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Could the aeronautics-aerospace industry renovate the “poles of growth” model as a path of development?

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1. Introduction.

The recent economic crisis has revealed that large sized firms like Multinational companies (MNFs) acting onto more national markets, have tolerated the impact of the crisis better than the small and medium ones (SMEs) as well as the countries having a continental dimension -like China and India- that have absorbed the negative effects of the same crisis in a shorter time.

According to a lot of researchers China and India are experiencing their increasing step of the economic growth cycle that was just experienced by European countries in the past; thus confirming the well known theory of “the stages of economic growth”: nothing seems new in the China and India economic dynamic.

Nevertheless we must recognize that the growth of these countries has some features in common, characteristics that the European countries never had in this stage (in addition to the continental size of the mentioned countries): first of all the duration of growth; secondly the financial size of a lot of single companies; third the worldwide diffusion of the main companies as well as a lot of SMEs; finally the contents of knowledge and technology of production process. These aspects clashes with the most well known theories of growth.

The growth experienced by the different European countries was and is country-based, in spite of the implementation of an over-national economic area and the enlargement of the UE. The components of the European economic system have the same evolution: small countries, small companies, small financial and real assets, low capacity to produce innovation and absorb technology; that is why the European Union does not have a continental economy but a multinational one.

¹ The work is the result of a common research; anyway Francesco Losurdo took care of parts 1, 3 and 6; Valeria Stragapede took care of parts 2, 4, and 5.

The last observations have urged us to think that the time has arrived to review the established opinion of the redeeming capacity of the SMEs and their networks that characterized an era closed by now after almost thirty years. This assumption introduces the question of how the European Union and first of all those regions - generally called “the Souths of Union” (Southern regions of Italy, most of the Greek regions, the Eastern Regions of Germany and Poland and most of the new member States of the European Union) - that show a slower growth dynamics compared to the Union average could experiment patterns of firms’ organization more suitable to support a higher rate of growth.

The most diffused opinion suggests that European countries can’t tackle the Chinese/Indian challenge in terms of cost and then they are obliged to enhance the contents of their production process in terms of innovation and technology. This is true, but is the innovation/technological policy enough to face this challenge? Have we the soldiers to fight the present competitive environment or must we endow ourselves with selected kinds of arms? Then the problem of firm size comes back again if we consider that European companies are really small to support innovation and absorb technology in terms of financial endowments, human capital, capacity to face risk, ability to penetrate external markets, etc.. At the same time the question of economic system dimension comes up again, though the borders of economic system as well as those of firms are not so clearly defined in the frame of a globalized economy. We wonder if being part of networks and the different kinds of enterprise clusters are suitable to tackle the present global competitiveness that is principally based on knowledge and information, as well as if the fragmentation of the economic systems like the national ones in the EU is able to face the new continental economic systems, like China and India supposing that we forget to consider the United States as the main competitor/attractor for EU system in the field of knowledge and innovation production.

The present paper tries to answer these questions by connecting two topics as guidelines: knowledge-innovation-technology transfer process and firm size. It is to be stated the role of knowledge and innovation capacity to create competitive advantage is universally recognized but the connections between the two topics are not so clear if we consider that there is, especially in Italy, a still diffused opinion according to which the networks and clusters of SMEs are enough to raise the Italian economy into the present frame of global competitiveness strongly based on knowledge and innovation.

In this paper, first of all we analyse selected national and international scientific literature and data and information derived from the most recent official reports published by the European Commission and other international organizations. We examine the theoretical foundations of the knowledge role as basic factor of growth; after we consider some aspects of the European firm structure compared to other continental economies and the related European policy. Finally, we offer an alternative model of knowledge-based companies coming back to the “poles of growth” created by the French school founded by Perroux. We think that the aeronautics-aerospace industry may interpret the role of “pole of growth” based on knowledge and innovation and it is able to involve a lot of SMEs in the knowledge and innovation production process thanks to the connection between the firms’ big stock of capital with innovation capacity. At the same time, this sector and some few more are able to overleap the national/continental borders of firms and economic systems, and it can become a new model of production organization and a new path of development in the less developed EU regions empowered with solid knowledge infrastructure, human capital, governance, programming and promotion abilities.

