wide range of indicators contained in the data-set.[4] The first two columns show for each indicator the average values for domestic firms and foreign affiliates, respectively; when foreign affiliates and domestic firms are compared at such an aggregate level, the following picture emerges: foreign affiliates show a higher propensity to innovate (INNO), rely more on R&D activities (RDY, RDEXTY) and tend to cooperate less with other firms and institutions, although they show frequent cooperation agreements with other firms within the corporate group that they belong to. In particular, the share of innovating firms is 5% higher among foreign affiliates than among domestic firms. Furthermore, compared to domestic firms, foreign affiliates devote a higher share of their innovation expenditures to R&D (both internal (+22%) and external (+46%)) and cooperate less with universities (-16%), R&D centres (-35%) and suppliers (-34%).

These results are likely to be affected by compositional effects, especially the concentration of foreign affiliates in science-based and scale-intensive industries and by the average size of foreign affiliates (which is much larger than that of domestic firms). To get rid of these effects, we can look at the last column of table 4, which shows the *b* coefficients estimated by running multinomial logit and ordinary least squares regressions with the inclusion of control factors (column 3). Each indicator (used as a dependent variable) has been regressed against the indicator "FA" (binary variable indicating foreign ownership of a firm) and a series of industry and firm size dummies. A positive sign of the b coefficient indicates the presence of a positive difference in the average values between foreign affiliates and the group of domestic firms after having controlled for the presence of fixed effects.

[4] For most indicators (those signed with a star in table 5) the comparison between foreign affiliates and domestic firms is made using data for a sub-sample of 584 innovating firms, excluding firms with missing values in the case of the most relevant indicators. The representativeness of this sub-sample – both across industries and firm size classes – remains nonetheless reasonably good.

Table 4. Innovation performances of foreign affiliates (FA) vis à vis domestic firms (DOM)

Type of indivator	Description		DOM average values	FA average values	FA-DOM Logit & OLS estimates (with control factors) B coeff. (associated to FA)	Sig
Innovativness	Per cent of innovating firms	INNO	70.9	77.4	0.04	0.817
Type of innovation	product innovation (%)	INPDT	86.5	90.2	0.19	0.490
	- product innov. developed internally (%)	INPDT1	68.5	69.1	-0.13	0.482
	- product innov. developed in coop. (%)	INPDT2	24.9	28.9	0.07	0.728
	- product innov. developed by others (%)	**INPDT3**	3.0	7.3	0.81	0.036
	process innovation (%)	**INPCS**	87.2	82.9	-0.49	0.034
*Innovation intensity**	total innovation costs per empl. (Euro*1000)	INEXP	6.88	7.19	0.44	0.804
	R&D expenditures per employee (Euro*1000)	RDEXP	2.24	2.71	0.01	0.988
*Type of innovation activity**	Total R&D exp. on total innov. Costs (%)	**RDY**	34.7	42.4	0.05	0.071
	External R&D/total R&D (%)	**RDEXTY**	13.8	20.2	0.07	0.005
	Investments/total innovation costs (%)	**RMACY**	23.4	24.7	-0.08	0.002
	Non-R&D exp. / total innov.costs (%)	NONRDY	41.9	33.0	0.00	0.127
*Patents**	Per cent of innovating firms with a patent application	**PAT**	43.4	42.7	-0.30	0.096
Information sources*	Per cent of innovating firms attaching importance to:					
	universities	**SUNI**	16.7	12.6	-0.57	0.018
	R&D inst.	**SGMT**	11.5	9.8	-0.48	0.089
	suppliers	**SSUP**	24.7	18.3	-0.34	0.102
Objectives of innovation*	relevance (average scores on a 1-3 scale)					
	substitute products &/or enter in new markets	**ORADIC**	1.69	1.90	0.16	0.034
	improve quality &/or fulfilling reg. & stand.	OINCR	1.93	1.95	0.04	0.532
*Cooperation**	Per cent of cooperating firms	CO	29.7	37.8	0.13	0.451
*Type of cooperation**	- with clients	COCLIE	8.9	11.4	0.10	0.747
	- with suppliers	COSUP	8.7	7.3	-0.51	0.148
	- with universities	**COUNI**	13.0	13.8	-0.54	0.077
	- with other R&D inst.	**CORD**	5.4	4.5	-0.72	0.087
	- world-wide cooperation**	COGLOBAL	8.2	16.7	-	-
Export prop.	Export/turnover (%)	EXPTURN	34.8	35.3	0.01	0.426

Source: the authors.

Variables in bold are those for which sigificant differences have been found when controlling for sectoral and firm-size compositional effects.

* Figures referring to a sub sample of 584 innovating firms with valid data for all indicators.

