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Peripheral Economies in Transition: the Case of Pisa

The case of Pisa, Italy, emerges as an effective representation of the possible difficulties and opportunities in the development of HT in peripheral regions, as well as of the challenges and phases that a knowledge-based local economic policy might face. The study by Scuola Sant'Anna (Di Minin et al., 2003) summarizes the results of a three-year empirical analysis of the local HT sector in Pisa. Over 200 firms, mostly very young, have been identified and analyzed in the province of Pisa, where a traditional manufacturing sector is slowly but constantly declining and coexists with an outstanding public research system, which attracts and retains important human resources in the city, generates high-tech start-ups, and attracts external companies to the area.

This paper starts by framing the phenomenon analyzed in the Sant'Anna study within the context of the literature dealing with the "paradox" of localization and globalization. The question here is to try and understand how these theories might help explain the growth and limits of the growth of the sector. I will then build a comparison with another case of peripheral development to shed some light on the exceptional case of Pisa. I will conclude by pointing out three policy recommendations that arise from the literature.

Clusters and Industrial Districts

The model suggested for the city should somehow resemble the model of the Italian industrial districts (Becattini, 1990; Brusco, 1982). In this framework the intuition of Marshall (1920), and the study of external economies (Vernon, 1960) are applied to the analysis of business dynamics and clustering. According to the literature that followed Marshallian studies, there are three sources of external economies: the first is the presence of a large pool of specialized labor and the consequent local division of labor; the second factor is the development of a network of specialized intermediate goods and service industries; the third factor is the emergence of a vibrant and local exchange of tacit knowledge, which leads to the circulation of knowledge spillovers

among the firms and other organizations within an industry. All these three factors explain a "positive feedback mechanism", whose main property is to be self-enforcing.

In Porter (1990), the concept of a cluster is different from an agglomeration of firms in the same industry, and has to do with:

> a geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate. (Porter, 1990)

The focus is on the interconnections between firms and the "spillover effects" that the presence of specialized factor of production, a vibrant business climate and the dynamics of cooperation and competition have on the competitive advantage of a cluster. The study of the industrial districts, led the national statistics bureau in Italy to identify local production systems, focusing on the commuting patterns and local sub-contractor interactions (Sforzi, 2002).

Bergman and Feser (1999) argue against the determinism of Porter's cluster. The self-enforcing mechanism that lays at the heart of the cluster theory cannot be taken for granted, since "changes in the social, cultural, or political environment could lead to altered relations between cluster firms such that the positive synergies are reduced". Becattini (2000 and 2002) writes that the main difference between the study of industrial districts and the literature focusing on cluster is the attention for the "embeddedness" of the local production system in the local society, whereas the cluster literature focuses principally on the "dynamic integration amongst productive units".

These authors affirm the importance of inter- and intra-industry linkages that have to be the most important unit of analysis, whereas the concept of (local) industrial districts and clusters might shift the attention away from what is the underlying mechanism that leads to external economies.

The study of the Italian case moved away from the assumption that it is possible to look at industrial district dynamics as agglomerations, focusing only at the cumulated effect of external economies. Geography, which is shaped by cumulative causation and historical accidents

(Krugman, 1991), is indeed part of the explanation, but social relations and competitive dynamics shape business climate and enable (or interfere with) the conditions for a fruitful circulation of tacit and local knowledge and flexible specialization. According to Harrison:

> The industrial district model posits a very strong form of the embedding of economic (business) relations into a deeper social fabric, providing a force powerful enough to provide for the reproduction of even so apparently paradoxical a practice as co-operative competition. (Harrison, 1992)

Soft indicators such as trust, the definition of a knowledge domain, and the dynamics of co-ompetition (cooperation and competition), are all elements that help explain the dynamics of vertical and horizontal concentration of firms and the competitiveness of a region. In the study of Italian industrial districts, such elements of the associational economy have been very often identified as the keys for success of the traditional sector (Cooke and Morgan, 1998). Sant'Anna study clearly identifies the difficulties in replicating this model for the HT sector, an important limitation for Pisa. More precisely, there are two main problems in moving "high tech wine in old bottles":

1. The first has to do with the dualism present in the Italian way of "light industrialization" and the role played by the big industry.
2. The second is the source of trust and co-ompetition that leads to reliance on resources of the network outside the firm.