We aim at underlining that the connection between a strong governance and the above mentioned factors can renovate a model of territorial organization of firms and production -like in France till the present day- and that global size companies if they are based on knowledge, innovation production, capacity of technology absorption, compatible organization model able to involve SMEs for enlarging the borders of enterprises (microeconomic approach) as well as national economic systems (macroeconomic approach), can be formed in Europe too.

2. Knowledge and European firm sizes.

Nowadays it is a shared idea that knowledge and the ability to innovate represent the main factors in competitive advantages, both at micro levels as well as macro ones in local systems. This concept is crucial if we want to accept the globalization challenge and react to the rapid development that characterizes countries such as China and India.

In fact capitalistic economies in Europe as well as in the USA are not able to compete with the new economic leaders in terms of cost, so they must necessarily increase their knowledge and technological innovation to keep their position in the global market².

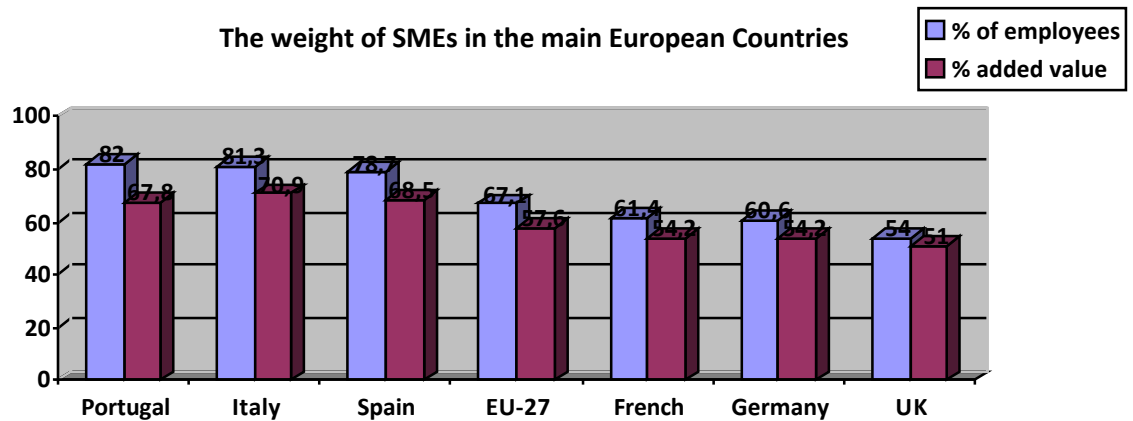
The Lisbon Agenda recognizes these priorities and fixes as targets in the medium-long term the diffusion of knowledge in Europe and the production of technological innovations. Nevertheless, the policy measures adopted so far by the whole EU and individual the Countries have not mirrored this aim and it is clear that the national and regional contexts are not ready for this challenge.

At the Union level the increase of private investments rather than the public ones in R&D activities is encouraged, but this target clashes with the typical characteristics that the research systems in the European economy present, systems that are characterized by a strong role played by the public institutions.

We can now operate a first classification between countries with a high or low level of expenditure in R&D, followed by a distinction between systems prevalently public or private. The characteristic that seems to be crucial in determining the success or failure in the policy measures for innovation, is the ability of the institutional systems to adapt themselves to the scientific and technological changes, characteristic almost inexistent in European Countries and it seems to be associated with other weaknesses such as the difficulty to convert innovation technologies into economic advantages combined with the generalized small dimension that European companies present.

Eurostat data (2008) demonstrate that SMEs in EU-27 absorb 67,1% of the employees and produce 57,6% of the added value, more significant percentages are registered in Portugal, Italy and Spain.