** With firms and institutions located in a continent different from the head office residence.

These estimates confirm that the greater innovativeness of foreign affiliates found by the simple comparison of aggregate average values was due to composition effects. In fact, when the latter are controlled for, foreign affiliates do not show a (statistically significant) higher propensity to innovate (INNO). Neither are significant differences found in the case of innovation intensity indicators. The amount of resources (per employee) devoted by foreign affiliates to innovation (INEXP), and in particular to R&D (RDEXP), are not significantly higher than the resources spent on the same activities by domestic firms. On the contrary: the average propensity to patent (PAT) is higher among domestic firms than foreign affiliates.

However, the results confirm that foreign affiliates tend to rely more than domestic firms on innovation developed externally to the firm (INPDT3) and on the acquisition of R&D services (RDEXTY), and both these features are likely to be due to their technological linkages with the parent companies, regional headquarters and other firms in their groups. Foreign affiliates devote a higher share of their financial resources to R&D (RDY), while domestic firms rely more on the acquisition of technology embodied in new capital equipment and the introduction of process innovation.

Finally, external linkages (as measured by the importance attached by firms to external sources of information) are less frequent and important in the case of foreign affiliates than in the case of domestic firms, and this is true both for the interactions with suppliers of equipment, materials and components (SSUP) and for linkages and interactions with science-based institutions such as universities (SUNI) and research institutes (SGMT). This is confirmed by the indicators measuring attitude towards cooperation. This result reflects the expected lower propensity of foreign affiliates to cooperate locally with universities and research institutions.

A sectoral picture

The results of the regression estimates presented in table 4 highlight some "stylized" features of foreign affiliates which

hold across (most) industries and firm size classes. However, the innovation profile of foreign affiliates might also be affected by industry specificities that are worth examining, focussing on those dimensions of innovation activities for which generalized differences between foreign affiliates and domestic firms have not been found.

Accordingly, in table 5, foreign affiliates and domestic firms are compared at the industry level, taking into account the propensity to innovate (INNO), the amount of resources devoted (for each employee), respectively, to all types of innovation activities and to R&D (RDEXP), and the percentage of firms that has indicated universities and other R&D institutes as being important information sources (SUNRD).

The comparison made on the basis of the first three indicators in table 4 shows that, although at an aggregate level foreign affiliates are only slightly more innovative than domestic firms, sharp industry differences between the two groups of firms do nonetheless emerge. In most technology-intensive industries, domestic firms seem to be more innovative than foreign affiliates, the exception being office machinery and chemicals. In most hi-tech industries, domestic firms outperform foreign affiliates in terms of total innovation spending per employee; the gap increases in terms of R&D expenditures. An opposite pattern characterizes medium and low innovative industries, including the most traditional industries such as textiles, footwear, wood and furniture.

These findings confirm the importance played by contextual conditions (strength of the host country) in affecting the innovation strategies of foreign affiliates, in particular their commitment to undertaking R&D locally. Taking into account the technological weakness of the Italian economy in science-based industries (Malerba, 1993; Ferrari *et al*., 2004), it is not surprising that FDI in these industries is undertaken in order to strengthen their knowledge assets or to develop new products. This interpretation is also supported by the comparison of foreign affiliates and domestic firms on the basis of the last indicator

Table 5. Innovation performances of foreign affiliates (FA) and domestic firms (DOM), by industry

Industry	Per cent of innovating firms			Total innovation expenditure per employee			R&D expenditures per employee			Per cent of firms regarding universities and R&D insit. as important information sources		
	DOM	FA	FA-DOM Per cent difference	DOM	FA	FA-DOM Per cent difference	DOM	FA	FA-DOM Per cent difference	DOM	FA	FA-DOM Per cent difference
Food, beverage and tobacco	72.7	81.0	11.3	17.7	11.1	-37.6	4.4	2.8	-36.5	46.9	17.6	-62.4
Textile, footware, wood, furniture	48.0	60.0	25.1	9.1	15.5	70.3	1.8	4.0	118.3	11.9	22.2	87.3
Paper and printing	57.6	58.8	2.1	16.8	24.5	46.3	1.1	0.8	-23.3	11.8	0.0	-100.0
Chemcal products	72.5	81.6	12.5	14.3	15.5	8.4	5.3	6.5	23.0	20.7	19.4	-6.5
Pharamceutical products	83.3	66.7	-20.0	33.0	20.8	-37.1	21.0	8.6	-59.1	53.3	14.3	-73.2
Rubber and plastic	69.8	85.7	22.9	11.4	8.9	-21.8	2.6	2.0	-22.9	13.3	5.6	-58.3
Metals	72.0	54.2	-24.8	8.6	11.9	38.4	1.1	2.1	87.5	16.7	15.4	-7.7
Metal products	67.9	81.0	19.2	6.9	6.5	-6.9	1.7	1.2	-28.2	16.7	17.6	5.9
Mech. machinery	88.0	85.2	-3.2	11.2	7.0	-37.2	4.6	2.9	-36.8	15.5	23.9	54.7
Office machinery, electr. products	82.8	88.2	6.6	18.1	20.1	11.2	6.8	9.8	42.9	30.6	26.7	-12.7
Automobile components	66.7	82.6	23.9	15.0	11.2	-25.0	6.9	6.0	-13.6	25.0	5.3	-78.9
Other transport	69.0	66.7	-3.3	17.6	9.1	-48.3	10.3	3.7	-63.6	45.0	0.0	-100.0
Other industries	78.8	55.6	-29.5	16.7	39.0	133.1	5.2	20.0	288.6	7.7	20.0	160.0
Total	70.9	77.4	9.1	13.3	13.9	4.5	4.3	5.2	21.0	21.0	17.9	-14.7