The Italian approach to "flexible specialization" was thought to be a very successful and non-disruptive way to accompany the transition from mass production to lean production (Sabel, 1989). The growing interdependence on resources outside the firms required a higher level of trust that could arise only in particular conditions. It seemed that Italian SME's were excelling in this practice, and one of the reasons was exactly the high level of trust and the reliance on external resources.

However, according to Bellandi (2002), the picture provided by this description is incomplete since it does not mention the "dual engine" behind the Italian light industrialization model. This model is characterized by an important dualism between small firms and large corporations. In an environment where flexible specialization is the key to international competition, large firms rely on the dynamism of highly specialized subcontractors, which however are then able to separate from their main customers and seek international demand. In the Italian case, the large industry was also relying upon significant public financial subsidies that were therefore indirectly beneficing the SME's contractors. Both large and small exporters were constantly favored by a weak currency.

In this model, the key element is the co-presence of both small and large firms within the industry. This dualism between big and small has been for decades at the heart of Pisa's economy. This is, for example, the case of the Piaggio industry and its network of highly specialized contractors, mostly SME's.

This is exactly the dualism that, according to the Sant'Anna study, lacks in the city HT sector. The few large HT companies in Pisa (mostly pharmaceutical and ICT) lament the lack of interactions with the local companies, and they claim that these do not significantly affect their competitiveness. Thus the HT sector in Pisa is characterized by no significant knowledge transfers nor significant market interaction between large and small private companies.

Case studies of successful HT regions focus on the advantages that spring off the agglomeration/clustering of activities in a particular sector, within the borders of a regional economy, such as biotech in Cambridge (Cooke et al., 2002) or Silicon Valley (Saxenian, 1994). By shifting the focus of the analysis from agglomerations to networks, researchers were able to show that the knowledge/awareness of resources available in the network became itself an important resource -- to be coupled with internal capabilities -- for the HT firm (Lee et al., 2001). An analysis of the level of the agglomeration cannot clarify why some groups of firms or entire regions have an

easier access to markets and technologies (Heydebreck and Klofsten, 2000). Social capital of the region is also found to be positively correlated with faster technical knowledge growth and competitiveness for HT companies (Yli-Renko and Autio, 2001). Cooke and Wills (1999) distinguish policies that are able to promote the emergence of this form of trust by encouraging association and consortia to work on HT projects. This in turn increases the confidence on each of the partner's capabilities.

Knowledge flows in HT are facilitated by mutual trust and understanding, but this sort of trust is not necessarily correlated with the presence of a vibrant civic society a la Putnam (1993), but more with a reliance on the quality of the know-how and competences of a commercial partner and on the infrastructures and institutions of the local system (Cohen and Fields, 1999). In this sense, it is not advisable to take for granted the fact that an "old economy" entrepreneurial environment, such as Pisa, which had been performing well on traditional markets and was characterized by virtuous dynamics of collaboration and competition, would perform well in the setting of a knowledge economy.

From the example of Silicon Valley, we learned that the key challenge for the transition to a knowledge economy is the activation of protean places (Saxenian, 1994), where everything changes but change itself. In this setting, new technological paradigms, and new organization models become quickly obsolete, after being the driver for fast growth of firms emerging out of the start up phase. Particular entrepreneurial dynamics need to become practice. Andy Grove, co-founder of Intel, talks about the "planning of the firefighter", to describe the type of management in these settings, where resources need to be made available quickly, to exploit an opportunity or to avoid a disaster; in his own words: "let chaos reign, then rein in chaos!"

As a consequence of this constant change, borders between organizations are blurring. The concept of interdependence can be experienced in that boundaries between firms, customers and suppliers, workers and entrepreneurs, product and components, and successes and failures are not

clear. Networking and local interactions in these settings emerge as the only possible response to a continuous flow of resources venture capital, human resources and innovative ideas.

