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COMPLEXITY IN REGIONAL ECONOMICS.
THEORETICAL MODELLING AND EMPIRICAL APPLICATIONS

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INTRODUCTION

Regions are part of a global network in which commodities and services are produced and traded (Becattini, Rullani, 2000; Scott, Storper, 2003). Their capacity to play a key role within such network depends on the local endowment of resources: advanced workforce's skills, capital, local (natural and cultural) amenities, and the degree of connectivity with the rest of the world (*ibid.*). Local institutions (rules and organisms) also play an important role in supporting regional performances through the production and delivery of public and collective goods (Arrighetti, Seravalli, 1999). On the one hand, a region that is home to such device has the potential to become a hub of the international network thus experiencing a dramatic growth (Krugman, 1991). On the other hand, a region that does not concentrate a critical amount of the aforementioned resources may become a peripheral region, not integrated within the international network, or positioned at the very end of the hierarchical scale of it (Camagni, 2002). In this vein it can be demonstrated that regions compete at the global scale for agglomerating the best factor of production.

Hierarchy is a key issue within the international network of regions. Some regions, such as metropolitan regions, for instance, act as command places, or hubs, for global economy ("*Cities are strategic places that concentrate command-and-control functions for the global economy*" – Sassen, 1991). This is due to the large concentration of resources (human capital, capital, and institutions), and their political importance (often such regions are administrative centres for large territories or nations). This kind of regions are often characterised by multiple specialisations in high value added sectors (Taylor, 2005). However, although they cannot experiment multiple specialisations as in the case of metropolitan regions, smaller regions can become important hubs within the international network if they are specialised in a given sector that has a key importance on the global economy. It is the case, for instance, of San Jose (Silicon Valley) in the United States, "industrial districts" localised in the so-called *Third Italy* (Bagnasco, 1977), and some other regions taking advantage from a remarkable endowment of natural or cultural *amenities* attracting international tourism (Pezzini, 2003).

The positioning within the international network is also subject to lock-in dynamics. Once a region has reached a given level of specialisation it keeps on agglomerating resources connected somehow to the local specialisation, thus enforcing its capacity to compete on the international market (Myrdal, 1957; Krugman, 1991). Vice versa, when a region has not such a critical concentration of resources, it can be challenging to concentrate factors of production. In other words, regional competitiveness presents path dependence (Arthur, 1988). Path dependence, in turn, is strongly affected by the

technological progress and the evolution of the international economy. For instance, whenever a new product or process is invented (technological shock), a given region has the possibility to start a new process of agglomeration of specialised factors of production, thus improving its positioning within the international economy.

The probability of such improvement depends on a variety of factors. Although it is challenging to set a list of *preconditions for local development*, some factors *facilitating* regional growth are: (*i*) the presence of a given know-how linked to the local tradition or culture (Becattini, 1979); (*ii*) the possibility to link such local know-how with the international market (Becattini, Rullani, 2000); (*iii*) the concentration of human capital; and, finally, (*iv*) the presence of effective institutions (i.e. the presence of an *integrated basket of public goods*) supporting local development. All these "forces" act at the same time and within an international and evolving framework. The result is complexity. A large number of agents interacting both at the local and international level generates a barely predictable dynamic of the local system.

Conventional economics cannot describe such dynamics. Even traditional agent-based approaches can barely reproduce the "real world" (i.e. a valuable counterfactual). Because of this theoretical limit (initially originated by the assumption of decreasing returns of scale), for a long time, competitive advantages featuring a given region were not properly detected. The most famous examples of this mismatch between reality and theory are the Italian (*Marshallian*) industrial districts, which generated a decades-long debate, since theory was not able to describe what was clearly detected by the empirical (on field) analysis (Brusco, Sabel, 1981). Nowadays, although industrial districts and other firms' agglomerations have become important units of analysis, regional economics are still far to be part of the mainstream economics.

The present research aims at discussing the current improvements made by economics in studying regional dynamics and suggests an innovative approach based on the implementation of new methodologies (i.e. introducing instruments to analyze complexity) and/or traditional ones yet used under new perspectives. In other terms, the classical problem of regional economics, e.g. "*which are the interacting forces generating or enhancing agglomeration dynamics in a given portion of territory?*" has been analyzed with theoretical instruments that allow the model to retain the original degree of complexity characterizing the context. In the same vein, the problem of understanding "*what the functional linkages within a regional economy are"* is assessed through the traditional input-output approach, which proves very helpful to define the drivers of local development, and evaluate the sustainability of regional growth. The aim is to create a set of tools for economic analysis to design regional policy.

In the first part, the essay will assess regional economic dynamics as a *self-reinforcing mechanism*: a positive (or negative) feedback that characterizes the evolution of a dynamic system. The concept of self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and a positive feedback, which tends to a large variety of asymptotic states. Every evolutionary step of the system influences the next one and then the evolution of the entire system, thus generating *path dependence.* Such a

system has a high number of asymptotic states, and the initial state (time zero), unpredicted shocks, or other kind of fluctuations, can all conduct the system in any of the different domains of the asymptotic states (Arthur, 1988). Furthermore, the system selects the state in which placing itself. It is worth noting that, the concept of positive feedback is relatively new for the economic science. The latter generally deals with problems of optimal allocation of scarce/insufficient resources, thus the feedback is usually considered to be negative (decreasing utility and decreasing productivity). Self reinforcing dynamics can be used to assess many different economic problems with different origins: from those related to the international dimension, e.g. to assess the reaction of a region to exogenous shocks, to those typical of the industrial economy, and, last but not least, problems related to regional economics. Specifically, this model demonstrates that the final state of the system (the level of productivity characterising a given region that depends on its actual capacity to attract/reproduce factors of production) will depend on the particular trail it has been covering during its dynamic evolution from an (instable) equilibrium towards another (instable) equilibrium, and so on. Under this perspective, the research focuses on three issues. First of all, identifying forces that act as attractors for the system; second, if these forces exist, assessing the possibility that the system has to move from a lower equilibrium to a higher one (and if so, in which way and how); finally, whether this transition from a level to another is spontaneous or need some particular policy (effectiveness of policies). The stylized facts confirm that the process of regional development is discontinuous and unexpected: as in the case of new territorial agglomeration (clusters) created by a collective reorganization of the local productive framework. Moreover, place-based policies are biased in their implementation by exogenous and endogenous factors. Therefore, policy effectiveness depends on a number of factors, among which the most important is the capacity of the local community of correctly detecting its competitive advantage and designing the policy expressly to enhance it.

Regarding the identification of the local drivers of economic development, the essay discusses the application of an input-output model to measure regional competitiveness. Although this is a well-known methodology, the essay discusses the possibility of using this model to measure sectoral productivity improvements and emerging clustering within a regional economy. Invented in the 1930s by V. Leontief to study national economies, the input-output approach has been revived because of the flourishing of statistical researches at a regional scale that have started to collect highly detailed social and economic data. The input-output model can be applied fairly easily to small regional economies and provides local planners with information of immense value. The transactions matrix is a detailed snap-shot of the input-output linkages existing in a given region. Input-output matrix can be used to forecast the consequences of any planned or potential changes in the demand for region's output. Moreover, the rationale for building a transaction table for a regional economy is to predict the consequences of exogenous demand shocks. Once interdependencies between sectors have been quantified, it is possible to estimate the effect of any changes in final demand on the entire system. Despite some well-known limits, as for instance the absence of economy of scale, when a

"time series" of transactions matrixes is available, it is also possible to estimate the evolution of some key indicators such as local employment and labour productivity.

The first conclusion that can be reached after implementing the different approaches discussed above is that regions should invest in sectors in which they have a sound competitive advantage at the international level. Concentrating resources on these sectors will determine a positive effect for the local economy as a whole thanks to a mechanism of transmission throughout the regional labour market. Such a conclusion is in line with that reached by other scholars in modelling regional economies (Cfr. Aoki, 2002).

Defining the unit of analysis is another key step in assessing regional economies. The misinterpretation of the functional region would bias the empirical assessment of the socioeconomic trends and, in turn, the setting of local policies. There are three different methodologies to define a functional region. First of all, it is possible to take into account the administrative boundaries of a region. The assumption will be that the presence of a local government or a local governance device shapes the socioeconomic trend of the area and favourite the creation of a homogenous economic area. Second, it is possible to focus on the morphology of the region: the form of the built environment and the presence of key infrastructures (mainly transportation facilities) assuming that the availability of such infrastructure increases the possibility of having business linkages. Finally the last approach tries to define the functional region by taking into account population size and population densities, and the commuting flows, i.e. the effective dimension of the local labour market. Obviously the last approach is by far the most precise in defining local linkages and the effective dimension of a given region. However, it is worth noting that there is a trade-off between the definition of a functional region and the possibility to measure local socio-economic trends. In many cases, the lack of administrative boundaries prevents the availability of statistical data and so the possibility of assessing the performances of the economy (OECD, 2007). This essay focuses on the definition of urban functional regions and takes into account two different methodologies: the two-component model, and the partitioning model. The first one, based on the assessment of commuting flows, is very effective in defining monocentric urban regions, while the second is usually implemented to define polycentric urban region and is based on the definition of small interacting labour pools.

The second part of the essay focuses on the Madrid metropolitan region and tries to verify some of the conclusions reached in the first part. The Madrid metro-region, recently assessed by the OECD in a Territorial Review (OECD, 2007), has been capturing advantages of globalisation by becoming a metropolitan region of 6 million, which attracts foreign workers and firms. The capital region has experienced impressive dynamic economic growth in recent years. It absorbs more than a half of the total FDI in Spain and has extended its economic relations with Latin American countries. Growth has occurred largely in the service sector (finance, banking, business services) as well as in logistics. Unemployment has reached a low level (6.5% in 2006) and growth rate has surpassed the national average and the average for OECD metro-regions. There is however a concern on how to sustain this positive economic path in the long run. Main

challenges to be addressed include a relatively low productivity level, insufficient specialisation in high-value added manufacturing activities, job-skills mismatches (especially for immigrants), and low innovation capacity.

Finally, in the last part of the essay, the productive framework of the Madrid metro-region is further analysed through an input-output approach. A cluster analysis conducted on the Leontief inverse matrix shows that Madrid is a de-specialised region. This is a common feature among large metropolitan regions. Moreover, through the Leontief inverse matrix, the essay assesses backward and forward linkages within the regional economy. Surprisingly enough, mature manufacturing sectors enjoy the most intense functional linkages with the rest of the regional productive framework. This conclusion supports the hypothesis that regional growth, albeit significant, may not be sustainable over the long run.

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THEORETICAL BACKGROUND

The new approach to regional competitiveness

Introduction

Globalisation increased the level of competition between regions all over the world. Although the country effect is still significant, the (competitive) advantage of regions has dramatically changed and some areas--even in some industrialised countries--are suffering a general worsening of their economic performance (i.e. GDP trends), while some others are enjoying astonishing development. The ongoing situation confirms part of the theoretical conclusions of the New Economic Geography, and, at the same time, creates a huge number of opportunities for further research on regional development.

An innovative theoretical approach extends to drawing the economic dynamic as the evolution of complex systems. Complexity can be introduced in economic formalization in many different shapes and patterns. A crisis of traditional economic models and (accordingly) of related policies is often a first result. The "Agent Based" models are sophisticated formalisations for studying complexity within regional economy and they also will be the main background for the analysis presented in this section. Specifically, by using sophisticated mathematical instruments it is possible to assess ongoing dynamics by combining three main issues. First of all, the presence of multiple specialisations in regions and their effect on consumer utility function (monopolistic competition à la Dixit – Stiglitz, 1977). Secondly, the effect that territorial contiguity of actors has on local development (shipping charges in transportation costs as in the ice-berg model of Samuelson). Lastly, the source of higher performance in those regions which host haphazard interactions among firms of different branches and industries (Aoki, 2002 – Storper, Venables, 2003). The first two points are embedded in the New Economic Geography (especially in the Krugman formalisation), which is the starting point of modern regional economics. The third (the evolutionary one) characterizes this contribution, which aims at giving a new interpretation of the concept of endogenous development, here considered as the dynamic development of a complex economic system.

This part of the essay will assess the economic dynamic as a *self-reinforcing mechanism*: positive (or negative) feedback that characterizes the evolution of a dynamic system. The concept of a self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and positive feedback, which tends to produce a large variety of asymptotic states. Every evolutionary step of the system influences the next

and thus the evolution of the entire system, so generating *path dependence*. Such a system has a high number of asymptotic states, and the initial state (Time zero), unforeseen shocks, or other kinds of fluctuations, can lead the system into any of the different domains of the asymptotic states (Arthur, 1988). Furthermore, the system selects the state in which it places itself. Such dynamics are well known in physics, chemistry and biology and the final asymptotic state is called the *emergent structure*. The concept of positive feedback is relatively new in economics. The latter generally deals with problems of optimal allocation of scarce/insufficient resources, thus the feedback is usually considered to be negative (decreasing utility and decreasing productivity).

Sf-reinforcing mechanism dynamics can be used to assess many different economic problems with different origins, from those related to the international dimension to those typical of the industrial economy, and, last but not least, problems related to regional economics. Many scholars have assessed multiple equilibria and their inefficiency (Marshall 1891, Arrow, Hahn 1971, Brown, Heal 1979, Scarf 1981). Multiple equilibria depend on the existence of increasing returns to scale. If the self-reinforcing mechanism is not counterbalanced by some opposite force, the output is local positive feedback. The latter, in turn, will amplify deviation from some states. Since these states derive from a local positive feedback, they are unstable by definition, so multiple equilibria exist and are efficient. If the *vector field* related to a given dynamic system is regular and its critical points follow some particular rules, then the existence of other critical points or of stable cycles (also called *attractors*) is a result (Marino, 1998).[1] The multi-attractor systems have some particular properties that are very useful to our research (Marino, 1998). Strict path dependence is therefore manifested, and the final state of the system will depend on the particular path it has covered during its dynamic evolution from one (unstable) equilibrium to another (unstable) equilibrium. Accordingly, the system's dynamic is a non-ergodic one.

Three are the points where the research can be focussed. First of all, the identification of forces that act as attractors for the system; secondly, if these forces exist, assessing the possibility that the system will move from a lower to a higher equilibrium (and if so, in which way and how); finally, whether this transition from one level to another is spontaneous or needs some particular policy (effectiveness of policies). A first remarkable result is that different mathematical instruments give the same result. Accordingly, patterns of evolution can be numerous and different from each other, because of the existence of many stable multiple equilibria, and convergence paths (or phase transitions between the states). The stylized facts confirm that the process of regional development is discontinuous and unexpected: as in the case of new territorial agglomeration (clusters) created by a collective reorganization of the local productive framework.

1 For instance, this issue justifies the efficiency of the lower technology pattern of production within the market

Self-reinforcing mechanism and complexity in regional economics

For many years, regional economics has not been considered as the economic mainstream. The main reasons for such a situation are mainly related to two orders of factors. First of all, the perfect competition approach required a world in which all agents were equal (or divided into well-defined categories such as households or firms), without any difference between them. Secondly, the economic system as a whole was trying to reach a stable equilibrium and then to maintain it for as long as possible. In other words, the steady state was considered as a *locus* in which the system had no more incentives to move toward any other state. The result of this kind of formalization was weak and counterfactual, too weak to be benchmarked with the empirical evidence of many regions.

The first attempt to give a theoretical (even though qualitative) basis to the empirical evidence for agglomeration dynamics dates back to 1890, when Alfred Marshall defined as "external economies" those economies which are external to a single firm but are internal to a specific area which is characterised by an "industrial atmosphere" (the latter being a form of public good). According to his definition, there are three main pillars that underpin the individual location choice of firms and workers:

1. the existence of a pooled labour market that enhances the probability of finding a job for workers, and, on the other hand, lowers the probability of labour shortages for firms;
2. the localized production of non-tradable specialized inputs;
3. the possibility for firms to gain a better production function thanks to the existence of informational spillover.

Marshall didn't leave a formalized model of his insight. He avoided facing a theoretical "Gordian Knot" since the existence of a source of competitive advantage for firms localized in a specific area was a sort of "shock" for *orthodox* economic theory: the presence of "unexhausted economies of scale at the level of firms undermine[d] perfect competition" (Krugman, 1998). The aim of preserving the coherence and elegance of the "perfect competition" formalization led many scholars to bypass the problem of the competitive advantage of firms by using the concept of "central city" in their static models considering the territory in a passive form[2]. This clearly appears, for example, in the Christaller (1933) assumption that larger cities can support a wider range of activities, and in the hexagonal market formalized by Lösch (1940), where some specialized economic activities can be undertaken only at a limited number of sites.[3]

2 Territory, in those pioneer formalizations, was homogeneous and isotropous (i.e. the same in every direction). In other words, the basic concept of land space was that of the endless plains of the central USA.