Source: the authors.

presented in table 5: in most industries, the percentage of foreign affiliates identifying universities and R&D institutes as important information sources is lower than for domestic firms. Among the few exceptions, we find again the traditional industries and the mechanical machinery industry, the latter being another major area of excellence of Italian industry.

In brief, the results of the comparisons made between the innovation behaviours of foreign affiliates and domestic firms – presented in tables 4 and 5 – can be summarized in the following three points:

- A large part of the differences in the innovation behaviour and performance of foreign affiliates and domestic firms is due to a compositional effect, i.e. to the high concentration of foreign affiliates in the most innovative industries and to the presence of a size factor.
- Foreign affiliates and domestic firms differ from each other more in terms of their type of innovation strategies than in terms of their innovation performance.
- The innovative behaviour of foreign affiliates appears to be industry specific and influenced by contextual conditions, in particular by the technological attractiveness and strength of the local context in which the investment is made.

6. Innovation patterns of foreign affiliates: the dominant role of adaptive strategies

The empirical evidence presented in the previous section shows that the innovation strategies of foreign affiliates are far from homogeneous. In section 2 we identified (ex-ante) three stylized patterns of innovation of foreign affiliates, categorized as low-tech, adaptive and asset-seeking. In this section we use the CIS2-ELIOS database to provide empirical support for the presence and consistency of such innovation patterns. Accordingly, first we identify the main innovation patterns of foreign affiliates as they emerge from a multivariate analysis of the CIS2-ELIOS data-set, assessing also their quantitative relevance and sectoral characterization. Second, we check

whether the innovation patterns identified are consistent with our starting hypotheses (sketched in table 1) and discuss the extent to which they are affected by the peculiar features of the Italian innovation system.

Results from factor and cluster analyses

The main innovation patterns of foreign affiliates are identified by running a factor and cluster analysis on a sub-set of indicators provided by the CIS2-ELIOS data-set. These statistical techniques have been carried out using data for a sub-sample of foreign affiliates, taking into account only innovative foreign affiliates, and excluding also low-tech firms defined as an ex-ante category.[5] The low-tech pattern has been identified by selecting firms for which at least one of the following conditions was satisfied:

- presence of process innovations only;
- introduction of innovation developed by other enterprises only;
- no R&D or design activities;
- no patent applications; and
- no interaction (through formal co-operation or informal contacts) with universities and other R&D centres.

Out of 331 foreign affiliates contained in our data-set, 106 are not innovative at all, and 47 have been classified as low-tech on the basis of the selection criteria described above. The factor analysis has been carried out on the remaining 178 foreign affiliates contained in the CIS2-ELIOS database. The list of indicators used and the results of the factor analysis are presented in tables 6a and 6b.

Tables 6a and 6b show that the factor analysis was quite effective in synthesizing the key dimensions of the innovation behaviour of foreign affiliates. Out of the nine variables

[5] The identification of low-tech firms as an ex-ante category has yielded more robust and interpretable results of both the factor and cluster analyses, allowing us to reach a rather clear-cut demarcation between the adaptive and asset-seeking profiles.

Table 6a. Results of the factor analysis

Rotated factor matrix

	FACTOR 1 *Asset seeking vs. adaptive*	FACTOR 2 *Innovation intensity*
INEXP	0.02	**0.85**
RDEXP	0.11	**0.84**
RDEXTY	-0.30	0.09
EXPTURN	**0.35**	-0.10
ORADIC	-0.06	**0.51**
SUNI	**0.68**	-0.07
COUNI	**0.78**	0.14
CORD	**0.54**	0.22
GLOBAL	**0.64**	0.22

Source: the authors.
Note: Extraction method: Principal components analysis.
Rotation method: Varimax with Kaiser normalization.
Convergence criteria reached through 3 iterations.

Table 6b. Variance explained by the "components"

Component	Eigen value	Variance explained (%)	Cumulative (%)
1	2.24	28.0	28.0
2	1.53	19.1	47.1
3	0.97	12.1	59.3
4	0.93	11.7	70.9
5	0.83	10.3	81.3
6	0.67	8.4	89.7
7	0.52	6.5	96.2
8	0.30	3.8	100.0

Source: the authors.
Note: Extraction method: Principal components analysis.