This is exactly what the study of the Scuola Sant'Anna show is missing in Pisa, where in spite of a long tradition of strong and local ties within the local economic system, and an excellent public research system, no virtuous dynamics is transferring to the HT sector.

The globalization paradox and traded clusters

The Sant'Anna study considers Pisa to be a particularly interesting and singular case. Considering its geographical position, Pisa is peripheral with respect to both the two main engines of Italian economic growth. The city is located outside of the "industrial triangle" of the North, and its traditional industrial districts are not fully integrated and only partially share the characteristics of the district of central and northern Italy. Given the presence of an impressive public research system, knowledge-based potentialities of the area represent a strong asset for its future development; nonetheless, the relative weakness of networking initiatives, the lack of a clear public and private leadership in the sector, and the inadequacy of the local financial market are identified as the main bottlenecks for the further growth of an already promising HT cluster.

The new literature on clusters identifies the limits of globalization and establishes the importance of regions and local clusters in the framework of global competition. Storper (1992) identifies in the product based technological learning one of the strengths that local economic systems can offer to achieve global competitiveness and to reaffirm the role of territory and clustering. As I will discuss more in detail later, this locally embedded form of learning can take place also in regions that are peripheral with respect to the main sources of technological and economic growth. The study of the Pisa economy starts from the assumption that in the city there is the potential to achieve this form of endogenous growth (Romer, 1994), but it shows also that there are reasons why the city is not able to fully exploit this potential.

In literature, the importance of regions on the global market is seen as one of the key findings of the contradictions of globalization. The concept of "sticky places in slippery space" (Markusen, 1996) is the result of new incentives and pressures coming from a global competitive environment for the possibilities of local learning and knowledge exchange (Malecki, 2000).

In the study of a new form of competition, which is based on regions, competitive advantage comes also from the dynamism and inventiveness of small high tech firms that are able to overcome the limits typical of the Chandlerian's firm (Best, 1990). The forms of "flexible specialization" achieved are not only competitive in a rapidly changing competitive environment, but also sustainable and socially accepted (Piore and Sabel, 1984 and Sabel, 1989).

Through the lens of Markusen's taxonomy of industrial districts, (Markusen, 1996) it is however possible to understand and better conceptualize the possibilities and limits for Pisa. The flexible specialization model has its own limits when it comes to the development of an HT industry. It is necessary to consider how these limits can be overcome, not only in focusing on the problems of the SME's but also by looking at the presence of public investment and large corporations. These actors can indeed play a leading role in the development of a technology intensive industrial sector.

Pisa policy makers are betting on the fact that the ICT sector will very soon have the characteristics of a traded cluster (Porter, 2003). In this model the competitiveness of a local economic system in a particular sector is proven with the competitiveness on the world market. The ICT sector in the city is indeed growing, and it is absorbing the fall in employment that is being experienced by the traditional manufacturing sector. However, if we match the empirical results of the study with the findings of the literature, it is possible to say that the model so far in place in Pisa fails to achieve the necessary result to become a successful traded cluster in the global economy with respect to three key dimensions:

1. employment mobility and market interaction between the HT firms in Pisa is not particularly vibrant. The concentration of firms in the city is not conducive to significant cluster effects, besides a relatively large local market for qualified labor, which clearly distinguishes Pisa from other peripheral areas in Italy.

2. the number of local firms is growing, but these firms remain small, facing significant problems in growth., It is very hard even for firms that claim that their market conditions would justify growth and new investments to get access to key resources necessary to exploit the good present moment and expand their activities.

3. most of the firms are serving a local demand, and they are not achieving significant levels of export, lacking therefore the most obvious characteristic of a traded cluster. They are not able to face the challenges of an international, or global demand, where the traditional Italian industrial sector used to excel.

It is not obvious that these problems are consequential, but indeed the lack of results in terms of exports represents the empirical evidence that the model is not working as expected.