2 Fagerberg J., (2000), Europe at the crossroads: the challenge from innovation-based growth, Centre for Technology, Innovation and Culture University of Oslo.
Presentation at the international Conference in Economics IV September 13-16 2000



The firm size is directly linked with innovative performances, in fact it is a common topic in literature that only big companies have financial instruments and human resources enough to invest in R&D activities.

In fact data confirm that most of SMEs haven't got the economic and organizational ability to employ highly qualified staff and they haven't got the necessary support from the bank system to undertake high risk investments that the research activities involve. These difficulties are so strong that the production of technological innovation and patent registration are nowadays the prerogative of big companies thus making the overcoming of size bonds an important step in increasing the competitiveness of the European system and in building the "knowledge society" described in the Lisbon Agenda.

But when size bonds are insuperable, an important alternative is the belonging to local productive systems, which allow to overcome dimension bonds converting dynamic uncertainties associated with research activities into static ones..

The first economist that stressed the importance of firm territorial concentration was Marshall; at the end of the Seventeenth Century he described economic spillovers. A further evolution in the cluster study was introduced by Arrow that analyzed the positive effects produced by clusters in terms of knowledge flows between companies. Romer and Krugman –the latter a main economist in the New Economic Geography – investigated the links between economic activity concentration and local development, thanks to positive externalities in the territorial context.

In defining the district concept Camagni and Maillat's contribution have also been important formalizing the concept of "milieu innovateur": it is a kind of cluster based on technology and ideas rather than product flows.

Considering the new challenges that global competition presents, the district models and the milieu innovateur can't guarantee a path of local development based on knowledge diffusion. These models have found their correspondence in limited local contexts and don't have the international projection fundamental in this age.

Consequently in this paper we analyze the aeronautics-aerospace case. These kind of companies represent a valid example of "dragging companies" in the local economic systems in which they settle. We present a revision of the theoretical model formalized by Perroux, based on knowledge in addition to products and services exchanges rather than only products and services as supposed in the original model.

3. The borders of the economic organizations.

In this paper we consider as economic organizations the economic systems and the firms. The differences between a continental economic system and a national one regard the capacity to create relations between the single system and its external environment. If we consider a small system, like a family, a firm or a country, they can have a lot of relations but generally inside a limited context. That is why the people that form the system are few: they may have a strong capacity to connect with other external systems and be considered clever by their potential interlocutors, but at the same time they are relatively poor as producers and consumers owing to their small number. That is probably due to the assessment criteria that are referred to the amount of material goods that can be produced by the considered system rather than the potential quality of transactions.

Knowledge, human abilities and other intangibles assets are tools to produce immaterial goods that may be added or not to materials ones. In this case the interlocutors' opinion could change and become better thanks to the different role that the system plays as producer of immaterial goods rather than as consumer. That is why knowledge and human abilities applied to production process could contribute to enlarge the borders defined by physical dimension of a system compared to the external environment.

The former quality –that is tangible and intangible assets- may be a proper quality of the system or of the firm, but it is quite different if this is a characteristic of the first or the second unit. In fact, if the above mentioned quality belongs to the system we could have an innovative system that may have a proper dimension, population, organization, institutions, firms etc., that contribute all together to the performance of the system, as result of new interactions among economic organizations (families, enterprises,

institutions) and external environment if we consider that this result implies a growing interdependence among all the above considered components, that are the production process, the organization of the knowledge infrastructure, the human abilities, the institutions and the social capabilities³.

Differently, if innovative capacity is a quality of just a firm or a small number of companies the innovative system is too small a one, then it may only contribute slightly to the evolution of the borders of the whole system that represents its external environment. In fact as enlargement of the borders of a system we mean the transformations that are able to organize knowledge and human abilities to the advantage of the whole system connecting individual needs and opportunities offered by the external environment. If the system is too small related to the external environment it will be able to connect only with a small part of the external environment. That is why to define the dimension as well as the borders of a system it is important to understand its potential role inside a competitive environment based on knowledge, innovation and technology.