KMO (Keiser Meyer Olkin) Test:	0.586
Bartlett (Sphericity) test:	
Chi-squared (approx.)	232.3
df	36.0
Sig.	0.000

incorporated in our analysis, two factors were extracted; they explain 47% of total variance.[6] More important, the first factor seems quite effective in discriminating between asset-seeking and adaptive innovation strategies. This emerges clearly when looking at the rotated factor matrix that shows the correlation coefficients between the original set of indicators and the factors extracted.[7]

[6] The percentage of variance explained by the first two factors might be considered not particularly high. However a proper judgement of the effectiveness of the empirical exercise proposed here should take due account of the specific characteristics of the data-set used. It is a well known fact that data collected by innovation surveys are characterized by a large amount of ("erratic") variance that is in turn due to the presence of a high degree of subjectivity in the firms' assessment of their innovation activities and performance.

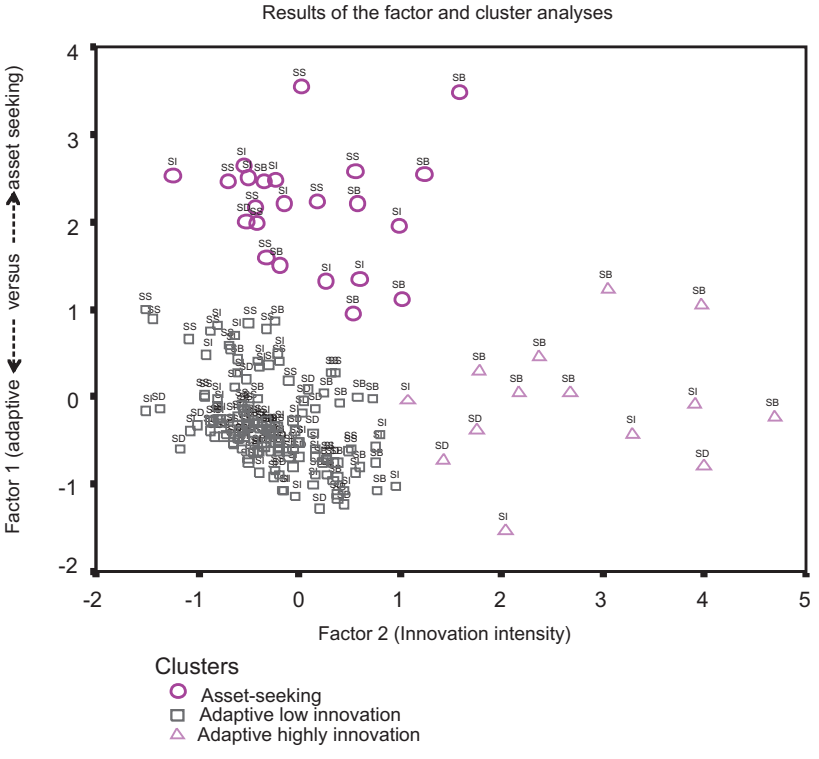
[7] These correlation indexes increase the interpretability of the "principal components".

The first factor is positively correlated with the importance of linkages (formal and informal) with universities and research centres, and with the variable GLOBAL, which indicates the presence of world-wide technological collaborations and linkages. The negative correlation with the acquisition of external R&D suggests that this factor also measures the presence of an endogenous R&D capacity of foreign affiliates. The positive correlation of this factor with the export propensity indicator confirms that foreign affiliates that rank high on this factor are active players at a macro-regional or global level. Conversely, firms that rank low on this factor pursue innovation strategies that are local and adaptive in scope. In brief, the first factor can be used to locate foreign affiliates along an asset seeking-adaptive strategy continuum.

The second factor measures the innovation intensity of foreign affiliates. The latter is likely to be related to the level of technological opportunity of the industry in which foreign affiliates operate, as well as to their specific attitudes towards innovation. Both these aspects are to a certain extent independent from the asset-seeking and adaptive dimension measured by the first factor. The second factor is in fact related to the total amount of resources spent on innovation (per employee), to R&D and to the importance attached by firms to strategies consisting of replacing/substituting products and entering into new markets.

In order to single out homogenous groups of foreign affiliates (and innovation behaviours) a cluster analysis was then performed using the two factors illustrated above. The clustering procedure identified three main clusters. Figure 1 allows a visualization, and first interpretation, of the three clusters. It shows the position of foreign affiliates with respect to factors 1 and 2. The vertical axis (factor 1) measures along a continuum the asset-seeking-adaptive profile of foreign affiliates, while the horizontal axis measures their innovation intensity. The industry type (à la Pavitt: i.e. science-based (SB), scale intensive (SI), specialized suppliers (SS), supplier dominated (SD)) of each foreign affiliate is also reported in the scatter-plot diagramme.