A possible answer can be found if we consider the role of the key players and the interactions within the local system. As I have mentioned, the study argues that some of the characteristics of the emerging model -- such as the interactions between companies and with local institutions, knowledge and technology transfer process, and localization advantages -- are the weakest links in Pisa. The literature identifies a necessary condition for the region to be a central hub for the global production system in the presence of active local knowledge transfer.

A qualitative approach is used by Sant'Anna to learn about the ways knowledge flows within the local system. One of the main findings of the study is that these knowledge flows in Pisa are not significant. This is surprising, since the presence of a particularly strong public research system should lead one to think that interactions between university, public labs and HT firms are

very frequent. The next section will explore this topic further, identifying key themes in the literature that might help in understanding this phenomenon.

Universities as engines of growth

Innovation and innovative ideas come from different sources, and the success of local firms depends (also) on their capacity to interact, appropriate and exploit resources and ideas that spin off of the market interactions (Teece, 1986; von Hippen, 1988, Cohen and Levinthal, 1990). Within this framework, universities have been recognized the as the potential role of "engines of growth". Research out of universities, however, is not ready for industrial application. Pavitt (2001) suggests that institutions and particular settings have to be in place in order to be able to record positive returns on the territory.

Developed and emerging countries recognize the university and public research in general an important role for endogenous growth of a local economic system, and efforts to understand and seize the advantages of knowledge transfer are on the political agenda of many agencies (GAO, 1998; OECD, 2000; Reamer et al., 2003). The "chain-link" or linear model of technology transfer (Kline and Rosenberg, 1986) has been revised to take into account a more sophisticated model, where public research takes an active role not only in the production of science, but also in the activities of technological transfer. Comparative approaches have been a quite popular methodology to contrast different successes and failures experienced at a local or national level (Saxenian (1994). Among other findings, these approaches point to the importance of university research and technology transfer initiatives to justify the success of Silicon Valley In Castells and Hall (1994), public research and technology transfer initiatives are also present among other variables to justify successes and failures.

The Sant'Anna study assigns the university the role of a "factory of entrepreneurs". The largest majority of HT entrepreneurs graduated from the local universities, but most of them were not born in Pisa and moved to the city for their undergraduate or graduate studies. The university in

the city is therefore able to attract and, to some extent, retain HT entrepreneurs in the area. However, the interaction between the HT community and the university and public research system is found to be sporadic and not conducive to significant knowledge flows.

The research that comes out of universities is not ready for commercial application, nor can it be taken for granted that it will be the spark of local endogenous growth. The convergence of interests and positive synergies between universities and firms is not the mere result of co-location (Markusen et al., 1999). However, evidence of the importance of technological transfer institutions and regulation is getting quite common. Success is usually well documented when institutional changes to facilitate active collaboration between industry and research are implemented. One of the most extensively discussed phenomena is the importance of the Bayh-Dole act of 1980, the consequent development of university technology transfer offices, and the impressive increase of patenting and licensing by American universities (Nelson and Sampat, 1999; Mowery et al. 2001). Attempts to generalize from the US experience point out possible solutions to overcome the "European paradox" (Pavitt, 2001). Efforts to understand the strengths and weaknesses of technology and knowledge transfer from public research and industry in the Italian economic system are underway. Recent studies (Piccaluga and Patrono, 2000; Cesaroni and Piccaluga, 2003) find interesting similarities between the Italian situation and the pre-Bayh-Dole Act American research system. In particular, the Italian public research system is characterized by the absence of a standardization of institutional behavior and the necessary reliance on individual entrepreneurship and best practices.

The Sant'Anna study clearly identifies the first efforts that the local university is making to achieve a more significant role for the local economy, even if the results are still not yet clear. Perhaps the comparison with another situation in Southern Italy, which is currently being discussed in literature, might help to shed some light on the case of Pisa.

Arno Valley versus Etna Valley. High tech growth in the periphery.

Nelson (2000) claims that the development of the HT sector can be desirable given the significant spillovers to the rest of the economy -- that is, that the development of an HT sector can have an effect on the rest of the economy. This is exactly the hope of planners in Pisa: that a vibrant scientific community with strong ties within the territory will activate positive significant synergies with a local HT entrepreneurial community, and that this will in turn have positive externalities on the rest of the economy and lead to the revitalization of the city and an economy that is able to excel on the global market.