3 It is important to note that neither the formalisation of Christaller or Lösch gave any explanation for the development of the central city, which existed "by default".

Both the models of Christaller and Lösch considered a manufacturing sector which sells its products to an agricultural sector. Accordingly, this kind of approach was not able to describe the circular feature of production in which some of the demand for manufacturing commodities comes from the manufacturing sector itself (*commodities produced using other commodities*). Empirical evidence shows that the presence of a well developed, strongly localized, manufacturing sector is attractive for other firms of the same sector or production chain[4]. This dynamic can be summarised with the expression "circular causation" utilized by Myrdal (1957) to describe a self-fulfilling process in which a given location starts attracting firms from a certain dimension of its manufacturing sector. The circularity of the process is due to the "backward and forward linkages" (Chenery, Watanabe, 1958; Rasmussen, 1956; Hirschman, 1958) that link firms to each other[5]. Furthermore, the physical proximity to suppliers and seller makes for lower transactional costs (Coase, 1937; Williamson, 1981).

The next step in the theory was to recognise the evolutionary nature of external economies. Vernon (1962), having analysed the New York productive framework during the 1950s, stressed the "rise and spread of external economies": new sectors are localised in central areas because they need a high concentration of positive externalities. The standardisation of the production reduces the need for a specialised external economy and thus firms leave the expensive urban centre and locate in the periphery of metropolitan areas.

The last issue was to discover the way in which a territory was able to achieve the right concentration of (manufacturing) firms to start a self-sustaining process of circular causation. Only in the early 1990s did economists find a sound theoretical basis for the empirical evidence by modelling a system of "monopolistic competition" (à la Dixit-Stiglitz) and, so, consider the "increasing returns of scale" which firms gain by choosing (or by being in) a particular region[6].

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4 The existence of strong relationships between clusters of firms in a well-defined territory was first discovered during the 1920s, as a consortium of economists of Columbia University analysed the collocation of firms and industries in New York. They discovered that standardisation of output played a remarkable role in location decision of agents. Firms with a low level of standardisation operating, for example, in the fashion sector, were located in the centre, closely related to their suppliers or sellers by wide use of face-to-face relationships. On the contrary, firms with a high level of standardisation and vertical integration (cooperage is the original example), were located in the outskirts of the city.

5 "The economies are external in the sense that the firm obtains them from outsiders, and they are economies in the sense that the firm can satisfy its variable or part-time needs in this manner more cheaply than it could satisfy them from within. The outsiders, in turn, can afford to cater to the firm's fractional needs because they also cater to many other firms" Hall (1959). This kind of inter-firm relationship, under some particular conditions (high level of environmental trustiness, strong meso-institutions, etc.), can be so strong that firms start to externalize their "Value Chain", forming what some scholars call a "Value Constellation".

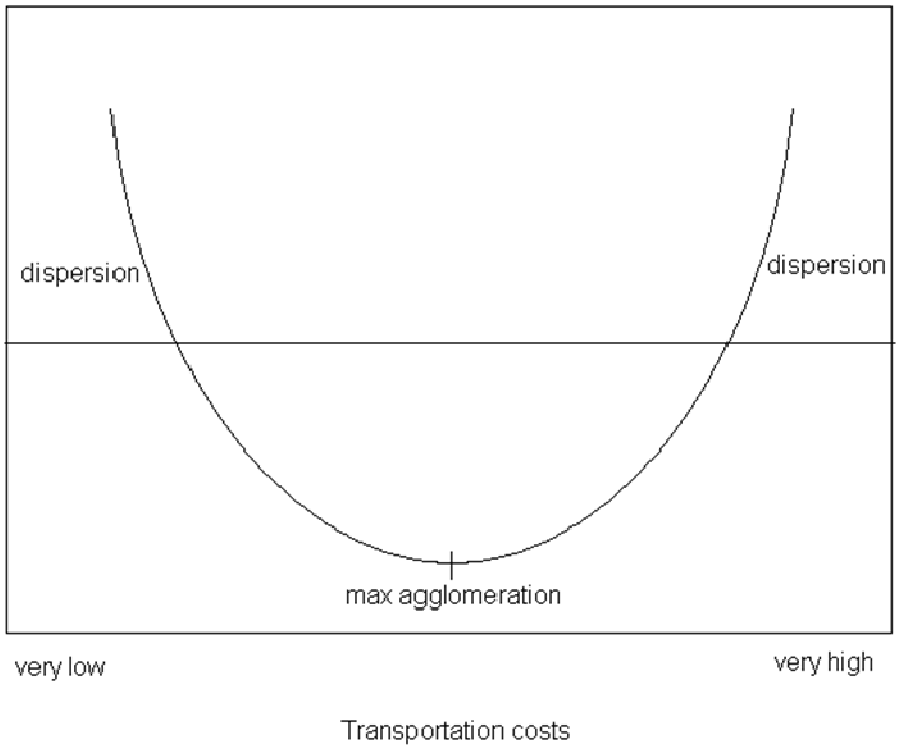
6 We are referring to the contributions of Fujita, Krugman, and Venables, among others, in the creation of the so called "New Economic Geography"

Specifically, the three fundamental conditions are:

1. the manufacturing sector has to employ a large proportion of the local population in order to generate large local demand;
2. the sector has to be characterised by large economies of scale;
3. low transportation costs.

When these conditions are satisfied, a region (or an urban area) with a *large local market* and *large availability of goods and services* will attract population from regions whose economic frameworks don't have such as characteristics (or have then in a less intensive form). In other words, *territories start competing against each other to attract manufacturing activities*. The approach to agglomeration seen above (New Economic Geography) can be useful to assess some long run dynamics. Indeed, when a broad temporal horizon is considered (i.e. starting from the Industrial Revolution) the importance of cheaper transportation costs in the development path of agglomeration is clearly apparent. However, "circular causation" seems to reduce dramatically when a shorter period (e.g. from the 1970s) is considered. Given that transportation costs were in a constant decreasing trend, empirical evidence seems to suggest a U-shaped relationship between the level of agglomeration and the cost of transportation, as shown in the figure below.

Figure 1 - Impact of transportation costs level on agglomeration



This dynamic can be explained theoretically by considering a system in which firms produce both for other firms and for the agricultural sector: when transportation costs are very high firms disperse to meet the demand of farmers in every region, on the other hand, if the cost of transportation is very low firms disperse, because of easy access to other firms and consumers. However, this formalisation assumes the intra-city transportation cost to be zero and the inter-city transportation cost to be positive. In other words, it is useful only to understand the conditions in which agglomeration arises in a given large region.

Heterogeneity of agents

Regions are often the location of a complex structure of heterogeneous agents acting in different ways. Agents do not actually optimize a common utility function and they do not share a common endowment of perfect information. Conversely, agents are part of a complex system and every agent (or group of agents) evolves toward unstable equilibria in which they adjust their strategies and their expectations continuously. Strategies and expectations together change the environment itself.

Accordingly, the path toward the equilibrium point, or the linear dynamic of growth, as in the neo-classical Solow (1970) formalization, is only one of an infinite number of patterns in which the system may evolve. In this situation, even small changes in some variables are able to change the system from one pattern to another (an emergent structure). As Arthur recently stressed (2005) a dynamic like that has three main features:

- *Perpetual novelty*: there is a constant incentive to evolve (while according to static economics, agents should not have any incentive to move from the equilibrium once it is achieved).

- *Equilibrium indeterminacy* and a selection process that means the evolutionary path of the system is not given and even small variations can change the intensity or the direction of the vector field.

- *Expectational indeterminacy and inductive behaviour*. In static economics, agents try to form their expectations about an outcome that is a function of their very expectations: a self-referential situation. With rational expectation the problem remains; indeed to avoid the onset of multiple equilibria, all the agents should adopt the same base theory (i.e. based on the same assumptions), which is at least a very special event.

Accordingly, complexity theory can be regarded as an emerging paradigm for understanding the complex dynamics underlying processes in regional economics, as, according to our definition above, regions are complex systems made up of many interacting parts. Complex systems can be described as a graph with nodes (elements) and edges (interactions). The number of interactions that exist between elements can define complexity. Accordingly, it is a function of the number of elements (N) acting in the defined domain.

Complexity ranges thus from a maximum level of N elements or agents generating N(N-1) interactions (assuming that interactions are not necessarily mutual) to a minimum of complexity in which there is only one agent (or a group of agents – firms and households) without any direct relationship (or with direct and linear relationships). However, empty graphs cannot really be considered systems because the elements have no relations with other elements.

Agent interactions can also have differing degrees of intensity, they can be weak or strong, and usually intensity of interaction is a function of proximity to different agents. The presence of a dense network of agents (i.e. firms), in fact, is a necessary but not a sufficient condition for creating dynamic regional competitiveness. According to Schmitz (1998), for instance, this *static* (or *passive*) *dimension of clustering*, characterized by the mere spatial concentration of agents should not be mistaken with a patterns of *active cooperation and interaction* among agents that are constantly cooperating and exchanging information to achieve a *collective efficiency* (Schmitz, 1998).[7] In this way it is possible to describe a pattern of interactions between elements along a continuum (instead of using a dichotomy approach). For instance, it is possible to use a range in which 0 represents the absence of interactions, and 1 represents a point of the system that is fully connected to the others. Nonetheless, it is also possible that some interactions are strong and effective over a long distance.[8] This methodology allows the use of a single parameter for studying complexity. Hence, the latter should not be mistaken for complicated models with many parameters and multiple behaviour patterns (Axelrod 1997). There are three main approaches to model complexity that satisfy the conditions imposed above: **Fitness landscapes** or A**daptive landscapes, Complex networks, and Percolation.**

Fitness Landscape Models

In evolutionary biology, **fitness landscapes** or **adaptive landscapes** (Wright, 1932) are used to visualize the relationship between genotypes (or phenotypes) and replicatory

7 . There are several indicators that could be used to measure the passive/static and active dimensions of clustering. Most of national and decentralized statistics allow the elaboration of some measure of spatial concentration in terms of employment, production/value added or the number of establishments. The active dimensions are more difficult to capture through quantitative measures alone, and require additional qualitative assessments of such variables as the pattern of relationships among firms (through technical collaboration and assistance within production and value chains, membership of business associations, informal mechanism of collaboration among business, relationships between businesses), the relation between firms and local governments and universities, among others. Schmitz (1998) and Nadvi and Schmitz (1994) elaborated specific surveys in the context of developing countries in order to detect the degree of collaborative networks within city-regions.

8 Storper and Venables (2003) developed a model in which the diffusion of information (intellectual spillovers) depends on face-to-face interactions of agents. Accordingly, geographical contiguity plays a fundamental role in developing some particular sectors in which knowledge evolves quickly. For a deeper assessment of the role of face-to-face interaction in spreading innovation, see Maggioni M.A. Roncari S.N. in this publication.

success. It is assumed that every genotype has a well defined replication rate (often called *fitness*). This fitness is the "height" of the landscape. Genotypes which are very similar are said to be "close" to each other, while those that are very different are "far" from each other. The two concepts of height and distance are sufficient to form the concept of a "landscape". The set of all possible genotypes, their degree of similarity, and their related fitness values is then called a fitness landscape. A typical formalization is the *NK-model*. Every component of the system has an "epistatic" relationship with the other components or elements.[9] In other word, each agent affects all other elements through a particular property. In the formalization of Kaufman (1993) each element of the system (where N is the total number of elements) is affected by K other elements. Through this model it is possible to simulate the effects of epistasis by constructing a *fitness landscape*. The original model deals with technology, and fitness landscapes are used to refer to efficiency or quality (for production process, and for products respectively). The fitness value *W* of a certain strategy *s* is calculated as the mean of the fitness values w_i of each element *i*.

$$W(s) = \frac{1}{N} * \sum_{i=1}^{N} w_i(s)$$

This model analyses mutation in the system due to epistatic relationships between the elements. If *K=0* there are no epistatic relationship and w_i has only two random values 0 or 1. When the epistatic relationships are at their maximum level (*K=N-1*), any mutation in a single element will produce new fitness values for each element within the system. It is important to note that in the case of clusters of epistatic relationships, the system tends to develop a variety of local equilibria at different heights. If the information is moderately complex, the level of equilibrium reached through a local search (within the epistatic cluster) will be quite efficient, and the level of local equilibria (on average) could be quite high. On the contrary, if the information is complex, the local search carried out by the cluster could be insufficient to generate a high equilibrium and the local search (or research) will be inefficient.

Complex network models

Complex networks are related to the idea of many agents connected in different patterns and with different intensities. The proprieties of networks are measured by using two fundamental dimensions: the "cliquishness" or *local density of the network*

$$C = \frac{1}{N} \sum_{i} \sum_{j,l \in \Gamma_i} \frac{X(j,l)}{\|\Gamma\|(\|\Gamma\|-1)/2}$$

9 In biology epistatic relationships refer to the case in which the action of one gene is modified by one or several genes that are classed independently. The two genes may be quite tightly linked, but their effects must reside at different loci in the genome. The gene whose phenotype is expressed is said to be epistatic, while the phenotype altered or suppressed is said to be hypostatic.

(where Γ_i is the set of neighbours of agent I and $\|\Gamma_i\|$ is the size of neighbourhood, while X can be either 0 absent – or 1 – present); and *average path length between any two agents*:

$$L = \frac{1}{N}\sum_i \sum_{j \neq i} \frac{d(i,j)}{N-1}$$

(where d(i,j) is the shortest path between I and j). According to these two properties, the formation of a cluster of the closer (or less distant) elements is highly probable in complex networks.

Percolation Models

Percolation Models refer to the movement and filtering of fluids through porous materials. In others words, they concern a stochastic dynamic of a phenomenon that can evolve in an environment that is able, in turn, to influence the dynamic. In economics percolation has been used to model the transmission of information in a given environment. It is mostly based on the concept of phase transition: a change of a given condition in the agent, or in the system, causes the agent to "jump" from one state into another. Broadly speaking, every step in the evolution of the system is influenced by the previous one, generating *path dependence*. Such a system has a huge number of asymptotic states, and the initial state (Time zero), unforeseen shocks, or other kinds of fluctuations, can conduct the system in any of the different domains of the asymptotic states (Arthur, 1988). Accordingly, the concept of a self-reinforcing mechanism can be expressed as a dynamic system, with path dependence and positive feedback, which tends to lead to a large variety of asymptotic states. Furthermore, the system selects the state in which it places itself. Such dynamics are well known in physics, chemistry and biology and the final asymptotic state it is called the *emergent structure*. The concept of positive feedback is relatively new in economics. Indeed, economics generally deals with problems of optimal allocation of scarce/insufficient resources, thus feedback is usually considered to be negative (decreasing utility and decreasing productivity). Path dependence, in turn, is the main characteristic of sf-reinforcing mechanisms (the other being multiple equilibria in the system, possible inefficiency of the equilibrium, and lock-in).The next section focuses on this approach and shows two different applications of it.

A. Path dependence as an allocation process.

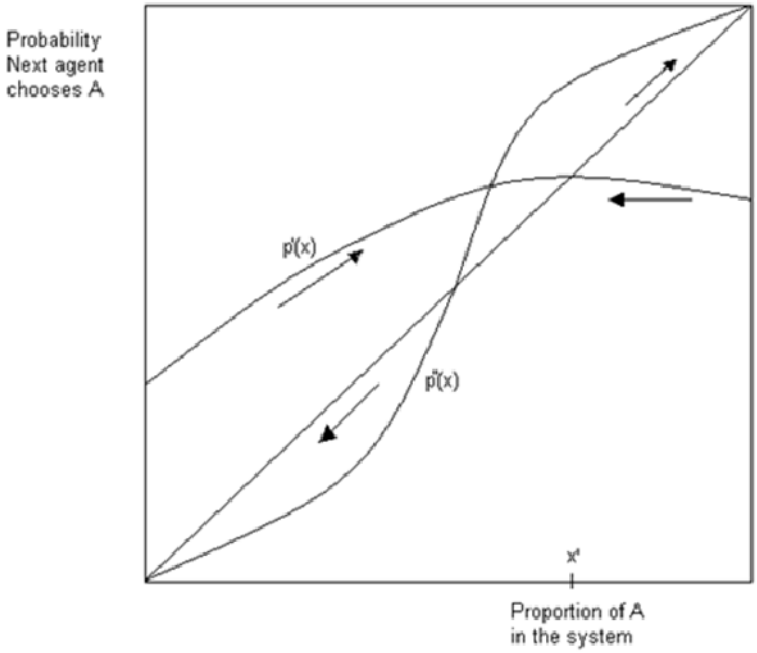
It is not possible to define precisely the dynamic occurring in a system which has the tendency to lock-in in a specific equilibrium, given the existence of multiple equilibria and a sf-reinforcing mechanism. Nonetheless, it is possible to define a system which has some characteristics that allow broad classes of analytical systems to be designed that encompass large number of examples. First of all, to avoid excessive complexity, the system should follow the linear sequence in which choices are undertaken. Second, the proportion of groups of feasible alternatives influences the choice itself (a concentration

of alternatives in a particular group at a particular time influence the choice of the system). Finally, a self-reinforcing mechanism usually begins from a "balanced" but unstable position, thus the end-state can be determined by both the initial conditions of the system and by small events outside the model. In this case, a small variation in a given exogenous variable could cause a catastrophic effect on the entire system. Therefore, the actual state of the system cannot determine the next position of the system, but rather the probability of the next action and then of the next position. Considering a general class of dynamic systems, it is possible to assess the dynamic of the allocation process. One of the possible applications of the allocation process concerns, for instance, the distribution of firms in K locations at a certain "event time". The probability that the next firm will join category *i* is $p_i(x)$ where *x* is the vector of current proportion or firm location.[10] That formalization allows us to determine *p*, at least implicitly. By taking only two territories (K = 2) into account, it is possible to show (Figure 2) all the possible dynamics of the system graphically. In the graph, it can be seen the quantity of agents concentrated in the A region is influenced by the number of agents that are already there. Specifically, if the number of agents in A is larger than a given proportion x^i, the probability that the next agent will decide to locate in region A will be higher. Therefore, the region A will attract more agents. On the contrary, if the number of agents in A is lower than the proportion x^i, the probability that agents will choose A as their next location will decrease over time. It is worth noting that it is impossible to use the *Strong Law of Large Numbers* in this stochastic distribution of elements, since past distributions influence the dynamic of the system, while in the Strong Law increments are independent. In this dynamic process, each choice of the system is irreversible and the process *must* converge to one of the points *p* of the feasible allocations.