Figure 1. Innovation patterns of foreign affiliates



Source: the authors.

The three clusters shown in figure 1 can be interpreted and labelled as follows.

Adaptive clusters : less innovative and highly innovative

Two clusters are located in the bottom half of the graph. On the basis of this location, both clusters might fall under the adaptive model. They differ in terms of the average innovation intensity of foreign affiliates. In fact, among firms following an adaptive strategy, we find a large number of foreign affiliates characterized by low innovation intensity and a restricted number of highly innovative firms. We can therefore label the first cluster as “adaptive less innovative” and the second one as “adaptive highly innovative ”.

Asset-seeking cluster

The third cluster is located in the upper-left side of the graph. For this reason, it can be labelled as "asset seeking". An important aspect to be noticed is that the upper-right quadrant of the graph is empty. Surprisingly enough, there are no foreign affiliates following an asset-seeking strategy and showing a high innovation intensity. We will return below to this puzzling result.

Table 7 shows the size (number of foreign affiliates) and the industry-type composition of the four clusters identified by our empirical analysis. As expected, the adaptive patterns (and in particular the adaptive less innovative one) are by far the most common ones. The latter account for 47% of all foreign affiliates. The dominant industries in this cluster are the scale-intensive ones. It is however a light dominance (42% of foreign affiliates in the scale-intensive industries do follow such an innovative pattern, as compared to a 30% share of scale intensive foreign affiliates in the entire CIS2-ELIOS sample).

The adaptive highly innovative cluster contains only 14 firms (5% of the total), but it is nevertheless worth taking into consideration: its presence suggests that the most innovative foreign affiliates, instead of pursuing an asset-seeking strategy, concentrate their efforts on adapting pre-existing technologies and know-how (of the corporate group) to the needs of the local market. It is interesting to note that half of the foreign affiliates in this cluster belong to Pavitt' science-based typology.

It is interesting to note that, if the low-tech and the non-innovating foreign affiliates were grouped together, they would account for 40% of total foreign affiliates. This means that 40% of foreign affiliates in our sample are characterized as either not carrying out any type of innovation activity or by a rather poor innovation performance. In terms of employees of foreign affiliates, the size of these two groups of firms is somewhat smaller, accounting for 22% of our sample.

Significantly, only 8% of all foreign affiliates pursue an asset-seeking innovation strategy. The economic relevance of

this group of firms is somewhat larger, accounting for 22% of total employment. Almost two thirds of foreign affiliates that follow an asset-seeking strategy operate in science-based and specialized suppliers industries, even though foreign affiliates in this cluster are not the most innovative of the sample.

All in all, table 7 highlights first the heavy concentration of foreign affiliates in the adaptive low innovative and non-innovative clusters, and second that the three innovative patterns identified appear to be only to a limited extent industry specific.

An interpretative reading of the clusters

The innovation profile of the four clusters identified in the previous subsection are described in detail in table 8. The table provides for each cluster the average values for the full list of indicators shown in table 4.

The picture provided by table 8 is consistent with the stylized patterns presented in section 2 and synthesized in table 1. Most of the values of the indicators reported in table 8 "behave" accordingly to our expectations. In particular, when compared to the low-tech and adaptive (low-innovative) patterns, the asset-seeking profile is characterized by innovation strategies based on strong internal technological capabilities – as emerges by the amount of resources put into the innovation process, the importance of R&D activities, the low dependence upon external R&D services, the high propensity to patent, and the radical nature of the objectives pursued through innovation. Among these factors, perhaps the most distinctive feature of the asset-seeking profile is related to the level and scope of the technological interactions established by foreign affiliates with the external environment. In this cluster, innovation activities are mostly undertaken in co-operation with other firms and institutions, and firms rely frequently on information flows coming from universities and R&D centres. In other words, our results show that foreign affiliates following an asset-seeking strategy tend to act as active world-wide technological players. In this cluster we do not find any foreign affiliates cooperating exclusively within the boundaries of the corporate group.

Table 7. Numerosity and sectoral composition of clusters of foreign affiliates[a]

Cluster	No. of firms	Per cent	No. of employees	Per cent	Science based	Scale intensity	Special supplement (Per cent of firms)	Supplier dominated	Total
Non-innovative FAs	72	24	22 037	11	13	42	17	29	100
Low-tech FAs	47	16	23 262	11	13	36	21	30	100
Adaptive low innovative FAs	141	47	107 538	53	13	42	27	18	100
Adaptive highly innovative FAs	14	5	6 577	3	50	29	0	21	100
Asset-seeking FAs	23	8	43 887	22	30	35	30	4	100
Total FAs	297	100	203 301	100	16	40	23	22	100

Source: the authors.

[a] The total number of foreign affiliates is different from the one presented in table 2 due to the exclusion of 21 innovating foreign affiliates with missing data on some relevant innovation variables.