Does the presence of an important investment in public research justify the attention of the local and regional political authorities to the development of an HT sector? The Sant'Anna study is so far showing that the case of Pisa is in line with the findings of the literature which claim that a research university is not a sufficient condition to activate a consistent knowledge and technology flow.

One of the aspects that I have not yet considered is the fact that possibilities of technological transfer and high tech growth rely not only on the institutional settings and on the recognition of an entrepreneurial function of the local public research system. Also the nature of the high tech companies might make a significant difference.

Various models try to predict the propensity of firms to get access to public research (see for example Spencer, 2001; Cohen, Nelson and Walsh, 2002). Empirical evidence (see for example Acs et al., 1994) shows that smaller companies are more likely to benefit from the interaction with public research investment since they are able to diversify their innovation strategies and can encompass investments for which returns are very much uncertain and are likely to happen only in the long run. Also start-ups are usually seen as more innovative than older firms (Cohen et. al, 2002). The absorptive capacity theory (Cohen and Levinthal, 1990) claims that firms with a higher

propensity to spend in R&D, are more likely to be able to exploit the advantages of proximity and close collaboration with universities.

This should be very good news for Pisa. The Sant'Anna study found that most of the HT firms are small, young, and spending heavily in R&D. However, before starting to talk about a "Pisa paradox", it might be useful to point out the fact that the literature finds that there are significant differences across sectors, and the better documented case of successful technological transfer between public research and small firms remains biotechnology (Jones, 1992; Norus, 2002; Shane, 2002), a sector where Pisa is not particularly strong and where the exit strategy for the small companies requires the interaction with large pharmaceutical corporations (Arora and Gambardella, 1990), that so far, in Pisa, have not pursued this line of action.

Firms in Pisa are specializing in ICT, and here the situation might be different. Historically Pisa research had a leading position in the development of ICT, but is the presence here of a large, highly innovative, young group of SMEs desirable? Is this group of firms able to interact with success and exploit knowledge which flows from the local universities?

In Italy, another emerging and peripheral cluster in ICT is becoming a recognized success story. This is the case of Catania, Sicily, where a large Italian-French multinational in the semiconductor industry, ST Microelectronics, decided to locate its production and R&D facilities on the slopes of the Etna volcano. The strategy of STM was to invest in a relatively peripheral location, that was characterized, however, by the availability of excellent human resources and research projects and, in particular, by heavy public investment in R&D (Cuomo, 2003).

Recent studies (Di Guardo and Schillaci, 2003) found that STM played a critical role in the formation of a local ICT cluster, characterized by a large and growing number of small and medium size suppliers, whose activity rotates around STM. Most of these companies are start-ups, and spend heavily in R&D. The key difference between Pisa and Catania is the fact that these firms are "forced" to communicate with each other and with their main client. Knowledge flow from the local

university and National Research Council to the industry is quite impressive both in terms of publications and of patenting, but it is mediated through STM.

Dunning (1998) points out the importance of an appropriate location strategy for a multinational enterprise. Such a strategy should not rely only on the possibilities to exploit access to cheap factors of production. Technology should also work as an interface to establish links for local external economies. In the case of STM and Catania, technology itself called for the definition of these interfaces. The development of semiconductors towards the use of MEMS called for the integration and interaction of scientific competencies and languages that were not used to working together. Great creativity became therefore necessary in order to find solutions for different scientific and technological communities to collaborate effectively in increasingly complex projects. STM was among the first group of companies that perceived the disruptive transformation that the emerging architecture of a "system on chip" was going to bring to the semiconductor industry. Besides the growing complexities for the manufacturing of a chip, which called for more dependence and interaction with the CAD industry, STM understood that in order to excel in the design and production of systems on chip, a vast and diverse network of partners had to be involved in a complex value chain structure. STM management claims to have found in Catania the perfect location for the exploitation of knowledge intensive externalities. This has been so far in line with the interests of the local economic development authorities, and Catania stands out with respect to the rest of Sicily in terms of HT employment and technology transfer.