The main channels of creation and diffusion of knowledge and human abilities in a defined economic system are the enterprises, the markets, the innovation process, the education and training of the workers. The above considered channels are typical of a complex system in which the production components are characterized by a material base, the other ones by an immaterial base⁴.

Consequently, if we have not a national or over-national system able to carry on a policy direct to create the above mentioned channels suitable to contribute to the evolution of system borders, we must necessarily ask other actors to play this role. These players may be the MNFs that –as acknowledged - play a fundamental role in innovation, technology transfer and productivity growth.

The model we suggest to explain the MNFs role is the “poles of growth”, in which the single MNF can play a key mission as vehicle of the system in terms of the international transfer and creation of technology⁵ or more generally as organization of opening the physical and immaterial borders of different systems thanks to specific policies as well as incentives. This new organization and application of an old scheme like the model of the “poles of growth” by Perroux, opportunely revisited and planned, may open the borders of

3 Antonelli G. (2005), “Organizzazione della conoscenza e confini esterni nei sistemi locali di produzione”, in Istituzioni e imprese nello sviluppo locale a cura di A. Lopes, M. Lorizio e F. Reganati.

4. Antonelli G. and Pegoretti G. (2005), “Economic Structure, Organization of Knowledge, Productivity” in G. Huber, H. Kramer, H.D. Kurz, eds. Einkommensverteilung, technischer Fortschritt und struktureller Wandel, Metropolis-Verlag, Marburg.

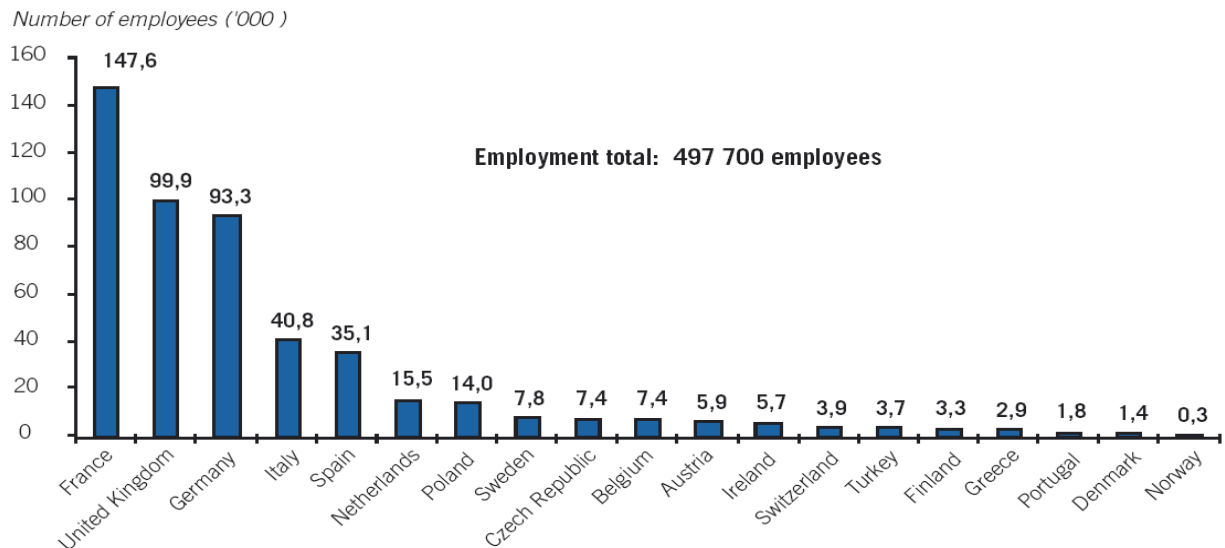
5 Castellani D. and Zanfei A. (2006), “Multinational Firms, Innovation and Productivity”, ed Edward Elgar Cheltenham, UK- Northampton, MA, USA.

territorial systems in the less developed regions of European Union and contribute to overleap the organizational scheme of the production mostly based only on material goods and SMEs like in the industrial districts.