System at t +1 = System at t + the choice with the highest probability + a random exogenous dynamic

10 "The vector of probabilities *p = (p1(x), p2(x),…, pK(x))* is the allocation function that maps the unit simplex *SK* of proportions into the unit simplex of probabilities" (Arthur, 1988)

Figure 2 - Two illustrative allocation functions for dimension K = 2



Source : Arthur, 1988

Without the random exogenous variable the expected value of System at time + 1 will be equal to the actual state at time + 1: ($E(X_{t+1}|X_t) = X_{t+1}$), which is the equivalent deterministic solution. The formalization assessed above is the pillar of many studies on the location of firms by a spin off process.[11] In these models new firms are added by "spinning off" from parent firms one at time. Accordingly, firms are added incrementally to regions with probabilities equal to the proportion of firms in each region at that time. Empirical evidence underpins this process especially in the high-tech/knowledge-intensive sectors. Every point of the unit simplex (the total of regions) may become an attractor point, so the system can converge to any point. In other words, "chance" dominates the dynamic completely.

B. Path dependence with recontracting processes.

In the allocation process assessed above, choices made by the system are irreversible. But what happens if every time the system can "change its mind", it decides to re-contract previous choices? To model this dynamic it is necessary to consider a Markov-transition in which the concentration of firms in region A influences the location choice of firms in region B which can change their location every time by "jumping" into the

11 See Cohen, 1976 or Klepper, 2004.

other region. The region that attracts more firms increases its probability of attracting the "next one" at time t + 1; hence, a self-reinforcing mechanism is still possible.

To give a formalization, let's imagine a case in which there are only two regions K (*K = (A, B) = 2*) and total population is *T = 2N*, with a state variable *m*. Accordingly, *N + m* firms will prefer region *A*, and *N – m* firms prefer region *B*. Since $p_{AB}(m)$ *is* the probability that a firm will change its location from *A* to *B*, and $p_{BA}(m)$ the probability that a firm will change its location from *B* to *A* (at every unit of time), the probability P(m,t) of finding the system at state *m* at time *t* will evolves as:

$$P(m,t+1) = P(m,t)((1 - p_{AB}(m) - p_{BA}(m)) + P(m+1,t)p_{BA}(m+1) + P(m-1,t)p_{AB}(m-1)$$

From which we derive the Master Equation:

$$\frac{dP(m,t)}{dt} = [P(m+1,t)p_{BA}(m+1) - P(m,t)p_{BA}(m)] + [P(m-1,t)p_{AB}(m-1) - P(m,t)p_{AB}(m)] \quad (*)$$

which normalized to the variable *x* in the continuous interval (-1, 1),

$$x = \frac{m}{N};$$

$$\varepsilon = \frac{1}{N};$$

$$P(x, t) = NP\ (m, t);$$

$$R(x) = \frac{[p_{AB}(m) - p_{BA}(m)]}{N};$$

$$Q(x) = \frac{[p_{AB}(m) + p_{BA}(m)]}{N}$$

yields the possibility of rewriting (*) in the form of a one-dimensional Fokker-Plank diffusion equation

$$\frac{\partial P(x,t)}{\partial t} = -\frac{\partial}{\partial x}R(x)P(x,t) + \frac{\varepsilon}{2}\frac{\partial^2}{\partial x^2}Q(x)P(x,t)$$

By substituting diffusion functions *R* and *Q* to describe some specific transition mechanism, it is possible to study the evolution of *P* over time and its distribution. It is worth noting that in recontracting process dynamics, transitions remain constant over time, while transition magnitude decrease over time in the allocation process formalization

To give another example, we can show a model that refers to this kind of dynamic in the labour market (Aoki, 2003). By adopting the mathematical instrument of the *master equation* (also called Chapman-Kormogorov equation), it is possible to assess a stochastic dynamic in which heterogeneous agents face the same limitations in their mobility or in their possibility of being hired by some sectors of the economy.[12] One of the first results that this kind of formalization gives is a stationary distribution of equilibria instead of a single stable equilibrium. Another feature of this approach is the possibility of considering workers with differences in **work experience**, **human capital stock**, **geographical location,** and the **sector** in which they work. The economy has *K* sectors, and sector *i* employs a certain number n_i, $i = 1, \ldots, K$ of workers. There are two "states" in which a sector could be: the first is the "normal time":

$$y_i = c_i n_i .$$

In this situation the sector produces an output that is equal to the demand expressed by the market for the sector's commodities. In the second case the demand is higher than the level of supply, and the sector goes into *overtime* capacity; with the same number of workers producing a higher output than before:

$$y_i = c_i (n_i + 1) .$$

Demand for goods *i* is given by $s_i Y$, with

$$Y = \sum_{i=1}^{K} y_i$$

and s_i is a positive share of the total output *Y* referred to goods produced by sector *i* with $\sum_i s_i = 1$. Every sector has the excess demand defined by:

$$f_i = s_i Y - y_i$$

with $i = 1, 2, \ldots, K$.

Sets of sectors with positive and negative excess demand are denoted by

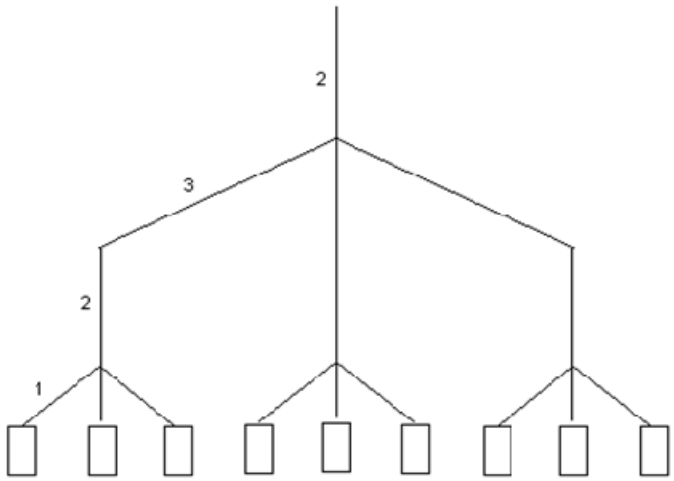
$$I_+ = \{i : f_i \geq 0\} \quad ; \quad I_- = \{i : f_i < 0\} . (**)$$

Changes in Y due to changes in any one of sectors affect the excess demand of all sectors. The model uses (**) as proxy to indicate which group of sectors is profitable (and thus whose production it wants to expand), and, conversely, which one is unprofitable (and whose production it tries to reduce). According to the model, only one

12 The model refers to the entire dynamics in the macroeconomic environment but here we refer to the part of labour market.

sector can adjust its production up or down by one unit at any given time. The sector with the shortest *sojourn time* will be the one to jump first (because of path dependence). And so dynamics are only determined by the transition rates in continuous-time Markov chains. Distance between different sectors is defined by using ultrametric distance. Therefore, the economic environment is structured as a tree diagram in which every sector is a "leaf" which is connected to the rest of the tree through "nodes". Transmission of economic shocks in the environment depends on distance between leaves and branches. The distance is measured between "nodes" (Figure 3).

Figure 3 - Ultrametric distances



Ultrametric distance $d(i, j)$ has the following properties:

a. it is positive unless $i = j$ (in which case it is zero);

b. it is symmetric $d(i, j) = d(j, i)$;

c. it satisfies $d(i, j) \leq max_k \{d(i, k), d(j, k)\}$

Every sector in overtime fills its vacancies (if there are no vacancies the overtime condition creates them) with workers laid off by itself or by the other sectors of the economy. Obviously, workers belonging to the hiring sector have more possibility of being hired than workers belonging to more distant sectors. The distribution of the stochastic probability that a certain worker of a certain sector will be hired by a sector can be assessed by using the master equation. Ultrametrics can also be introduced as dummies for institutions and other kind of "special agents" whose actions can influence the system as a whole. Accordingly, the analysis can be used not only to forecast the

evolutions of the system sic *rebus stantibus*, but it can also show which are the main attractors in the system.

Another important result of this approach is that it may be helpful to design policies taking into account other variables characterising the contemporary economy such as natural and environmental resources, human resources, and technology. Furthermore, incorporating these factors into the model does not increase the complexity of the mathematical instrument. This specific issue is broadly analysed in the next section.

Economic Policies in Spatially Extended Systems: New Paradigms

Description of the evolution of spatialised economies emphasizes the role of new rather than classical paradigms. New factors seem to have replaced land, work and physical capital. Natural and environmental resources, human resources and technology are beginning to get the upper hand following the "technological revolution". Co-operation within businesses and between businesses and business systems takes place on a vertical and horizontal scale in which the local dimension and the territorial variables constitute the catalyst for processes of development. Technological expertise and social capabilities (Latella - Marino, 1996) are the basic elements capable of explaining the different levels of development seen in different territorial contexts. Territorial variables, in other words, are decisive factors in explaining development differentials, especially when they are associated with the idea of the market conceived as a social construction. This new market requires rules that will guarantee its smooth running given that access rights, exchange mechanisms and opportunities for distribution of the wealth generated not only do not re-assemble uniformly and autonomously in time and space (Sen, 1984 and 1985), but almost always require outside intervention to achieve the objectives set for development policies. Re-equilibrium policies thus appear necessary to guarantee a more equitable development process. Within the market it is necessary to define collective rules ensuring that positive dynamics (increasing returns) can develop through the interaction of the agents operating in it. The territorial dimension and the systemic nature of the production process are fundamental elements to understanding and governing development processes.

Public intervention in such a scenario cannot simply be thought of as a mechanism for allocating resources within the economy but must assume the role of guide and director of processes. It must taking the shape, on the one hand, of a set of actions aimed at defining and guaranteeing individual access rights and, on the other , of interventions aimed at developing the exchange capacities of markets and business systems (Bianchi, 1995). An explanation may be sought in the fact that local communities increasingly interact with the rest of the world in a continuous process of integration and globalization without necessarily responding to stimuli from the central state. This obliges us to re-examine the composition of the economic policy maker's "tool box" and, at the same time, forces us to radically rethink the very meaning of government policies, given that the central public authority is no longer able to guarantee the development of the local community in the presence of particular actions enforced by the central authorities (Bianchi, 1995).

Traditional economic policies lose their capacity to produce the expected results when enforced in the context of an open market or of a market characterized by strong interrelations between agents, because the mechanism of response to the policy maker's input has to deal with a system characterized by high levels of interrelations between individual decisions and which therefore displays collective response characteristics which are different from individual response mechanisms. The consolidated logic of public intervention in economics assumes that the government authority will identify objectives for which the instruments most likely to achieve results (which can be verified and therefore simulated) are chosen. Traditional macroeconomic policies only work if acting on a closed system for which it is possible to order objectives and priorities with certainty. In this case the policy maker can govern the system of underlying relations by assuming linear-type response mechanisms. If these assumptions are not verified, the complexity of the system makes traditional policies pointless; therefore, to govern complex system policy-makers must equip themselves with a set of objective instruments and programming actions able to cope with non-linearity and the consequences of complexity.

Planning Actions in Spatially Extended Systems: Old and New Approach

From the aforementioned concept that an economy is a "complex evolving system" in which single individuals are linked to each other by strong relationships, it follows that dynamic characteristics cannot be represented by individual approaches but rather by collective properties subjected to subsequent non-reversible scansions (Arthur, 1988). It is thus conceivable that each economic system, in its evolution, might manifest both a multiplicity of equilibria, each dependent on previous historical interrelations, and the presence of inefficiencies and lock-in which can be selected during the evolutionary course of the system to the detriment of possible efficient solutions. Government of an economy seen as a complex evolving system therefore excludes the possibility that commands might be expressed with a prescriptive-type mechanism in mind, as would happen if the system being analysed were essentially closed and characterized by low levels of interactions between agents. To this must be added the considerable incidence of variables of a territorial nature. Territory cannot be thought of simply as a physical support for business activities but must itself become an active factor conditioning the exploitation of local resources and the capacities of single businesses to cope with international competition. Therefore, the general objective of regional policy becomes that of structural adjustment with a view to greater economic and social territorial integration. So new regional policy must firstly contemplate a "transactive" rather than a "prescriptive" type of approach and the basis for any action must consider not just "what must be done" but "in what manner, by what procedures and with whom". This means making systematic and widespread use at all levels of the principle of subsidiarity which implies that decisions should be taken as near as possible to the problem and be appropriate to its solution, and individual responsibilities should also be identified using the same criterion. Thus the main task of decision-makers in each Spatial Extended System is to aim at reassembling the rules and re-establishing the access rights which are the basis of any subsequent action designed to re-appropriate local culture and raise the

threshold of contextual knowledge. On these premises it is possible to imagine the transfer of outside knowledge and the creation of networks which build up the basis for the realization of a self-sustained model of development.

To achieve these aims the *Spatially Extended System* (SES) needs to equip itself with instruments capable of identifying moments of participation and complementarity among all the actors that make up the local system. To do this opportunities must be created to allow the human resources to increase the know-how and acquired cognition that will qualify them to introduce innovative codes and routines within the productive system. If such cognitive improvement occurs, there will be an increase in flexibility and specialization and a greater capacity to understand and govern change and innovation and ultimately an improvement in the overall efficiency of the productive system. The government of a local system which is complex because of the continuous, strong interrelationships between the individuals operating within it cannot be of a deterministic kind unless part of it is isolated from the rest of the relationships.

The government of a complex system demands a series of deliberations over interventions, which by their intrinsic nature are irreversible, i.e. they produce permanent changes in the state of the system. To return to the now extensively examined concept of SES, multiplicity of equilibria, co-operation, proximity, resilience and freedom of access can be pointed to as some important categories in the description and government of a complex system. The conceptual field within which the local system has to move is, in fact, of a bottom-up kind and provides the archetype for programming actions capable of leading the evolutionary paths of the SES towards states of greater growth.

Bianchi's (1995) taxonomy of interventions identifies the following three procedures:

1. programming according to exogenous concepts;

2. programming according to critical situations;

3. programming according to integration contexts.

Programming according to exogenous concepts is nothing more than the traditional concept of programming, achieved by means of the exogenous definition of objectives by the policy maker in conjunction with the identification of the instruments necessary to achieve the pre-established goals. If complexity and environmental turbulence are low, this method of programming is effective. This type of programming enters a crisis when the system enters those critical areas characterised by high levels of turbulence or uncertainty. In such circumstances it is necessary to programme according to critical situations, i.e. to devise programming capable of self-regulation in the presence of criticality and of varying parameters in order to overcome any lock-in or bottle-neck situations. As long as the critical areas are small in size, this approach is sufficient. If, however, levels of turbulence and complexity are so high that criticality can occur at any moment, then it is necessary to programme according to integration contexts, i.e.

considering the system as a whole as an organism capable of adapting continuously to the outside environment.

In this case policies have to take into account the changes they induce in the system itself, i.e. the way the system metabolises them. The need for programming according to integration contexts therefore justifies, as fundamental elements for regional policy, forms of structural adjustment whose objective is to lower the costs of transaction and which concern:

- the social dimension, linked to the quality of life and culture;
- the ecological aspect, closely connected to the urban habitat, the landscape and the ecosystem;
- public institutions and productive sectors, with special reference to the organizational aspect and the quest for efficiency.