Interesting enough this cluster is also populated by firms that do not belong to the typical science-based industries. This suggests that FDI might be driven by an asset-seeking strategy in a wide range of industries.

As discussed before, our analysis has revealed the presence of two distinct adaptive patterns: one characterized by low innovation performance and another one that is more innovative (adaptive highly-innovative). In line with our expectations, foreign affiliates in both these clusters are characterized by a narrower and inward-looking approach to innovation. Compared to the asset-seeking pattern, external linkages are in this case much weaker and often take the form of intra-group technology transfer (from headquarters to foreign affiliates). In particular, local sources of knowledge such as universities and R&D centres are not perceived as important by the majority of foreign affiliates. In the adaptive highly innovative cluster, foreign affiliates devote a large amount of resources to innovation. This (unexpected) feature reflects the sectoral connotation of this cluster which is composed mainly of science-based and scale-intensive foreign affiliates.

The emergence of this cluster, although unexpected, is nonetheless an interesting result that needs to be further interpreted. On the one hand, it suggests that "adaptive" and "production oriented" strategies of TNCs can be found in typical R&D-intensive industries. On the other hand, the profile of this cluster might be the result of the peculiar feature of the Italian innovation system (Malerba, 1993). There is, in fact, little doubt that the specific Italian context influences the innovation profile and size of all four clusters identified in our analysis. The large number of firms found in the low-tech and adaptive low innovative patterns is in fact not surprising, taking into consideration the relatively large size of the Italian market and its weak technological base. The same argument can be used to explain the fact that most of the foreign affiliates operating in science-based industries follow an adaptive strategy. Also the scarce presence, and relatively low innovation performance, of foreign affiliates pursuing an asset-seeking strategy might be

the result of the low technological attractiveness of the Italian innovation system.

All in all, it can be argued that the prevailing strategies of foreign affiliates in Italy are focussed on accessing a large domestic market, while asset-seeking strategies are not stimulated by the weak performance of the national innovation system nor by the presence of active innovation policies. This line of reasoning helps also to explain the presence of the white area in the upper-right part of figure 1, i.e. the lack in Italy of a pattern characterized by asset-seeking strategies and high innovative performance, as would be expected. This finding seems to be consistent also with the conclusions of section 5 based on the comparison made between the innovation performance of foreign affiliates and that of domestic firms.

These results also suggest that FDI with an asset-seeking orientation is more likely to be found in medium-technology industries where Italian firms hold a comparative advantage (i.e. in mechanical engineering and traditional industries), while the attractiveness of the country emerges as being modest, and probably decreasing, in the most typical high-tech industries. In other words, the Italian case seems to show that an "asset seeking" pattern of internationalization is a prerogative not only of TNCs operating in science- based industries. FDI might in fact be driven by asset-seeking motives also in the case of traditional industries, as long as the host country (or region) has accumulated a sufficient stock of knowledge that can be shared and exploited. This finding might suggest interesting generalizations beyond the Italian case.

7. Final remarks: country-specific factors and general findings

This article has provided fresh empirical evidence on the innovation strategies of foreign affiliates of TNCs and the role they play in a host country. The wide range of information provided by CIS has been used to assess the technological contribution of foreign affiliates in Italy, to highlight the

technological determinants and objectives of FDI and to identify the main patterns of technological internationalization of TNCs. CIS data have allowed us to assess both the quantitative and the qualitative dimensions of innovative activities carried out by foreign affiliates.

The empirical evidence presented in section 5 shows that foreign affiliates and domestic firms differ from each other more in terms of their "type of innovation strategies" than in terms of their "innovation performance", and that the greater innovativeness of foreign affiliates depends on a double composition effect: their concentration in science-based and scale-intensive industries and their larger size. As expected, foreign affiliates tend to rely more than domestic firms on innovations developed externally and on tight technological linkages with their parent companies and with other firms of the corporate groups. At a sectoral level, more clearcut differences between foreign affiliates and domestic firms do nonetheless emerge: in the majority of technology-intensive industries, domestic firms outperform foreign affiliates, especially in terms of financial resources devoted to innovation and R&D activities, while an opposite pattern characterizes the medium and low innovative industries.

These results are fully consistent with findings from section 6: the heterogeneous nature of foreign affiliates' innovative behaviour was further explored by carrying out a factor and cluster analysis on a selected number of indicators provided by the CIS-ELIOS data-set. We have identified three main innovation patterns of foreign affiliates labelled as "low-technology", "adaptive" and "asset seeking". These patterns differ on the basis of the overall commitment of foreign affiliates to innovation, the sources and objectives of the technological activities undertaken, and according to the nature, strength and geographical horizon of technological links established with the external environment.