The most obvious risk for Catania is an overspecialization and the emergence of a Hub-and-spoke model of development (Markusen et al., 1999). This is an obvious concern, given the clear dominance of the axis public research-STM with respect to most of the technology transfer programs. Even if diversification is an important safety net to consider, it is important to notice that local firms are growing not only in number but also in dimension, working to achieve some form of

independence from the main client (Di Guardo and Schillaci, 2003). These are exactly the results that are still lacking in Pisa.

Policy recommendations

The approach of local political authorities in Pisa seems to imply that for the jump start of the knowledge economy in the city all the ingredients for endogenous growth (Romer, 1994) are in place, and it's only necessary to cook them with a pinch of trust and networking, borrowed from the traditional sector. The reality revealed by this study is that the HT sector in the city is far from the activation of a virtuous cycle. The challenges faced are therefore different, and, as such, so are the implications for the appropriate policies to be adopted in response.

Technological niches for the jump start

The local HT community needs to identify a technological and market niche to focus on and to specialize in. A desirable niche for Pisa, is one that could have a clear opportunity for excellence and differentiation, and it would allow to create strong ties between the local entrepreneurial community and the research system. ICT services is probably a sector that is already too crowded to find such an opportunity with ease. Nevertheless, the case of STM and Catania shows that this is (or was) still possible due to an entrepreneurial and visionary effort and socioeconomic conditions that facilitated the implementation of a coherent strategy. In this lucky case, the technology roadmap identified by the company called necessarily for a partnership between private industry and public research. This has been the (risky but rewarding) strategy that was used by other peripheral systems to become new centers of a knowledge intensive sector and to jump start into a cluster's virtuous cycle (Bresnahan et al., 2001).

The role of the private sector, and the need of leadership.

In an economy characterized by the dominance/monoculture of a successful "traditional" industry, the transition, so much desired, to a new HT based excellence is all but obvious. The selection of a HT niche where to focus is even less obvious. Traditionally the role played by venture capitalists as "gatekeepers of new initiatives" (Smith and Florida, 2000) has been considered particularly important by the literature. However, Pisa cannot count on the presence of a vibrant financial community, which has been found in the study to be one of the reasons behind the fact that local companies do not find the resources growing. The emphasis of the literature shows that the attention of the researchers has to be focused on the appropriate combination of entrepreneurial culture and the capacity to attract or to endogenously create new technological competences. The different firms identified in Pisa all face similar challenges given their small dimension and lack of leadership. A clever and farsighted policy of investment attraction might be necessary, even if the crisis of the big industry in Tuscany and in Italy certainly does not help the resurgence of any dual model. STM is the exception, rather than the rule.

Local engines of growth. The role of public research

According to Malecki (2000), the focus on learning and therefore on knowledge accumulation is terribly important to compete in a "two way globalization" system. Peripheral areas in transition should fear to be left out, and this is indeed the danger for Pisa. As I've said, such a location represents the incentive to consider new technologies as a gateway for a new centrality and growth, though posing as an obstacle for policy makers to consider to secure the efficacy of their efforts. Italy is a country which traditionally lags behind in R&D investments, mainly because of the large numbers of small and very small firms, and it lacks overall large R&D-based companies.

A bottleneck is therefore consequential to the reliance on a public research system that has good scientific performance in terms of number and quality of publications, but it is not generating

much needed intense technological transfer processes, which on the other hand seem to be experienced elsewhere in both Northern Europe and US. According to recent studies (Bonaccorsi, 2003), the infrastructural chasm to cross for the Italian public (but also private) research system is granting researchers an easier and more efficient access to an effective IP protection system and a strategy for the management and exploitation of IP.

Rather than the vestiges of past splendor, easier access to specialized financial resources, a more efficient exploitation of IP, and ultimately the definition of technological opportunities seem to be the key factors giving a peripheral economy new "stickiness properties", and granting Pisa the status of a new core in the global competition. These factors will ultimately increase the capacity to become a magnet of exogenous resources and knowledge -- or at least to retain and exploit what is already available.

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