Public-private co-operation, improved social standards, the construction of R&D networks and appropriate territorial policies designed to provide the basis for integration are irreplaceable instruments for governing the economy and for leading it to the highest levels of development.

The Transmission Mechanism of Economic Policy in the Presence of Complexity

The collective properties of a territorial economic system in relation to the link existing between productivity growth and information could be represented in terms of response function. We would like, at this point, to generalize the previous relationship by constructing an interpretative model which describes the propagation mechanism of economic policy in a situation of complexity. The description of the transmission mechanism logically completes the previous observations regarding objectives and instruments. Single economic policy decisions, aimed at achieving the *j-th* objective through the use of the *i-th* instrument, can be represented as an outside stimulus which superimposes itself on interactions between agents.

Agents in this approach are thought of as being spatially distributed and linked to each other by local mutual interactions (of a nearest neighbour type). We use H to indicate the effect of the economic policy. We can thus define an effective *Heff* stimulus which includes both outside stimulus and agent interaction.[13] Obviously, without agent interaction *H* and *Heff* are equal. *Heff* therefore assumes the form:

$$Heff = H + \int dr' c(r-r') \delta\gamma(r')$$

Where $c(r-r')$ is a function of correlation between agents which can constitute an acceptable means of modelling the concept of proximity, $\delta\gamma(r')$ is a variation in the

13 Heff represents the actual output of the implemented policy.

behaviour of agents induced by the policy applied, the integral can be linked to the concept of resilience. This type of behaviour arises in the area of a linear response model for systems with collective properties. The effect of an economic policy on a complex system made up of many agents interacting with each other can therefore be described in this way and modelled, as seen in the previous chapter, by means of the response properties of the system itself. Therefore, in the area of linear response theory we have a cause-effect relationship of the type:

$$E(X) = G(X) \otimes H(X)$$

where $E(X)$ represents the generalized effect, $G(X)$ the response function, and $H(X)$ the generalized cause.

Therefore it is possible to study the generalised transmission mechanism of economic policy by describing the response function as a sort of susceptivity which comes to depend on the distribution of agents within the market. Obviously the type of response depends not only on distribution, but also on the type of interaction between agents.

Some concluding considerations

The debate in economics between those who maintain that complexity and its causes play a decisive role in the construction of models with high levels of realism and those who think that a complete and exhaustive description of economic phenomena can be achieved by using linear and equilibrium-type models regardless of the complexity of the behaviour of agents and markets is relatively recent. In this work we analysed the relationship between complexity and economic policies from the point of view of regional and territorial economics. The economy as a complex evolving system (Arthur, 1988) therefore implies that:

- individuals are bound to each other by strong relationships;
- dynamic characteristics cannot be represented by means of individual approaches but only by collective properties;
- evolution manifests itself by means of multiple equilibria;
- each equilibrium depends on previous historical interrelations through possible inefficiencies and/or lock-in.

From a conceptual point of view, the main characteristics of the effects that emerge in the dynamic evolution of a system with complex behaviour can be explained by:

- the difficulty prescriptive-type regional and territorial policies have had in promoting and sustaining economic development;

- the loss of importance of the national dimension: the local dimension clashes with the global dimension;

- the faltering view of economic policy and its propagation mechanism as being based on principles of command and control;

- the inability of a central planner to govern all the underlying relationships between economic agents at any given time according to linear-type response procedures.

Assessing the quality of local development through an input-output model

Introduction

After having discussed agglomeration dynamics in the global context, the essay tries to assess the *quality* of local development by taking into account two key dimensions: the (regional) industrial mix, and the level of (labour) productivity. In other words, this section discusses the qualitative patterns of regional development using the input-matrix as an instrument to understand what happens when a regional economy changes its productivity function or when, on the contrary, it retains the same productivity function. As in the case of national economies (Arrow and Hahn 1972), each individual region can be modelled as a linear input-output system to assess whether the local community has transformed its factors of production or not; i.e. whether a new production function has been implemented or not. If the region has adopted a new production function, local growth can be intended as a collective development of skills, human capital and investment capacity, which influence the sustainability of growth. Otherwise, the region is just exploiting in an extensive way its resources and factors of production. Such condition may affect the sustainability of growth, since the community is not investing its energies in developing new skills or human capital: the local community has not created *a new competitive advantage*.

As assessed above, because of globalisation many regions have achieved a remarkable growth thanks to local specialisation in a given sector or activity. This is due to international division of labour and increased factor mobility. On the one hand, in a number of regions this phenomenon has brought about the possibility of concentrating capital and labour in new sectors characterised by an high level of productivity and, thus, by an higher potential of development. In this case, the economy has gone through a process of technological transformation that impacts on (*i*) factor productivity, and (*ii*) knowledge, skills, and occupational structure of employment. This is the most desiderable pattern of development, even though in some cases the impact on the employment (creation of jobs) may be neutral.[14] On the other hand, in some regions growth depends on an extensive use of resources and factors of productions. This means that the region has not changed its productivity function or the sectoral composition of the economy. Such a pattern of growth is based on the *multiplication* of factor of production. Far to be the exception, regional development due to factor multiplication is very common also in industrialised countries that can use the large influx of low-skilled workers (e.g. immigrants coming from less developed countries), an outcome of globalisation, to improve sectors characterised by low per capita productivity such as construction, traditional manufacturing, or proximity and personal services.[15] This

14 . This phenomenon is often labelled as “job-less growth” or employment neutral growth (Gordon, 1993).

15 . Growth can occur through factor multiplication process or factor transformation process (Barewald, 1970). Factor multiplication involves increase in the quantity of the same factor inputs of the given quality to be transformed into highest output of the same type and quality

pattern of growth may lead to a paradox: that economic growth does not depend on movement from less efficient to more efficient technology, yet the higher (regional) income is associated with higher employment rate but lower productivity per capita.[16]

To evaluate the *quality* of regional development, this essay uses the input/output analysis. The input/output analysis is a method used to characterise economic activity in a given time period, and to predict the reaction of a regional economy to stimulation, for example, from increased consumption or changes in government policy. For instance, the input/output analysis can be used to describe the way in which the productive system satisfies final demand (consisting of consumption, investments and exports). An input-output matrix represents the links between an economy's resources and its consumption. The matrix may vary from the simple (three sectors: industry, services and agriculture) to the complex (over 500 branches). It is one of the only techniques applicable to the evaluation of the sectoral impacts of structural interventions, because it allows for the detailed division of an economy's productive structure. An input-output matrix can be compared to a macro-economic model that is highly simplified regarding the economic mechanisms represented, but which is extremely detailed from the sectoral point of view.

Input-output analysis is used primarily in scenario analysis and simulation, where it serves to verify policy scenarios, based on the technological structure of the economy of a given country (or region, as in this case) and on the state of final demand. Also, it can be used in predicting dynamics. For instance, there are numerous applications of input-output matrices to the evaluation of development programmes, including estimating impacts differentiated according to the different branches of an economy. Following the aim of this essay, the input-output analysis will be used to assess the typology (or, as stated above, the *quality*) of regional development.

Input-output matrices are based on the notion that the production of outputs requires inputs. These inputs may take the form of raw materials or semi-manufactured goods, or

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through the use of the same production function. But the factor transformation process involves a different production function resulting in more and different quality output per unit of factor inputs. New production function generally embodies different technology. Technology affects the nature, direction and magnitude of relationship between employment and income. Development of technology has generally been capital intensive and labour displacing, and hence, labour augmenting. Besides, new technology is often more knowledge and skill intensive. Knowledge and skill requirements are not only greater in magnitude and superior in quality but these are also very different from earlier ones. This makes some occupations and types of knowledge/skills redundant and obsolete, while some new occupations and types of education emerge

16 . Classical economics states that economic growth is generally characterized with a movement from less efficient to more efficient technology (Mathur, 1962). The technological change leads to growth of income, through improvements in employment and productivity. However, technological development has generally been capital intensive and labour displacing. This may lead to a paradox: on the one hand, economic growth can be associated with higher productivity and income but lower employment; on the other hand, a higher income can be associated with higher employment rate but lower productivity per capita.

inputs of services supplied by households or the government. Households, provide labour inputs, while the government supplies a wide range of services such as national security, social services and the road system. Having purchased inputs from other producing sectors, or primary inputs from households, an industry then produces output and sells this output either to other industries or to final demanders, such as households or residents of other regions. Thus, a wide range of inputs is used to produce an equally wide range of outputs.

Assessing inputs and outputs through an input-output model it is possible to detect the (regional) productive specialization. For instance, the industrial mix of the region is clearly depicted by the transaction matrix and key sectors are easily detectable. Thus, if the previous part of this essay studied the agglomeration forces that concentrate factors in a given territory, this part aims at understanding whether the achieved agglomeration (i.e. the local specialization) is characterized by (*i*) a specialisation in high-tech sectors, or mature sectors enjoying a large and stable international demand, and (*ii*) a higher level of productivity.[17]

Detecting backward and forward linkages through an input-output analysis

In a regional assessment is obviously important to know how closely "linked" sectors are with each other, and which sectors may considered as the *drivers* of the economy. Of course, the direct linkages are shown in the matrix of technological coefficients (the so-called *A* matrix), and the direct plus the indirect linkages are revealed by the Leontief inverse (Mathallah, 1996). However, we need to distinguish between *backward* linkages and *forward* linkages. Backward linkages are the relationship between the activity in a sector and its purchases. Forward linkages are the relationship between the activity in a sector and its sales. These linkages may give rise to the agglomeration of activity in a given region.[18] Input-output models are based on the assumption that export demand (or the ability of industries to sell to the external economy) is the engine that generates activity in the regional economy (and the pillar of their competitiveness, cfr. Camagni, 2002). Changes in final demand (direct effects) infuse local industries with new funds, which increase output and employment. [19] The

17 . It is important to bear in mind that it is very difficult to evaluate the quantity of technology that a sector embodies. To have a clear assessment of the level of technology used by a given industry one should look at the supply-chain rather than at the sectors. Empirical evidence demonstrates that often in some mature production such as textile there are specific activities that can be considered as high tech ones. On the contrary in other sectors commonly defined like “high tech sectors” or capital intensive sectors, there are some activities that are rather labour intensive.

18 . New economic geography theory argues that although flexibility in location decisions exists a priori, once the agglomeration process has begun, spatial differences become quite rigid. Krugman and Venables (1995) and Venables (1996) have shown how this feature can be explained by backward and forward linkages. The same result of lock-in dynamics is achieved with different hipotesis as the possibility that location decisions are influenced by previous equilibria of the system, as it was stated in the first part of this essay.

19 . A sector’s outputs are demanded both inside and outside the regional economy. Final demand in an input-output framework is that portion of demand that is not used in the production of other

present essay assumes that a region with stronger backward and forward linkages in sectors with high rate of export is in a more favourable condition than a region with weak linkages in export oriented sectors (Cfr. Aoki 2002).

The analysis of linkages, used to examine the interdependency in production structures, has a long history within the field of input-output analysis. Since the pioneering work of Chenery & Watanabe (1958), Rasmussen (1956) and Hirschman (1958) on the use of linkages to compare international productive structures, this analytical tool has been improved and expanded in several ways, and many different methods have been proposed for the measurement of linkage coefficients. The measures, including backward and forward linkages, have extensively been used for the analysis of both interdependent relationships between economic sectors, and for the formation of development strategies (Hirschman, 1958). In the 1970s, these traditional measures were widely discussed and several adapted forms were put forward (Yotopoulos & Nugent, 1973; Laumas, 1976; Riedel, 1976, Jones, 1976; Schultz, 1977). Moreover, linkage analysis methods have attracted increasing attention from the part of input-output analysts (Cella, 1984; Clements, 1990; Heimler, 1991; Sonis et al, 1995; Dietzenbacher, 1997).

In this essay both backward linkages and forward linkages are taken into account. Such choice can expose the analysis to a possible criticism. There is some literature against the reliability of this methodology (Cardenete and Sancho, 2006). In fact, while backward linkages are constructed from the Leontief inverse matrix, forward linkages use the inverse matrix from the Ghosh model.[20] While the Leontief model has a clear technological interpretation well rooted in production theory, the Ghosh model lacked a corresponding embedding in standard micro theory until Dietzenbacher (1997) suggested to interpret the model as a price model. For a long time therefore, more conceptual credit has been given to backward linkages than to forward linkages since only the former were believed to trace the ripple effects implicit in the underlying technology.

The output multipliers, defined as the column sum of the Leontief inverse matrix, obviously indicate backward linkages. Using the row sums of the Leontief inverse, the output multipliers are given by $(I-A)^{-1}\, i$. This shows the effect on the total activity in each sector if every sector increases its final demand by unity. This is sometimes referred to as "sensitivity" of the sector. This is true if we assume that intermediate inputs are proportional to total output. Otherwise we would assume that intermediate flows are supply led rather than demand led. For most economies this is a less acceptable assumption (Matallah and Proof, 1994).

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outputs inside the regional economy (intermediate demand). Final demand includes consumption, investment, government and exports.

20 . Ghosh's "supply-driven" input-output model is a well-known alternative for Leontief's traditional "demand-driven" input-output model. The Ghosh model calculates changes in gross sectoral outputs for exogenously specified changes in the sectoral inputs of primary factors. Typically, the model is interpreted so as to describe physical output changes as caused by changes in the physical inputs of primary factors (Dietzenbacher, 1997).

The backward linkages of each given sector represented in the matrix can be represented as an index derived by the *i*th(s) sectoral multipliers. In this case, the result is an index in which z_{ij} is an element of $(I\text{-}A)^{-1}$(*). The index is constructed to measure the relative strength of the backward linkages by dividing each of the sectors' backward linkages by their respective averages for the whole economy.

$$n\sum_i z_{ij} / \sum_j \sum_i z_{ij} \qquad (*)$$

Concerning forward linkages, rather than using the inverse matrix from the Ghosh model (see above) and assuming that intermediate inputs are proportional to total output, one might assume that they are proportional to total inputs (Jones, 1976); i.e. rather than using

$$x_{ij} = a_{ij} X_j$$

we might use

$$x_{ij} = b_{ij} X_j.$$

This means that the intermediate flows are supply led rather than demand led. Therefore, if the matrix (B) is defined as above, then the row sums of $(I\text{-}B)^{-1}$ are measures of forward linkages. In other words, thanks to this method it is possible to define forward linkages by using the Leontief inverse matrix. Accordingly, the "input multiplier" (that is the result of our assumption) will generate the index (**) measuring the intensity of forward linkages per each sector:

$$n\sum_i q_{ij} / \sum_j \sum_i q_{ij} \qquad (**)$$

where q_{ij} is an element of $(I\text{-}B)^{-1}$.

Finally, these indexes can be used to measure the relative strength of the forward and backward linkages within the regional economy. Sectors possessing weak forward linkage indices meant that these industries sell their output mostly to final demand and hence do not figure significantly in the measures as they depend on intermediate flows. Sectors possessing weak backward linkage indices meant that their dependence on other sectors for their inputs is relatively low, i.e., their principal inputs are provided mainly by imports. Key sectors, according to Hirschman (1958), are those sectors with both backward and forward indices greater than unity. However, it is possible to consider some nuances rather than a dicotomic approach (Matallah, Proops, 1996).

A numerical application of these indexes and a calculation of the strengths of linkages within the regional economy is presented in the last part of the essay, where the case of the Madrid metropolitan region will be analysed through this *lens*.

On the relationship between the labour productivity and employment

Before discussing the measurement of labour productivity through an input-output model it is important to highlight the relation intercurring between labour productivity and employment. Employment has become an increasing concern. The concept of "jobless growth" has emerged as the focus of debate both among analysts and policy makers (Bailey and Lawrence, 2001). Employment income-growth interrelation cannot be a homogenous phenomenon across the sectors, over space and through time; nature and degree of this relationship is bound to vary among sectors. Probably the nature of employment, specially its knowledge and skills profile, has undergone radical transformation. *A priori* reasoning suggests the tertiary activities to have emerged as the dominant generator of job opportunities. Conceptual categories, such as casual and marginal employment, knowledge, skilled, technical and professional workers have now acquired greater importance in the knowledge economy. This justifies the rising interest of regions in attracting human capital from other regions to avoid constraints to growth on the supply side of the labour market.[21]

Above we have assumed that if growth is due to *factor transformation*, local development will be sustainable on the long-run. Such hypothesis will be maintained in this section, even though some specifications are needed. Enhancing the local knowledge-base means to improve the use of some given factors such as skilled labour. However, especially at the very beginning of the *transformation* process, new sectors are not able to absorb that part of displaced workforce coming from low tech sectors, thus local development is often neutral to employment. In the case of *factor transformation* the new workforce is more, better and differently educated. Human capital, which is the human resource deployed on productive work, embodies different knowledge profiles to match the changing industry-occupation structure as the economy moves from lower to higher stages of growth. Therefore, transformation of both the local industrial mix and human resources take places. The replacement of the old by new technological transformation of production may involve knowledge, skills, industry and occupational production function through the change in technology and may adversely impact employment in the process of growth of income.