In line with our expectations, the "adaptive" pattern is by far the dominant one. Our analysis has however revealed the

presence of two distinct adaptive patterns in Italy: one characterized by a low or medium innovation performance, and another by an "adaptive highly innovative" pattern. The emergence of the last cluster, somewhat unexpectedly, is an interesting finding. It suggests that a number of highly innovative foreign affiliates adopt user-oriented strategies to serve the domestic market, with poor linkages with the local industrial and productive milieu.

On the other hand, foreign affiliates that follow an "asset-seeking" or "global" profile, which tend to be characterized by more radical innovation strategies aimed at further strengthening their knowledge assets, show only a moderate innovation intensity in Italy. This means that the embeddedness of high-tech TNCs in the country is limited.

The empirical findings presented in this article, in addition to highlighting some stylized features of innovative strategies of foreign affiliates, also reflect the structural features of Italian industry and its innovation system. There is little doubt in fact that the specific Italian context has affected some of the features and the relative size of the clusters we have identified. The well known technological weaknesses of the Italian innovation system explain why most foreign affiliates seem to be mainly interested in gaining access to a large domestic market, while asset-seeking innovation strategies are much more rare. The attractiveness of the country seems, in fact, to be modest, and probably decreasing, in high-tech industries. This, in turn, reflects the decline, in the past decade, of the "oligopolistic core" of Italian industry, which has not been compensated for by the emergence of new innovative medium-sized TNCs in traditional industries.

The Italian case seems to suggest a more general conclusion. It shows that an "asset seeking" pattern of internationalization can be found also in traditional industries, as long as the host country (or region) has accumulated a sufficient stock of sharable knowledge. This finding could have interesting applications and generalizations for other countries,

especially those specialized and competing in low and medium technology industries. Our results, if extended to other countries, could suggest a convergence between the competitive advantages of the host economy and its innovation-based attractiveness for TNCs. More work is needed to clarify this issue through comparative analyses based on the use of CIS data for other countries, while using CIS 3 data will allow the creation of a dynamic picture of these processes. ■

References

Almeida, Paul (1996). "Knowledge sourcing by foreign multinationals: patent citation analysis in the US semiconductor industry", *Strategic Management Journal*, 17, pp. 155-165.

Almeida, Paul and Anupama Phene (2004). "Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation", *Strategic Management Journal*, 25, pp. 847-864.

Antonelli, Cristiano (1995).*The Economics of Localised Technological Change and Industrial Dynamics* (Boston: Kluwer).

_____ (1999). *The Microdynamics of Technological Change* (London: Routledge).

Archibugi, Daniele and Jonathan Michie (1997). "The globalisation of technology: a new taxonomy", in Daniele Archibugi and Jonathan Michie (eds.), *Technology, Globalisation and Economic Performance* (Cambridge: Cambridge University Press), pp. 172-197.

Balcet, Giovanni (1988). "Italian non-equity ventures abroad: evidence from field interviews", in Fabrizio Onida and Gianfranco Viesti, eds., *The Italian Multinationals* (London: Croom Helm), pp. 96-109.

_____ (1997). "International relocations strategies of Italian firms", in: Peter Buckley and Jean-Louis Mucchielli, eds., *Multinational Firms and International Relocation* (Cheltenham: Edward Elgar), pp. 71-89.

Balcet, Giovanni and Francesca Cornaglia (2002). "The innovative activities of multinational firms in Italy", in R. Lipsey and Jean-Louis Mucchielli, eds., *Multinational Firms, and Impacts on Employment, Trade and Technology: New Perspectives for a New Century* (London: Harwood Press), pp. 197-219.

Balcet, Giovanni and Aldo Enrietti (2002). "The impact of focused globalisation in the italian automotive industry", *Journal of Interdisciplinary Economics*, 13(1), pp. 97-133.

Begg, Ian, Bent Dalum, Paolo Guerrieri and Mario Pianta (1999). "The impact of specialisation in Europe" in Jan Fagerberg, Paolo Guerrieri and Bart Verspagen, eds, *The Economic Challenge for Europe: Adapting to Innovation-based Growth*, (Chelteham: Edward Elgar), pp. 21-41.

Cantwell, John (1994). *Transnational Corporations and Innovatory Activities* (London: Routledge).

_____ (1997). "The globalisation of technology: what remains of the product cycle model?", in Daniele Archibugi and Jonathan Michie, eds, *Technology, Globalisation and Economic Performance* (Cambridge: Cambridge University Press), pp. 215-240.

Cantwell, John and Simona Iammarino (1998). "MNCs, technological innovation and regional systems in the EU: some evidence in the Italian case", *International Journal of the Economics of Business*, 5 (3), pp. 383-408.

_____ (2003). *Multinational Corporations and European Regional Systems of Innovation* (London: Routledge).

Castellani, Davide and Antonello Zanfei (2002). "Sectoral patterns of inward FDI and domestic productivity in Europe", *Journal of Interdisciplinary Economics*, 13, N. 1-2., pp. 51-70.