4. Aeronautics-aerospace sector characteristics.

With more than one million direct and indirect employees, Europe has a main position in the global market of the aeronautics-aerospace sector. To maintain this position it is necessary to overcome the national interest and invest in alliances at Union level. This tendency is confirmed by the fact that EU in the Seventh Program Framework has assigned 2,2 euro billion to the thematic area “Space” and a lot of initiatives have been carried out at Union levels in the field of space exploration (GALILEO, Gmes etc.)

National Contributions to Direct European Aerospace Industry Employment



Source: ASD National Associations. All Space data are provided by Eurospace or ASD National Associations

The aeronautics- aerospace sector has proved itself to be able to guarantee the economic development in many regions, such as in France in Midi-Pyrénées region and in Hamburg's region as well as more recently in Poland and Spain.

Compared to other sectors, it presents a relatively low performance in terms of number of employees and turnover, but it has a relevant ability in generating new technologies able to

extend the boundaries of knowledge and transfer a lot of innovation for common use and civil applications.

The fundamental characteristic of the sector is to combine technological information that comes from other sectors (spin-in) and produce a lot of innovations that can be useful in many fields (spin-off).

The aeronautics-aerospace industry presents a typical pyramidal structure: at the top there are big companies such as Boeing, EADS, Lockheed Martin, Northrop Grumman, that coordinate the product and information flows between firms and they select partners that can participate different research programs⁶.

At the second level we have companies such as General Electric, Pratt & Whitney e Rolls-Royce that produce motors and companies that make avionic products such as BAE System, Honeywell e Thales.

Companies with a specific know how in the production of particular components that is sections of wings or fuselage, electronic components or propellers follow.

At the bottom of the pyramid there are a lot of SMEs that work as sub-suppliers. They participate the local or international production making components that bigger companies convert into final products.

The local or international dimension of knowledge spillovers is linked with the position in the pyramid.

5. Aeronautics-aerospace companies as “dragging companies”.

Aeronautics-aerospace companies have the typical characteristics of multinationals: they make products, knowledge and technological innovation, they attract around themselves a relevant network of companies that work as suppliers and sub-suppliers whose districts are often localized in regions not particularly developed from the economic point of view (such as Spain, Poland and Southern Italy).

The above mentioned characteristics of the aeronautics-aerospace industry enables to understand the relationship between innovative companies and territorial environment.

The theoretical framework taken into consideration but with some differences because at the economist's time knowledge was considered a “residual factor”, is the Perroux's “dragging companies”.

6 Niosi J., Zhegu M. (2005), “Aerospace Clusters: Local or Global Knowledge Spillovers?”, *Industry and Innovation*, vol 12, No. 1, 1-25.

Is it possible to revalue this theoretical model as a complement of production district and a milieu innovateur one?

In 50's Perroux supported the idea that the economic development can manifest itself in the territorial context with a variable intensity assuming the form of poles of development that produce a selective growth.

This is possible thanks to a dragging company that generates an accelerator effect on income - as described by the keynesian theory -, a stimulating effect on companies that are at the top as well as at the bottom of the supply chain - conforming to the Leontief's theory - and a multiplicative effect on other firm investments.

Some aspects in the poles of development theory have been criticized and can be enriched thanks to the contemporary literature. Doubts have been expressed about the choice of the dragging company's localization. In Italian history, when this choice has been politically influenced with the creation of a planned pole, as for iron and petrochemical companies in Southern Italy, the positive effects have been limited. The Perroux's theoretical model based on input-output relations between companies, works better in case of a spontaneous initiative of a company that operates in a very large productive chain with a relevant induced activity, characteristic that the aeronautics-aerospace sector has, in fact its induced activities means six times as big as its core business.

Moreover considering that aeronautics-aerospace poles support the increasing of intangible assets as human capital, knowledge and learning processes, we can understand which relevant contribution these companies can determine in the local technological fertilization.