Although neutrality to employment should be transitory (positive effects should arise when local workforce reach an high level of specialization and, of course, when the high tech sectors are sufficiently developed), the presence of a large number of semi or unskilled workers tossed out from the labour market is likely to challenge local development. On the contrary, the large increase of the employment rate that goes hand in hand with the *factor multiplication growth* is likely to have a positive effect on the

21 . This concept is close to that discussed by Richard Florida (2002). According to Florida, the key resource of contemporary economy is the so called "creative class". Regions have to offer a large series of advanced services and amenities to concentrate a high level of such creative class. For another approach to workers' preference for amenities Cf. J. Roback 1988.

overall economy. Because of such characteristics, place-based policies point often at increasing employment more than specialization in knowledge intensive sectors.[22]

The *factor transformation* process through technological improvement may be envisaged to have three different impacts on employment; (*i*) *employment less growth*; (*ii*) *employment loss growth*; and (*iii*) *employment gain growth* (Barewald, 1969).

The use of technology of different vintages in regions implies the simultaneous operation of *factor multiplication* and *factor transformation* processes of growth. It is, therefore, probable that all three types of employment effect of growth are manifested as the economy moves from lower to higher stages of growth. Within each broad sectoral category, some sub sectors tend to stagnate and even decline, while some others emerge as fast growing/leading sectors of development within the given category; growth may carry different employment implications for different sectors. Some more knowledge intensive sectors, may register employment gain, whereas the employment loss of other sectors may swamp this gain.[23] In other words, a trade-off between productivity and employment is likely to exist. Therefore, the thesis that *liberalization*, *privatization* and *globalization* has resulted in *employment less growth* may be empirically and logical valid in a macro sense.

Measuring per capita productivity to detect a factor transformation process: the input-output model

The nature of local development can be detected by measuring (labour) productivity gains at the regional level. There are many ways to measure productivity (OECD, 2001). The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Broadly, productivity measures can be classified as single factor productivity measures (relating a measure of output to a single measure of input) or multifactor productivity measures (relating a measure of output to a bundle of inputs). Another distinction, of particular relevance at the industry or firm level is between productivity measures that relate some measure of gross output to one or several inputs and those which use a value-added concept to capture movements of

22 . It is the case, for instance, of policies that improve flexibility in the labour market. The aim is to improve the activity rate allowing low skilled to join the labour market. Although the effect on growth can be neutral, the advantage is to increase overall productivity, while the effect on per capita productivity is likely to be negative. To overcome such productivity loss policies improving labour market flexibility should be coupled with policies aiming at increasing human capital (for instance, by increasing schooling). In a global economy, the prosperity of a region depends on the skills, knowledge and intellectual capital of those capable of creating and fostering innovations. In this scenario, education becomes central to economic policy because it is through education that knowledge revolution can take place.

23 . It is worth to note that this dynamic is the same that was assessed in the first part of the essay. In a economic-system where all components are linked, the sectors that are enjoying a positive dynamic tend to attract resources from other stagnant sectors. The overall result will depend on the intensity of growth in driving sectors, which in turn depends on their position within the global market (Cfr. Aoki, 2002).

output. Using these criteria to enumerate the main productivity measures it is possible to enumerate measures of labour and capital productivity, and multifactor productivity measures (MFP), either in the form of capital-labour MFP, based on a value-added concept of output, or in the form of capital-labour-energy-materials MFP (KLEMS), based on a concept of gross output. Among those measures, value-added based labour productivity is the single most frequently computed productivity statistic, followed by capital-labour MFP and KLEMS MFP. These measures are not independent of each other. For example, it is possible to identify various driving forces behind labour productivity growth, one of which is the rate of MFP change. This and other links between productivity measures can be established with the help of the economic theory of production.

The choice of the way in which measuring productivity will depend on the suitability of each index to the main purpose the researcher has in mind. Whenever the aim is to measure competitiveness, as in this case, the proper measure will be the inverse of the total labour embodied in one unit of final product; or, what amounts to the same, the labour employed in the vertically integrated sector corresponding to each final good. Considering labour as the only factor of production, the entire output of the economy is attributed to it.

The model

Let's consider to have a time series of transaction matrixes (Prakash, Balakrishnan, 2005). In this case data coming from transaction matrix will be taken into account to measure local factor productivity.[24] It is postulated that total output, X equals the product of total employment, N and average productivity, P:

$$X = P * N \qquad (1)$$

X is GDP at factor cost in t_0 prices. Differencing the equation partially, we get

$$dX = dP * N + dN * P + dP * dN \qquad (2)$$

First term of this equation measures the effect of income growth due to change in productivity, when employment is constant, second term determines employment effect of income growth with constant productivity, and the last term determines the interaction effect of change in employment and productivity in response to the given change in output. Interaction effect may be distributed between employment and productivity effect exactly in proportion to the shares of first and second terms in overall growth. Division of equation (2) by X yields

24 . An increasing number of regions have started producing input-output matrix of their economy. This is due to the devolution of administrative power to local governments. They need to improve analytical tools to set up policies.

$$dX/X = (dP / P + (dN / N) + \{dP / P\} * \{dN / N\} \quad (3)$$

This also is expressed as

$$G_x = G_p + G_n + G_p * G_n \quad (4)$$

G_x is the rate of growth of income, G_p is the rate of growth of productivity and G_n is the rate of growth of employment. The model can also be modified as follows in order to estimate the relative shares/contribution of productivity and employment growth in the growth of income.

$$\{G_p / G_x\} + \{G_n / G_x\} + \{(G_p * G_n) / G_x\} = 1 \quad (5)$$

To capture both the direct and indirect repercussions of growth of income on employment and productivity, Input Output model has been used to determine output, X:

$$X = (I-A)^{-1}F \quad (6)$$

X is the column vector of gross output, A is matrix of technical coefficients of production, $a_{ij}\ \varepsilon\ A$, $(I-A)^{-1}$ is Leontief Inverse, and F is final demand. Employment involved in the production of this output may be given by

$$\hat{N} = LX \quad (7)$$

$\hat{N}$ is a column vector of sectoral employment. This will also furnish an idea about the sectoral composition of total employment. L is a diagonal matrix of employment coefficients, a_{oi} where

$$a_{oi} = L_{oi} / X_i$$

is labour required per unit of output, $\sum_i L_{oi}$ is total employment in the economy.

Substituting for X from (6) into (7), we get

$$\hat{N} = L\ (I-A)^{-1}F \quad (8)$$

Recalling what we have stated above, net productivity may be estimated by working out the ratio of factors used in production and net output (value added) which is given by V_j/l_j; where

$$l_j = a_{oj} * \Sigma a_{ij}$$

and V_j is the value added per unit of output. The gross factor productivity $\hat{P}$ is given by

$$\hat{P} = L^{-1}X \tag{9}$$

where $\hat{P}$ is sector wise column vector of productivity $p_j = X_j/L_{0j}$. The following relation shall furnish the estimates of productivity

$$\hat{P} = \hat{A}_0 X^{-1} = L\,(1 - A)^{-1} \tag{10}$$

where P` is the sector wise column vector of productivity, and $\hat{A}_0$ is a diagonal matrix whose elements are $A_{01,} A_{02,} A_{03,} \ldots A_{0i.}$

$$1/a_{oj} = p_j$$

is the direct/partial estimate of productivity. If A_{0j} denotes total labour required per unit of final demand, then

$$1/A_{0j} = \hat{p}_j$$

will be the total labour productivity. Use of solution rather than observed value of X in the above formula is an attempt to (i) consider both direct and indirect requirement of labour for production (ii) direct and indirect requirement of capital. The capital requirements are embodied as a component of final demand which comprises both Gross Fixed Capital Formation (GFCF) and change in stocks (Juan and Febrero, 2000) and (iii) requirements of growth, since growth is financed out of surplus. This is taken into account by matrix *A*. This surplus feeds the multiplier process through consumption while accelerator is taken care of through change in stock reflecting working capital requirements and fixed capital formation part of final demand. As stressed above, productivity index is here used to evaluate the competitiveness of a given industry in a given region by X_j/L_{0j}, which is the conventional measure of productivity (Juan and Febrero, 2000). The growth rates of sectoral productivity are given by

$$G_p = \Delta \hat{P}.\hat{\mathrm{P}}^{-1} \tag{11}$$

$d\hat{P}$ is the row vector of change in sectoral productivity, G_p is the vector of productivity growth rates, and $\hat{\mathrm{P}}^{-1}$ is a diagonal matrix of initial levels of sectoral productivity. Following equation yields the estimate of sectoral employment growth:

$$G_n = d\hat{N}\,N^{\backprime -1} \tag{12}$$

dN is the row vector of change in employment, G_n is the vector of sectoral employment growth rates and *N`* is the diagonal matrix of sectoral employment levels. Growth rates of sectoral output may be derived analogously:

$$G_x = d\hat{X}\, X'^{-1} \qquad (13)$$

$d\hat{X}$ is the row vector of change in output and X' is the diagonal matrix of initial output. It is implicitly assumed that the change in output $d\hat{X}$ embodies the effect of change in i) technology, ii) human capital, iii) policy regime, from all the period of the series. In this way it is not necessary to build a capital coefficient matrix. There is still the problem of isolating the effect of change in technology from other components of change (Solow, 1962):

$$X_t = (I - A_{t-1})^{-1} F_t \qquad (14)$$

t refers to the current period. The use of the preceding period's I-O table to estimate X_t from relation (6) nullifies, in part, the change in technology. Similarly, the effect of change in final demand may take the form of:

$$X_t = (I - A_t)^{-1} F_{t-1} \qquad (15)$$

Differential output of 6 and 13 will furnish estimates of differential employment and productivity levels due to the difference of technology. As against this, differential of output of (5) and (13) will reflect the effect of change in final demand, which may manifest the human capital effect on employment.

A complication: the offsetting effect of increasing final demand on labour productivity measurements

According the model discussed above when the vector of final demand is held constant, technical improvement will result in an increase in the level of measured labour productivity at both the aggregate and sectoral level. Technical change is here considered as reduction in one or more input-output coefficients with no increases in any input-output coefficients. It is worth recalling that reductions in input-output coefficients can be due to a number of reasons apart from technical improvement as, for instance, economies of scale, substitutions induced by changes in relative input prices, and changes in sectoral product mix (Galatin, 1988).

Taking into account two different periods and maintaining the same vector of demand X_F, it is possible to verify that the improvement of technical coefficients (lower coefficients in the LIM) generates an increase in labour productivity.

$$X_t = (I - A)^{-1}{}_t\, X_F$$

In the equation above the output X at t is derived from the LIM multiplied by the aggregate demand. If there is a technological improvement, the LIM (will be reduced ($I - A^{-1}_t < I - A^{-1}_{t+1}$), and with the same aggregate demand X_F, the output X at time t+1 will increase, as shown in the eqation below.[25]

$$X_{t+1} = (I - A)^{-1}{}_{t+1} X_F$$

Let *p* be the n * 1 vector of prices of the outputs in the *n* sectors. Then aggregate value added, *V*, is given by

$$V = p' X_F \qquad (16)$$

V may be assumed to be identical to gross domestic product (GDP) originating in the private business sector. Total labour input, L, is

$$L = a_0 X = a_0 (I-A)^{-1} X_F \qquad (17)$$

Then the measure of aggregate labour productivity in that part of the economy covered by the input-output model is

$$\theta = V/L = p' X_f / a_0 (I-A)^{-1} X_F \qquad (18)$$

This is value added per unit of labour in the private business sector. The first problem we will examine is how technological improvement affects the level of the aggregate measure of labour productivity defined in Equation (18). Technological improvement, hereafter called technical change, will be reflected in a decrease in one or more of the input-output coefficients in the technical matrix A, and/or in the elements of the vector of unit labour requirements, a_0, a reduction in intermediate and/or the primary input, labour, required for production. Thus, if *t* indicates time, technical change is formally defined here by the condition that

$$dA/dt < [0] \qquad (19)$$

which implies that $d(I - A)/dt > [0]$, and/or that

$$d_0/dt < [0] \qquad (20)$$

Inequality (19) means that

$$da_0 / dt \leq 0$$

for all terms a_{ij} and that

$$da_{ij} / dt < 0$$

25 . The elements of (I-A)-1 must be non negative, for they represent the increases in gross outputs required for unit increases in the amount of final demands.

for at least one term a_{ij}. Similarly, the inequality in (20) means that

$$da_{0i}/dt \leq 0$$

for all *i* and the inequality holds for at least one *i*. To see how technical change affects the level of measured labour productivity, we differentiate both sides of (18) with respect to *t* with the level of prices assumed constant.

Differentiating the logarithm of aggregate labour productivity, θ, in Equation (18) with p constant, we have

$$\dot{\theta}/\theta = \dot{V}/V - \dot{L}/L \tag{21}$$

where a dot above a variable, be it a scalar, vector, or matrix, indicates its derivative with respect to time (Galatin, 1988). Now from the derivative of L in Equation (17), we find that

$$\dot{L} = a_0 T^{-1} X_F + \dot{a}_0 T^{-1} + a_0 \dot{T}^{-1} X_F \tag{22}$$

Where $T = (I - A)$.

Since, for any non-singular matrix, *Q*,

$$\dot{Q}^{-1} = -Q^{-1} Q \dot{Q}^{-1} \tag{23}$$

Considering $(I-A) = T$, $\dot{L}$ becomes

$$\dot{L} = a_0 T^{-1} \dot{X}_F + \dot{a}_0 X_F - a_0 T^{-1} \dot{T} X \tag{24}$$

Then substituting (24) in (21) and noting that

$$\dot{V} = p' \dot{X}_F$$

It is possible to find that

$$\dot{\theta}/\theta = p' \dot{X}_F / V - a_0 T^{-1} \dot{X}_F / L - \dot{a}_0 X / L + a_0 T^{-1} \dot{T} X$$

This equation can be rewritten in the following form

$$\frac{d\theta / dt}{\theta} = \frac{dV / dt}{V} - B_0 - (B_1 - B_2) \qquad (25)$$

Where $(dV/dt)/V = p'(dX_F/dt)p'X_F$

$$B_0 = a_0 T^{-1} (dX_F / dt) / L$$

$$B_1 = a_0 T^{-1} (da_0 / dt) X / L$$

$$B_2 = a_0 (dT^{-1} / dt) X_F / L = a_0 T^{-1} (dT / dt) T^{-1} X_F / L$$

The variable on the left-hand side of Equation (25) is the proportional rate of growth in aggregate labour productivity. The equation shows that it can be decomposed into four terms:

$$(dV / dt) / V$$

is the actual rate of growth of aggregate value added due to a change in the vector X_F of final demand (since prices, p, are held fixed throughout). The second term, B_0, is the proportionate change in aggregate labour input that would occur due only to the change in X_F with technology, the a_0, vector and the T (hence A) matrix, held fixed. Thus, the first two terms on the right-hand side of (25) depend on shifts in final demands, X_F, assuming that technology is held fixed, and are zero if final demand is constant.

The third term, B_1, is the proportionate change in labour input that would be caused by a change in the vector of unit labour requirements a_0, alone, with X_F and T (hence A) assumed fixed. Finally, B_2, is the proportionate change in unit labour requirements caused by a change in T (hence A), but with a_0, and X_F assumed constant.

With technical change, $-(B_1 - B_2)$ is positive and if final demand X_F remains unchanged, the first two terms on the right-hand side of Equation (25) are zero. Hence, if the vector of final demands remains constant (that is $dX_F / dt = 0$), then technical change results in an increase in the level of measured aggregate labour productivity.

However, when the vector of final demand changes throughout the periods, it may generate the paradox that, in spite of the reduction of coefficients, *the aggregate value of productivity decreases over time*. In fact, if the vector of final demands, X_F, changes and there is technical change, the sign of $(dV/dt) / V - B_0$ in (25) may be positive, negative, or zero, while $-(B_1 - B_2)$ is positive. Therefore, If the vector of final demands changes (that is, $dX_F / dt \neq 0$) and there is also technical change, then *the level of aggregate labour productivity may increase, remain unchanged, or decrease.* Thus, if final demands shift, technological change need not lead to an increase in the level of measured labour productivity.

How to define a Functional Urban Region

Introduction

Defining the unit of analysis is a basic step when assessing the performances of a given region. Often the administrative boundaries of a region do not correspond to its functional region. This part of the essay presents various methodologies to define the functional region; i.e. the portion of territory home to the economic and social interaction of a given homogeneous community. The main conclusion is that, according to the availability of data, there is a trade-off between "defining" (delimiting the exact portion of territory in which all the socio-economic interaction take place) and "measuring" (assessing the quality and quantity of the socio-economic interactions within the functional area).