_____ (2003a). "Technology gaps, absorptive capacity and the impact of inward investments on productivity of European firms", *Economics of Innovation and New Technology*, 21 (6), pp. 555-576.

_____ (2003b). "Innovation, foreign ownership and multinationality. An empirical analysis on Italian manufacturing firms". Paper presented to the 2003 European International Business Academy Conference, Copenhagen, mimeo.

Ciborra, Claudio (1992). "Innovations, networks and organisational learning", in Cristiano Antonelli ed., *The Economics of Information Networks* (Amsterdam, North Holland, 1992), pp. 91-102.

Contractor, Farok J. and Peter Lorange (2002). *Cooperative Strategies and Alliances in International Business* (London: Pergamon Press).

Dunning, John (1993). *Multinational Enterprises and the Global Economy* (Addison: Wokingham).

_____ (1997). *Alliance Capitalism and Global Business* (London: Routledge).

Dunning, John and Rajneesh Narula (1995). "The R&D activities of foreign firms in the United States", *International Studies of Management & Organization*, 25 (1-2), pp. 39-73.

Fagerberg, Jan, Paolo Guerrieri, and Bart Verspagen (eds.) (1999). *The Economic Challenge for Europe: Adapting to Innovation Based Growth* (London: Edward Elgar).

Ferrari, Sergio, Paolo Guerrieri, Franco Malerba, Sergio Mariotti and Daniela Palma (2004). L'Italia *nella competizione tecnologica internazionale*. Quarto rapporto, Franco Angeli, Milano.

Frost, Tony (2001). "The geographic sources of foreign subsidiaries' innovations", *Strategic Management Journal*, 22, pp. 101-123.

Hagedoorn, John (2002). "Inter-firm R&D partnerships: an overview of major trends and patterns since 1960", *Research Policy*, 31(4), pp. 477-492.

Hagedoorn, John, Albert N. Link and Nicholas S. Vonortas (2000). "Research partnerships", *Research Policy,* 29, pp. 567-586.

Ietto-Gillies, Grazia (2002). *Transnational Corporation: Fragmentation amidst Integration* (London: Routledge).

Kim, Linsu (1997). *Imitation to Innovation: The Dynamics of Korea's Technological Learning* (Boston: Harvard Business School Press).

Kuemmerle, Walter (1999). "Foreign direct investment in industrial research in the pharmaceutical and electronic industries: results from a survey of multinational firms", *Research Policy*, 28(2-3) pp. 179-193.

Le Bas, Christian and Christophe Sierra (2002). "Location versus country advantages in R&D activities: some further results on multinationals' locational strategies", *Research Policy*, 31(4), pp. 589-609.

Lundvall, Bengt-Åke (ed.) (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (London: Pinter Publishers).

Malerba, Franco (1993). "The national system of innovation: Italy", in Richard Nelson, ed., *National Systems of Innovation* (Oxford: Oxford University Press).

Mariotti, Sergio and Marco Mutinelli (2004). *Italia Multinazionale 2004* (Rome: Istituto Commercio Estero).

March, James G. (1991). "Exploration and exploitation in organizational learning", *Organization Science*, 2(1), pp. 71-87.

Narula, Rajneesh (1999). "Explaining the growth of strategic R&D alliances by European firms", *Journal of Common Market Studies*, 37(4), pp. 711-723.

_____ (2003). *Technology and Globalisation* (Cambridge, UK: Polity Press).

Narula, Rajneesh and Antonello Zanfei (2005). "The international dimension of innovation", in Jan Fagerberger, David Mowery and Richard R. Nelson, eds., *Handbook of Innovation* (Oxford: Oxford University Press), pp. 319-346.

Nelson, Richard R. (ed.) (1993). *National Systems of Innovation* (Oxford: Oxford University Press).

OECD (1992). *Technology and Economy: The Key Relationships* (Paris: OECD).

_____ (2001). Measuring *Globalisation. The Role of Multinationals in OECD Economies*, vol. 1: Manufacturing (Paris: OECD).

_____ (2004). *Science, Technology and Industry (STI) Outlook* (Paris: OECD).

Patel, Pari (1997). "Localised production of technology for global markets", in Daniele Archibugi and Jonathan Michie, eds., *Technology, Globalisation and Economic Performance* (Cambridge: Cambridge University Press), pp. 198-214.

UNCTAD (2001). *World Investment Report 2001: Promoting Linkages* (Geneva and New York: United Nations).

Vernon, Raymond (1966). "International investment and international trade in product cycle", *Quarterly Journal of Economics*, 80(2), pp. 190-207.

_____ (1979). "The product cycle hypothesis in a new international environment", *Oxford Bulletin of Economics and Statistics*, 41(4), pp. 255-267.

Wortmann, Michael (1990). "Multinationals and the internationalization of R&D: new developments in German companies", *Research Policy*, 19(2), pp. 175-183.