Aeronautics-aerospace companies operate without a doubt on a global market, in spite of this evidence the sector is characterized by a strong local concentration and by relevant relationship with universities, other companies and institutions.

In the aeronautics-aerospace history both for industrial policy choice and externalities linked with spatial proximity between suppliers and system integrators, we often have significant clusters with a strong specialization in component production as in the areas of Seattle and Toulouse.

In many cases the cluster is composed by the system integrator and a lot of SMEs at the pyramid basis, in this case technological spillovers and the knowledge diffusion take place at the local level.

This structure depends on the asymmetric knowledge distribution that is directly controlled by system integrators. Big companies are the core of the district but they can't operate

without SMEs, this is the reason why this process of clustering, so far spontaneous, must be supported at policy level.

Now it is possible to stress the advantages that aeronautics-aerospace companies can produce at the local level thanks to their characteristics.

The theoretical approach is the Porter's one where boundaries between firms and local context are not stationary: they must focus not only on the ability of the firm to manage, check and plan technological innovation but also on the firm's readiness to react rapidly to stimuli that come from external environment. In this perspective the idea that companies and local context are mutually extraneous is denied, the habitat becomes a relevant source of restrictions and opportunities.

The strong link that connects aeronautics-aerospace sector and regional context can be explained through the pyramidal structure that characterizes the production chain which demands a significant coordination between different production and research activities and a strong geographical concentration in order to reduce technical uncertainties.

When these knowledge flows concern a big company with financial and human resources on one hand and SMEs often located in regions defined the "EU Souths" on the other, it is possible to understand the relevant benefits these companies can generate in regional context.

It is also relevant the positive effect these companies can produce on local human capital thus avoiding the escape of high qualified people from their underdeveloped regions.

The presence of this kind of companies can also stimulate the academic education in technological fields where applied research is crucial and it is favored both nationally and at the Union level.

In conclusion companies that operate in this sector, thanks to their international dimension can represent for hosts regions opportunities to enter those global networks of knowledge exchange, human capital circulation and capital flows that are usually inaccessible for these regions.

6. Conclusion.

The purpose of this paper is based on the assumption of the increasing role of China and India as the greatest producers of material goods. In this way China and India and few more continental economic systems are saturating the worldwide market. In perspective the old producers like the European countries could play the role of consumers of both

material goods and immaterial if they do not renovate their production systems towards a more intensive knowledge and innovation model of production suitable to specialize the European countries in the immaterial goods production. In fact if the EU plays in the field of immaterial goods, productions could have new space of market and acquire a comparative advantage as a producer of immaterial goods together with material goods whose production is based on intangible assets. In this way European countries could reduce the path dependence from the new producers of material goods thanks to the higher terms of trade of immaterial goods against the material ones.

To achieve these goals the EU needs to become a continental player and be as much a producer as he is a consumer. Then we suggest that EU should act with a single policy in the field of R&D and national model of organization of the related activities.

In addition we suggest adopting an attractive policy for the MNFs in order to have continuous flows of transfer and creation of technology. The European system must adopt a common policy and structure of incentives in order to attract the MNFs and must enlarge its borders more than the territorial ones that may become an obstacle for its achievements. This way is considered particularly effective in the opening of the physical borders of the “Souths of Europe” as defined above: the MNFs can bridge the different innovation systems. That is why we suggested applying as a model of territorial organization of production systems the scheme of the “poles of growth” in which the MNFs could play the role of vehicle of knowledge, innovation and technology transfer.

We have selected the aeronautics-aerospace industry as case study and application of the above mentioned model, taking into consideration the following targets: relevant role played in the innovation technology production, pyramidal structure that guarantees a global perspective thanks to companies that are at the top, combined with a strong link with local context across companies at the basis; in addition the aeronautics-aerospace districts have demonstrated to be able to promote a technological fertilization in regions where they operate.

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