Different methodologies and approaches

Before assessing international competitiveness of a given metropolitan region, it is important to find a standardised definition of Functional Urban Region (FUR) and using it to benchmark metro-regions with each other. In fact, the lack of a shared definition of FUR represents a big obstacle to comparative analysis of metro-regions' competitiveness. Different essays show different results because they use different definition of FURs. Broadly speaking there are three different ways to define metro-regions:

1. **The administrative approach** defines metropolitan regions based on the legal or administrative boundaries of municipalities or equivalent entity, or sometimes a group of municipalities under a regional government. This approach is typically used by the national administration to structure, organise and rule the country.

1. **The morphological approach** defines metropolitan areas taking into account the extent and/or continuity of the build-up area, the number of inhabitants, and proportion of the municipal areas covered by urban settlements. The morphological approach, independent of political boundaries, is an efficient way of defining the visible city for inhabitants, especially from satellite or aerial view.

2. **The functional approach** defines a Metropolitan Regions based on daily commuting flows between a core area – that might be defined according to morphological or administrative criteria – and the surrounding territories. Analyses of commuting flows determine which areas are included (or not) in the Metropolitan Region.

Each definition out of the three tends to be better suited for specific purposes but not for others. For instance, an administrative definition would probably be appropriate for analysing governance issues within a metropolitan region such as fiscal policies. In

contrast the morphological approach is better suited to analyse or define zoning, environmental issues, and housing development policies. Nonetheless, it does not takes into account all those people living out of the realm of the city but depending on it for their work, public service delivery, or leisure consumption. Interaction out of the built environment are well detected by the functional definition which will be used here for analysing socio-economic problems such as infrastructure and transportation, traffic congestion, labour market analysis, and inter-linkages of firms. However, within the functional approach one can use different methods to define the FUR. Broadly arguing, they are the *two components model* and the *partitioning method*. They will be discussed in turn below.

The two-component model

In the *two-component model* a metropolitan region is conceived as an area containing a large population core and adjacent communities (building blocks) with a high degree of integration with the core. The degree of integration is generally measured by commuting flows between the adjacent communities and the core area. The first step of the model, therefore, consists of selecting the core, also called city-core or nucleus, which can be defined on administrative, morphological (i.e. build up area), functional or a combination of these criteria.[26]

In the second step, the Metropolitan Region is expanded to surrounding areas that have a high degree of integration with the core. The size of these "building blocks" differs from one definition to another.[27] The degree of integration – between the core and

26 . For example, the core of the Urban Audit (Eurostat) for European countries is administrative and corresponds to a local government unit with the political function (i.e., a council and a mayor). In most EU countries, this administrative core is typically composed of a LAU 2 region (e.g., municipality or "commune"). Greece Ireland, Portugal and the UK are exceptions to this general rule, as the core corresponds to a LAU 1 region (i.e., an aggregation of LAU 2 regions). In addition, the core city in France, Cyprus or Malta is composed of a group of municipalities – all engaging in joint co-operation to deal with urban issues – instead of a single municipality. This is widely recognised to be an interim measure pending a more economically robust definition of the core, imposed by the requirement of collecting an initial benchmark set of statistics within an acceptable time frame. In contrast to the Urban Audit, the core of the GEMACA (Group of European Metropolitan Area Comparative Analysis) definition for European countries is functional and is defined as a contiguous area of adjacent LAU 2 municipalities with an employment density of at least seven jobs per hectare. For the case of the US and Canada, the core is both functional and administrative. The administrative component corresponds to the choice of counties for the US and municipalities for Canada; as for the functional component, the counties in the US must have at least 50% of their population or 5 000 persons residing in an urbanized area while the municipalities in Canada must have over 75% of the population living in the urban area. The latter is defined in both cases according to a population density threshold (500 persons per square kilometres in the US and 400 in Canada) and minimum population requirement (2 500 in the US and 1 000 in Canada).

27 . In Eurostat's definition, the building blocks match to NUTS 3 or LAU 1 regions, with the exception of some northern and central European countries which use LAU 2. These latter countries use a nominally smaller regional unit since recent reforms in their local government have reduced the number of municipalities. In the GEMACA definition, the building blocks are

adjacent communities – is measured through a commuting ratio capturing the percentage of the employed population (or labour force) of the adjacent communities that work in the core. If the commuting ratio is above the specified threshold, the adjacent community becomes part of the Metropolitan Region.[28] Most National Statistical Offices (NSOs) have used the two-component model, or an offspring of it, to delineate Metropolitan Regions. This method is well suited for monocentric metropolitan structures characterized by a single city core and surrounding zones of influence.

On the one hand the two components model has the great advantage of being a statistical method is easy to implement; on the other hand it has four major shortcomings:

- First of all, such method may lead to low international comparability due to the different size of the building blocks (due to different statistical definitions).[29] However, some preliminary results of sensitivity analysis suggest that the size of these differences may be smaller than expected.[30]

- Second, results change according to the criteria used to select the core regions, *i.e.*, administrative or functional. For instance, in the cases of Eurostat and ESPON, the core is selected according to an *administrative criterion* (*i.e.*, a city-core) with a minimum population threshold while in the case of GEMACA (2002) it is selected using a *functional criterion* (*i.e.*, six jobs per hectare). In general, whether one criterion should be preferred to another will depend of the purpose of the definition. However, one would expect the choice of one criterion

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municipalities, while in the US the building blocks match to the county level and in Canada to the municipality level.

28 . In Eurostat the threshold level, measured by the number of commuters to the city-core to resident employed in the municipality, was tested applying two thresholds: a narrow commuting field of 20% and a wider commuting field of 15%. In GEMACA's definition the threshold stands at 10% of their economically active population working in the economic core. A common trend identified in the US and Canadian definition reveals that jobs are also created in the fringes in addition to the core therefore both definitions use counter-commuting ratios from the core to the fringes and vice-versa. The forward commuting ratio in the US is lower (25%) than in Canada (50%). The backwards commuting ratio in both cases is set at 25%.

29 . In general, US counties are larger than Canadian municipalities while European regions are either too large (NUTS 3) or too small (LAU 2) in comparison to US counties and Canadian municipalities. Only the municipalities in Northern Europe seem comparable with Canadian municipalities in size. Therefore, the size of the building blocks in Europe do not match those of the US and Canada. The same is true also for the size of the core.

30 . For instance, Alan Freeman (2004) compared the frequency distribution of the sizes of US counties and European NUTS 3 regions. The frequency distribution turned out to be more uneven within the US than between the US and Europe. In particular, a much higher proportion of US counties are rural or settled at a low population density. 83 per cent of US counties have a population of less than 100, whilst 76 per cent of NUTS3 areas contain a population greater than 100. To some extent this arises because the US contains much more rural or sparsely-settled territory than Europe, in relation to its size. The discrepancy is much smaller if only urban counties and NUTS3 areas are considered: 19 per cent of US urban counties contain less than 100 people compared with 13 per cent of NUTS3 areas.

to have a significant impact on the international comparability of Metropolitan Regions.[31]

- The third shortcoming is the usage of different thresholds (*i.e.*, commuting ratios) to expand the building blocks around the core. Different definitions use different threshold values. Furthermore, definitions in the case of Europe use a one-way commuting ratio (in-commuting to the core) while in the case of North America they use a two-way commuting ratio (in-commuting to + out-commuting from the core). In Europe the threshold value varies among the definitions.[32]

- Lastly, the two-component model is inadequate to identify Metropolitan Regions with a polycentric structure. The two-component model assumes a monocentric structure with one city core and its adjacent zone of influence. This model is inadequate for polycentric metropolitan structures. In these circumstances, the partitioning method is better suited.

Partitioning the National Territory into large self-contained regions (Labour Market Basins)

The partitioning approach is a two-step method: in the first step the national territory is divided into mutual exclusive and completely exhaustive regional units that are large enough to justify separate recognition and strong self containment, enough to be relative autonomous according to internal patterns of flow; the second step is about determining which of the self-contained regions are metropolitan regions. Unlike the two-component model, the partitioning method does not predefine a city-core. Instead, it first partitions the national territory into strongly self-contained economic regions according to interactions of flows between building block areas, and afterwards it determines which of these regions are metropolitan. The criteria for what is a "self-contained labour market" are of course crucial. This second method makes use of more sophisticated tools and has emerged with advances in computational resources. In principle, these tools would be

31 . Again, preliminary results of sensitivity analysis suggest that the size of these differences may be smaller than expected. For instance, Alan Freeman compared the size of the London core in the US system and GEMACA, by changing the core from four hectares (1 000 per square mile) to 9-10 hectares (2 500 per square mile). His findings suggest that the population of the core changes substantially but the changes in the total population of the Metropolitan Region were pretty small (between 2-4%). The residential population of the core using the US threshold of 1 000 is 7 959 000 and 5 617 000 – 30 per cent smaller – using a threshold of 2,500. Applying the GEMACA threshold yields 6 944 000. For the FUR as a whole the figures are 13,310,000 for the US threshold, 12,766,000 for the GEMACA threshold and 12 407 000 for a threshold of 2 500.

32 . Eurostat uses two distinct commuting ratios to their definition: a wider threshold of 15% and the narrow one of 20%. In GEMACA's the threshold is set at 10%, and ESPON applies different thresholds to different countries (10% for Norway, 20% for Finland, and 40% for France). In North America, the US definition applies a 25% forward commuting (in-commuting) ratio to their definition while in Canada it is set at 50%. The back commuting ratio (out-commuting) in both cases is set at 25%.

capable of measuring complex interactions of flows both in the form of physical mobility (*i.e.*, commuting, chained school-shop-work trips, etc.) and in electronically-mediated interactions (*i.e.*, teleworking). In practice, the criterion to delineate the autonomy of a region is based on commuting patterns since data for commuting are widely available. The partitioned regions that are strongly self-contained can be identified as *labour market areas*. When commuting data are not available there are computer-routines that estimate the commuting flow using micro-data on employed people (at home) and jobs (at the workplace). Therefore, this method measures by construction a *functional labour market basin (catchment area).* Under certain conditions, such labour market basins may be used as proxies for *functional Metropolitan Regions*. Advantages of the partitioning method over the two-component model include flexibility in relation to building block areas, and not relying on predefined cores. This is why the partitioning method is better suited for international comparisons: it is transferable and adaptable between countries with different urban systems, commuting patterns, datasets and building block areas. In addition, it is better suited to delineate Metropolitan Regions with polycentric structures as it allows for monocentric or polycentric regions to emerge equally. But there is a risk that vast areas with too many centres are coalesced into single basins, in particular if there is circular or sequential commuting along chains of cities or if there is a high degree of commuting in all directions in a densely populated country. The main shortcoming of this method, however, lies in its dependence on computing algorithms and the availability of commuting flow data to partition the territory into self-contained economic regions. In particular, to reach international comparability the partitioning method would require that the same thresholds for self-containment are used in all countries. With modern computing facilities this is not a heavy task in computational terms, but does require suitable data in all countries.[33]

The trade-off between defining and measuring FURs

Having discussed the analytical tool, it is now possible to actually define in a normative way a metropolitan region as an *urban economy whose boundaries define a portion of territory which is both self-contained and homogeneous at the same time*. Of course, besides the accurateness of the definition, it is of a paramount importance of having statistical data corresponding to the associated area. Regional statistics are commonly available for administrative or statistical units rather than according to "functional" boundaries, e.g. commuting zones, school districts, etc.

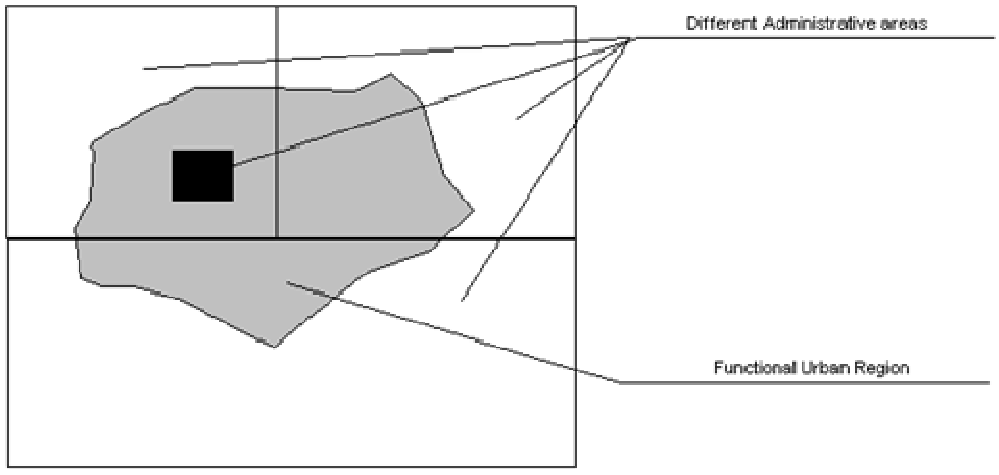
There are a wide range of projects that recognize the importance of collecting data at the boundaries of administrative cities and towns. Elected officials and local administrators are service providers to the residents of cities and town. Therefore the availability of data within administrative boundaries permits to measure their performance and the quality of the services they provide. For example the UN-Habitat developed the Large Cities Statistics Project (LSCP) questionnaire together with five

33 . Another minor short-coming is that, although the definition of a metropolitan region based on the partitioning method is independent of the regional grids specific to each country, regional data are often available for administrative regions only.

partners including the United Nations Statistics Division. This project collected and harmonised data from more than three thousand cities. The outcome was the publication of 1000-cities International Yearbook of Large Cities Statistics. In Europe, the urban audit collects and harmonised data on 258 participating cities at three spatial levels, the city-core (i.e., administrative boundary), the larger urban zone (i.e., the functional boundary) and the sub-city district (neighbourhood). In the U.S. and Canada, administrative city-level data are collected by their respective census. Data for functional Metropolitan Regions are also made available in census publications as well as estimates of some indicators.

The availability of statistical figures represents the Gordian knot of any definition of Metropolitan Regions. One defining a metro-region has to take into account the availability of comparable data at the corresponding geographic levels. Figure 1 depicts the common situation where the functional borders of a Metropolitan Region vary significantly from those of the administrative region but statistics (*e.g.*, employment, GDP, etc.) are only available for administrative regions. In such cases, the theoretical distinction between the functional and the administrative definition of Metropolitan Regions breaks down when it comes to measurement. The functional Metropolitan Region is different from the administrative Metropolitan regions but only the latter can be measured (see figure 4).

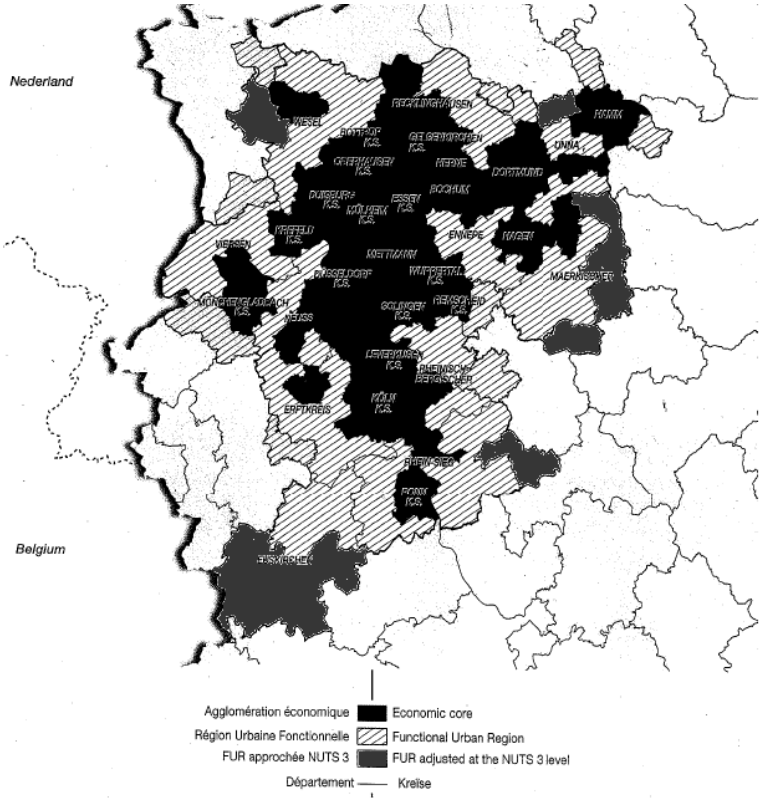
Figure 4 – Functional and administrative boundaries diverge considerably



Therefore, often a trade-off emerges between the accurateness of a functional definition and the availability of data which is typically limited to the administrative

level.[34] If the boundaries of the functional Metropolitan Region closely resemble to the administrative region then data from the latter can be attached to the functional area. Alternatively, some "rule" has to be applied to associate administrative regions to the functional borders. In the GEMACA project, for instance, when the majority of the population of a NUTS 3 region live in a Metropolitan Region, all NUTS 3 statistics are "attached" to the Metropolitan Region, despite the fact that the latter is smaller than the NUTS 3 region (GEMACA, 2002). This rule systematically introduces an error in the measurement of the Metropolitan Region as it overestimates all its variables. In some cases (Figure 5) the error is small but in some others (Figure 6) the approximation in hardly acceptable. Of course, one can imagine more sophisticated methods to generate estimates for functional regions based on data for administrative units. The difficulty with this approach is clearly to agree internationally on some set of procedures to estimate missing data in different statistical areas (regional account, labour force, etc.).

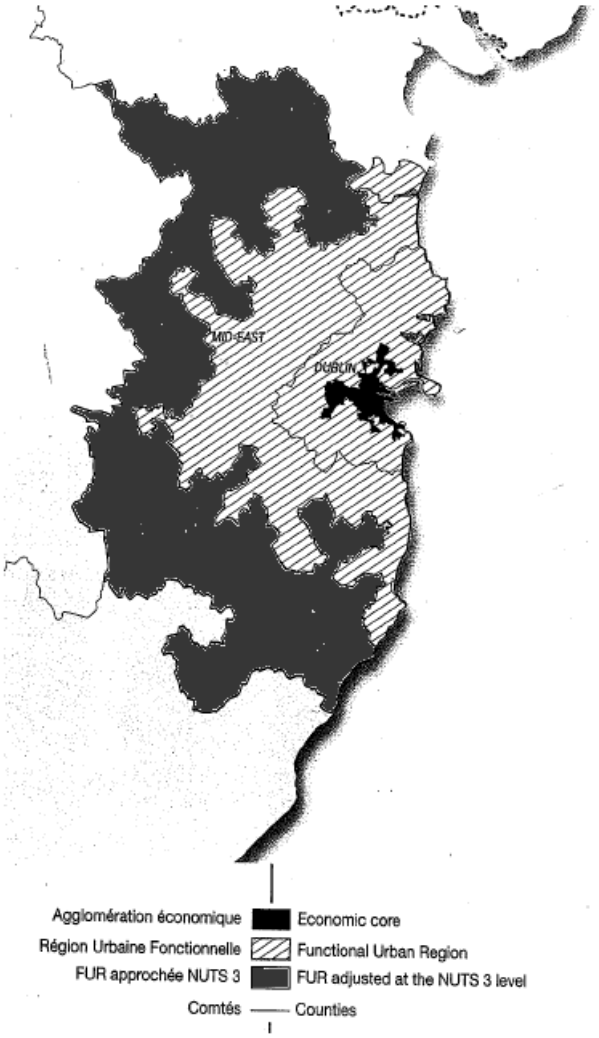
Figure 5 - GEMACA Functional Urban and Adjusted Administrative Region for Rheinruhr, 1999



Source: GEMACA 2002

34 . For instance, according to the OECD metropolitan database (OECD, 2006), administrative regions in some cases are much smaller than their Metropolitan Region; e.g., Paris, Athens, Barcelona, Copenhagen, and Milan. In other cases (Australia, Canada, Mexico, and the US) some regional data, in particular reliable GDP data, are available only for regions that are much larger than their Metropolitan Regions and only estimates are available for the functional area.

Figure 6 - GEMACA Functional Urban and Adjusted Administrative Region for Dublin, 1999



Source: GEMACA 2002

THE CASE STUDY: THE METROPOLITAN REGION OF MADRID

Introduction

This chapter of the essays presents a case study and discusses the recent socioeconomic trends in the Madrid metro-region. The Madrid metropolitan area has reached a high level of international competitiveness during the last decade. Once a regional capital with a central role in Spain but relatively isolated from the rest of Europe, Madrid is becoming a powerful hub within the global economy. Over the last eight years, the economic growth of the metro region has more than doubled the average of the euro zone. Madrid has become a large metropolitan region, home to 3 million workers and more than 450 000 firms, several of which are headquarters of some of the most competitive companies in the world. Broadly speaking, there are three factors underpinning this good performance: (i) a large supply of labour provided both by immigrants (among which a large number of Spanish speaking natives coming from South American countries) and young educated fixed-term workers; (ii) the presence of first-class transportation facilities, such as Barajas airport, that enable Madrid to mitigate the challenge of being a peripheral European region; and (iii) the growth dynamic itself, in response to the stability of the economy due to the introduction of the euro, which has generated positive expectations among population promoting the local demand. Of course, behind the regional good performance there is a "country effect" that proves difficult to isolate from the local comparative advantage. Although this phenomenon can be observed in many OECD metro-regions, in Madrid it has a larger importance. The historical concentration of the national investment within the Madrid metro-region, in fact, has played a key role in promoting Madrid's international accessibility as well as the localisation of some knowledge intensive industries such as aerospace.

Despite this good performance, a first analysis has highlighted some challenging issues, which should be address to sustain Madrid' positive path and strengthen its competitiveness in order to stand as one of the most competitive metro-regions in Europe. A first challenge is the relatively low level of labour productivity which is a common trend in Spain. Among the reasons are the impermanence of jobs with an over use of short term contracts that are likely to generate educational-skills mismatches. Second, linked with this first challenge, the low innovation capacity in Madrid as compared to other leading OECD metropolitan regions does not allow further specialisation in high value added activities, especially in the manufacturing sector. Public R&D is high in Madrid as compared to Spain, but low by international standards whilst private R&D is also limited. Finally, rapid in-migration to Madrid as long as fast

urbanisation and urban sprawl have generated traffic congestion typical to large metro-regions whilst rigidities on the housing market is causing strain especially on the more vulnerable segment of the population. Immigration is not an issue but is raising new demands that would require appropriate measures to avoid tensions when the economic cycle will be in the downturn.

The first section of the chapter presents an all-round assessment of the regional socioeconomic trends and a descriptive analysis the place-based competitive advantage. A last section assesses a series of possible policies that local authorities could implement in order to face the emerging problems linked to the decline of labour productivity and the large influx of migrants.

Defining the FUR of the Madrid metropolitan region

Considering the aforementioned problems that researchers meet in defining FURs, the Madrid metro-region has been defined according two main principles. First of all, matching as much as possible the real dimension of the local labour market. Second, avoiding going down TL3 (NUTS3) given the availability of reliable statistics at that territorial level.[35]

The functional economic area of Madrid, as defined by the commuting flows within a labour market area or inter-firm linkages, goes well beyond the geographic border of the municipal district of Madrid. A few depth analyses have been conducted to define the commuting zone, though there is a widespread agreement that it coincides more or less with the geographical borders of the Community of Madrid. In this section, dedicated to analysis of socio-economic trends and challenges, the essays will use *two units of analysis*[36]:

- **City of Madrid** (represented by the municipal district of Madrid)
- **Madrid Metro-region** (represented by the Community of Madrid)

The City of Madrid, 3.13 million inhabitants as of 2006, has become the central area of a larger territory, which is the Functional Urban Region (FUR) of Madrid (Figure 7). During the last 50 years the development of the Madrid metropolitan region has been built upon the interdependence between the central city and the outskirts, generating a series of *metropolitan rings*. The administrative boundaries of the municipality of Madrid are thus too small to cover its area of influence and while the Community of

35 . It is worth noting that Madrid is also a region and that TL3 and TL2 are actually the same definition of the area, since the provincial level is missing.

36 . The unit of analysis used depends on the availability of data and the objective of the analysis. For instance, for international comparison, and most of the socio-economic trends, the unit of analysis will be systematically the Madrid metro-region whilst particular focus will be put on Madrid City for its role as an advanced services centre within the metro-region and towards Spain.

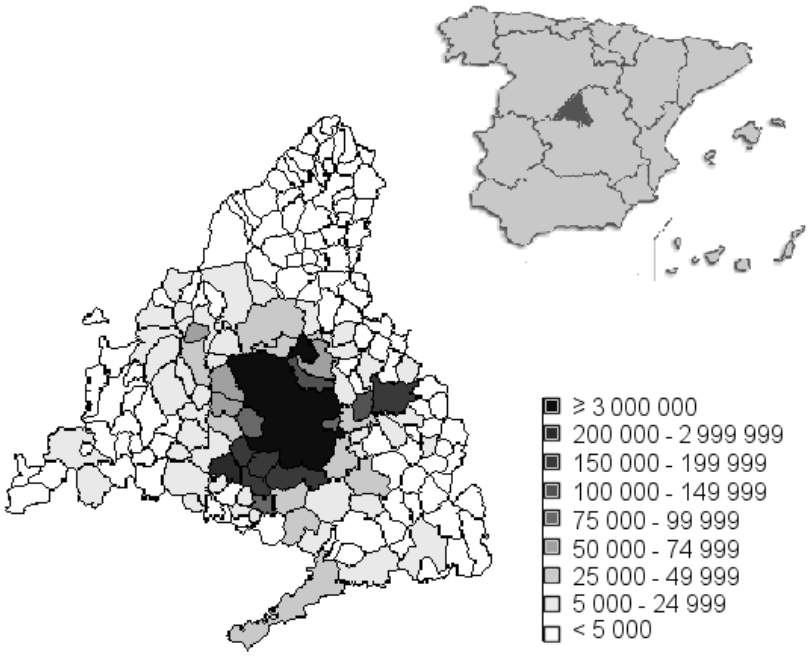
Madrid's boundaries encompass most of Madrid's commuting and socioeconomic-activity, the influence of Madrid in some places even spills beyond regional boundaries. Accordingly, data must be found to reflect the FUR of Madrid. Broadly speaking, the FUR is a self-contained metropolitan area that should reflect the spatial organisation of social and economic relations within an urban territory. The methodology to define the FUR is based on three criteria: (*i*) large size (in terms of either employment or population); (*ii*) high population density; and (*iii*) higher commuting within the region than between it and other surrounding areas (the local labour market has to be "self-contained"). By using definitions of industrial development (e.g. clusters development and the inter-firm relationships within the area) or transport infrastructure this report could in fact expand the metro-region definition of Madrid. For instance, the "Consorcio Transporte de Madrid" (the consortium that coordinates all local transportation facilities) includes part of the Castilla-La Mancha region, specifically the cities of Toledo and Guadalajara, in its daily transport and commuting services (Figure 8). This transportation consortium is one of the key elements in the functional integration and territorial cohesion of different areas into an FUR, as it facilitates mobility within the metropolitan area. This creates the infrastructure network for further development of greater agglomeration economies. Unfortunately, in the case of Madrid this assessment is constrained by the lack of data below Territorial Level 3 (TL3).[37]

This report, like other studies regarding the Spanish capital, considers the Community of Madrid as a proxy for the Madrid FUR (M. Tomás, 2002). With around 6 million inhabitants in 2006, Madrid is the most populated urban region in Spain and ranks as a medium-sized metropolitan area in the Competitive Cities in the Global Economy, OECD, Paris, 2006 (which includes 78 other OECD metro-regions with at least 1.5 million inhabitants). The Community of Madrid is composed of 179 municipalities. The City of Madrid represents the core of the functional metropolitan region. Although the City of Madrid covers only 8% of the Region's territory, it contains more than 52% of the regional population, as compared for instance to 19% for Paris within the region Île-de-France and 48% for Rome in the Latium region (Table 1).[38] Thus, the metropolitan area is strongly concentrated at the centre, but through its evolution it has encompassed surrounding territories which have gradually been incorporated into this core, such as satellite towns, economic activity areas, and logistical nodes. This has contributed to the relocation of the population, the restructuring of economic activities in the metropolitan area and the increase in core-periphery and periphery-periphery relationships.

37 . For Spain, the Territorial Level 3 is consistent with the provinces or, as for Madrid, with the Community of Madrid.

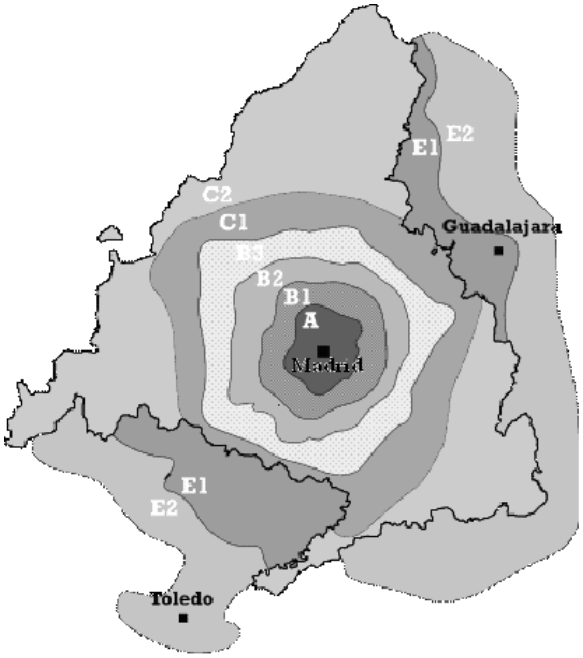
38 . Data are for 2002.

Figure 7 – Population in municipalities within the Madrid metro-region (2004)



Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Figure 8 – Areas where transportation infrastructure is managed by the "Consorcio Transporte de Madrid"



Source: Consorcio Transporte de Madrid (Madrid Transport Consortium)

Table 1 – Basic indicators of the Madrid metro-region

	Population in 2006	% of total	Surface area (Km^2)	%of total	Density in 2006	Evolution of population from 2001 to 2006 (%)
City of Madrid	3 128 600	52.07	607	7.56	5 154.20	8.52
Community of Madrid	6 008 183	100	2 704	100	2 221.96	11.83

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

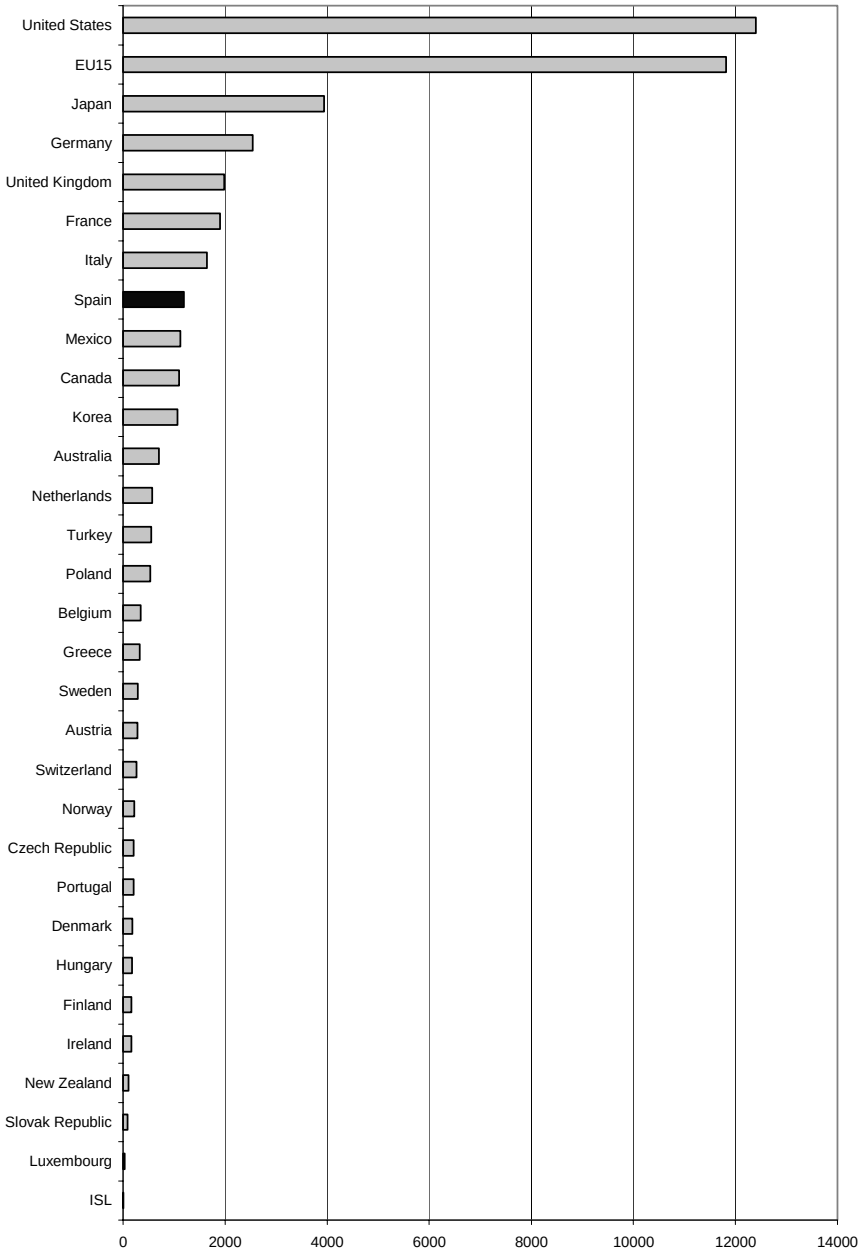
Main socioeconomic trends within the Madrid region

The influence of the national trend on regional dynamics

Before entering into the core of the analysis it is important to open a "macroeconomic window" and assess the importance of national trends on regional development. Sustainable regional development can be achieved only if and only if local strategies are placed within a stable framework of orthodox macroeconomic policies (stability of macroeconomic conditions, fair competition, and sound environmental policies). The remarkable development of Spain over the last decade, and the historical concentration of a large share of the national investment have positively affected the growth of the Madrid metro-region. Spain is one of the fastest-growing countries in Europe and the national effect has stimulated local growth. Some others factors have a local origin and depend on local comparative advantages. Spain's economic success over the past 20 years has transformed the country, making it the OECD's seventh largest economy (Figure 9) in 2005. Over the last ten years Spain has grown at twice the average of the European Union (3.4% in 2005 compared to 1.6% in the EU-25), and per-capita GDP has converged towards the average in the Euro and OECD areas (Spain's GDP per head was USD 24 500 in 2003, compared with an OECD average of USD 26 000). This remarkable economic performance has been the consequence of different factors: international openness, European Union membership and structural reforms pursued since the 1990s. Since 1999, strong revenue growth and public expenditure control have contributed to reducing the budget deficit. Moreover, in 2006 a surplus (1.8% of GDP) was achieved for the second straight year, proof of the compromise for fiscal stability. In this environment Spain has benefited from a virtuous circle of sustained growth, job creation and convergence with the more advanced economies of the world (OECD Economic Survey – Spain 2006).

Figure 9 – GDP in the OECD (2005)

Billion US dollars, current prices and PPPs



Source: OECD Factbook 2007

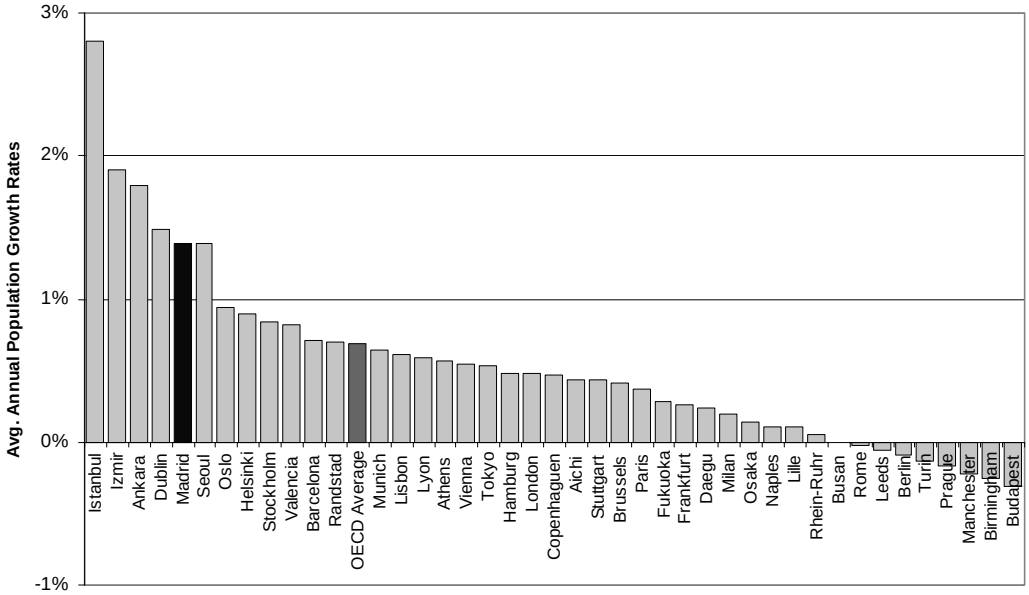
However, an important challenge for the Spanish economy is to improve its specialisation in knowledge-intensive industries. Since the birth of the euro in 1999, the loss of competitiveness has reached 7.5 % points in relation to OECD member countries. As pointed out by the OECD Economic Survey of Spain (OECD, 2006), this loss of

competitiveness is reflected in, among other indicators, a growing current account deficit, which reached 8.7% of GDP in 2006. This is not only the result of inflation rates that have remained consistently above the Euro-area average, but also because many Spanish exports are in sectors and markets characterized by poor performance and growth, mainly in medium- and low-technology sectors. This, in turn, reflects the low level of innovation of Spanish companies. Expenditure in R&D in 2005 was 1.13% of GDP, well below the EU average of 2%. There is therefore a need for Spanish institutions and firms to adopt policies that promote greater innovation and specialisation in higher-end sectors if Spain is to avoid becoming locked into medium and low technology sectors, where competition from new EU member states and from other countries (*e.g.* the Asian Dragons) is likely to prove challenging for the Spanish economy.

Madrid has positive demographic trends due to immigration

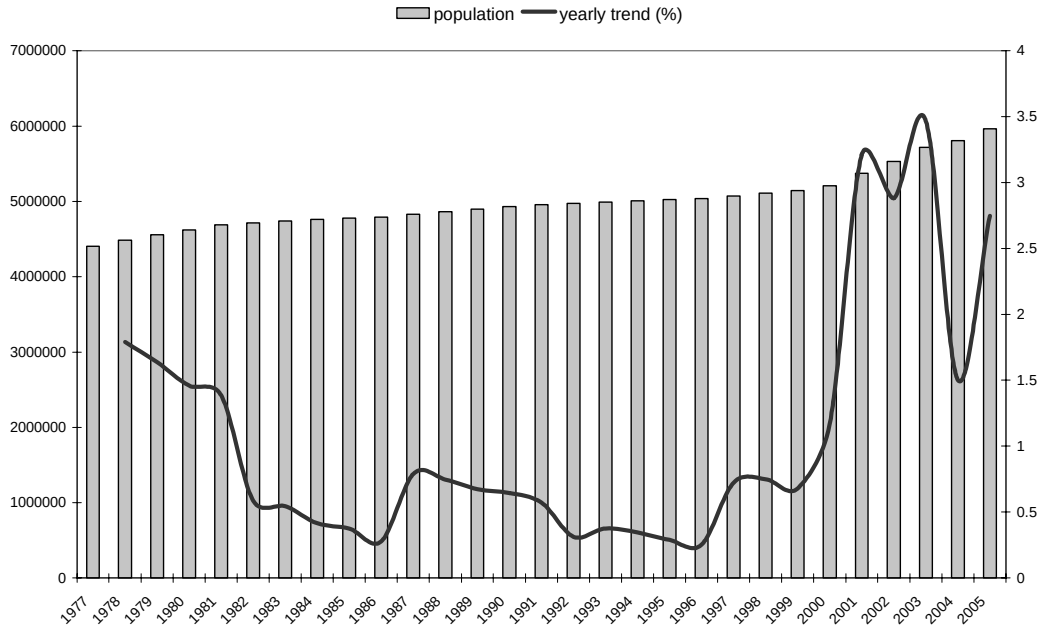
Demography is among the most important indicators to understanding the regional performances. People, in fact, are attracted by places that can offer them a large and articulated basked of public goods and amenities. Madrid has been among the fastest growing OECD metro-regions in terms of population from 1995-2002 (Figure 10). Population increased in the Madrid metro-region by 1.5 million inhabitants from 1977 and 2005 (Figure 11). Looking at yearly trends, the demographic growth is almost entirely concentrated in the last nine years of the series (1996 – 2005). Although the positive demographic trend impacts both the core of the metropolitan area (the City of Madrid) and the "Ring Belt" (the Madrid metropolitan region excluding the City of Madrid), it is the latter that concentrates the bulk of the increase (more than 4.5 % increase in population reached in 2003) (Figure 12). This confirms the existence of an urban decentralisation pattern, a constant in almost all major metro-regions in the developed world. This dynamic is probably due to several factors: the greater availability of land in the ring belt than in the core; the deconcentration of industrial economic activities; external diseconomies; the tertiarization of the economic structure; cheaper housing in the periphery; and the availability of a modern and extensive network of infrastructure within the metro-region that facilitates commuting. Thanks to the availability of greenfields in the city surroundings (Madrid is not surrounded by other major urban areas or other physical constraints), Madrid has avoided a "leap frog" pattern in its urban growth, maintaining strong urban unity with the large urban continuum that stretches around the core area.

Figure 10 – Average annual population growth rates among OECD member countries (1995 – 2002)



Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

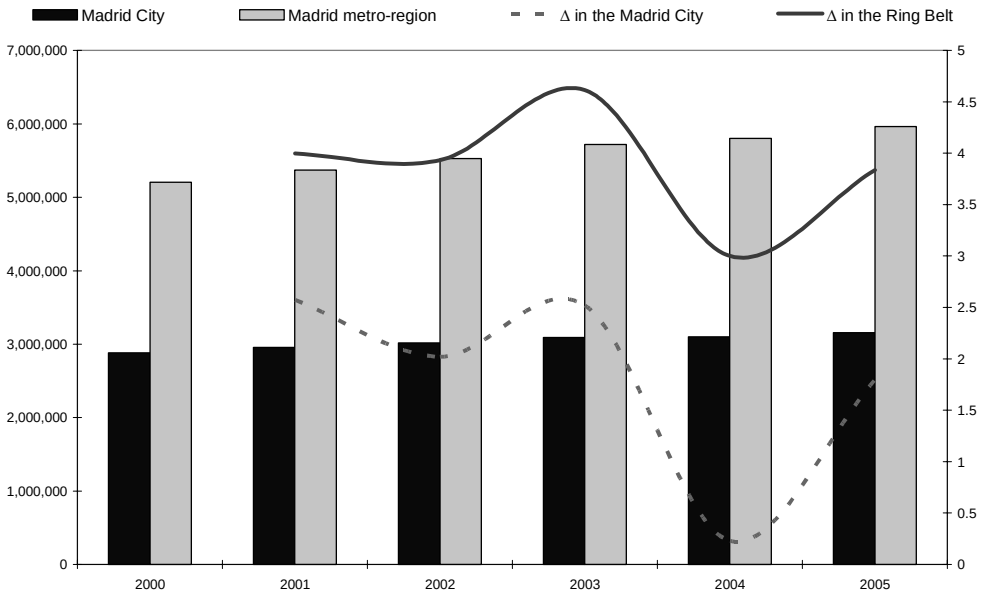
Figure 11 – Long term demographic trend in the Madrid metro-region



- The yearly trend refers to the population growth rate trend (measured by the scale on the right)

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Figure 12 – Demographic trend in the City of Madrid and in the Ring Belt (2000 – 2005)



Note: the "ring belt" is the population of the Madrid metro-region minus the population of the City of Madrid

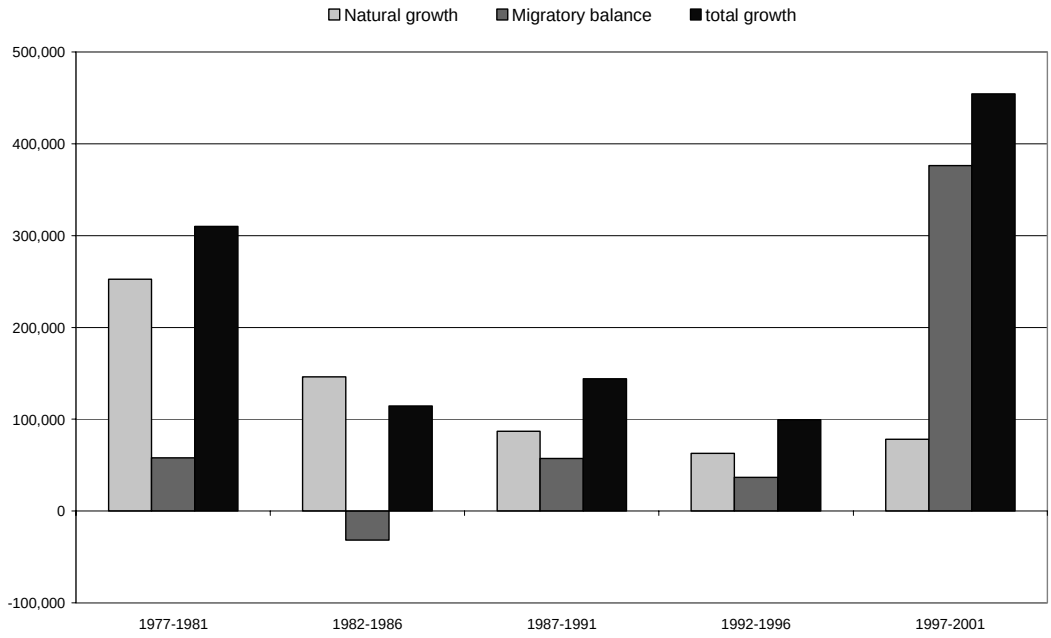
Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Given the low natural growth rate - comparable to that of other European metropolitan regions - local population growth is fundamentally due to migrant inflows (Figure 13). The influx of immigrants has also had a positive impact on the age structure of the region. For instance, taking into account only the City of Madrid, the working age population is larger than in the past (Figure 14). Immigration into the Madrid metro-region is not a new phenomenon, but recent migration is new with respect to the past. Until the early 1970s Madrid, as one of the main economic poles in Spain, was a major magnet for national migration. In recent years it has continued to attract nationals, mainly young students and workers, motivated by the educational[39] and labour market opportunities the city offers. However, the bulk of new migration to Madrid – as is the case for the rest of Spain – is made up of foreigners, transforming what was a relatively homogenous city until the mid-1990s into an increasingly multiethnic metropolis (Figure 15). Madrid is the largest recipient of foreign migrants in Spain, accounting for 19.3% of total foreigners in 2006. The growth of foreign migrants has been accompanied by an increase in diversity of origin. The largest group of foreigners is from Latin America, followed, at some distance, by Central and Eastern Europeans, Africans, citizens of other countries of the EU15, and Asians. The largest contingent is Ecuadorian, which on July 2006 made up 26% of the total foreign population. The second and third largest groups were Colombians, 8.9%, and Romanians, with 7.2%. These were followed by Peruvians, Bolivians, Moroccans, Chinese, and Dominicans, each representing between 6.5 and 3%

39 . The Community of Madrid is the number one destination for Spanish students studying outside their city of residence (8.37 % of the national total).

of the total. Foreign migrants originally clustered in the City of Madrid (67% of the total immigration of the region in 2006), but have in recent years the immigration has spread out to the metropolitan rings of the metro-region. Between 2000 and 2002 the largest growth was registered in municipalities located in the south and to the east of the Madrid metro-region.

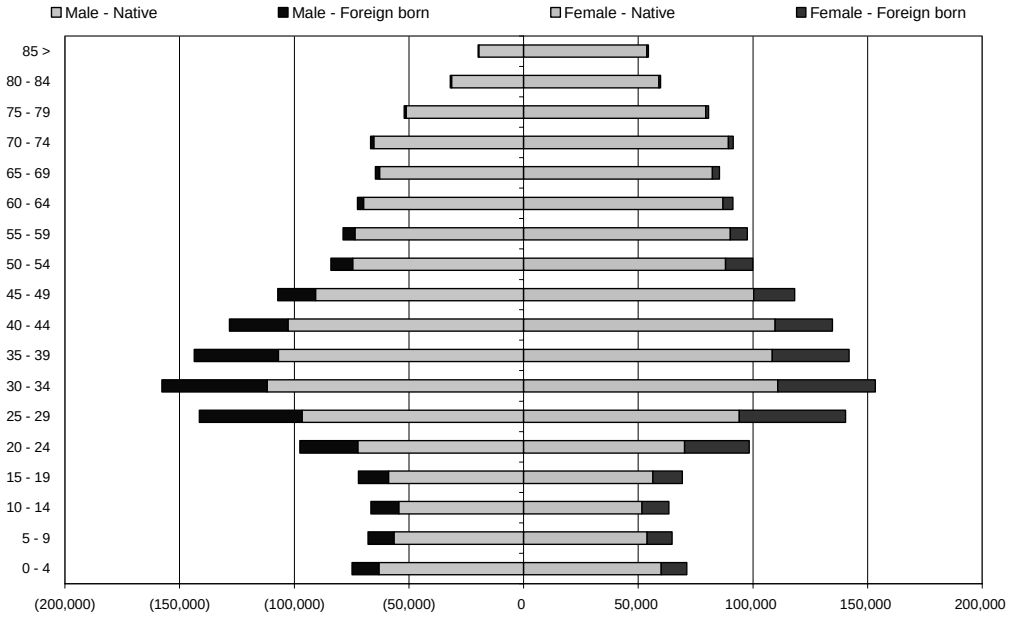
Figure 13 – Natural and migratory growth trends in the Madrid metro-region (1977 – 2002)



Source: Regional Institute of Statistics – Community of Madrid

Figure 14 – Demographic pyramid of the City of Madrid (2006)

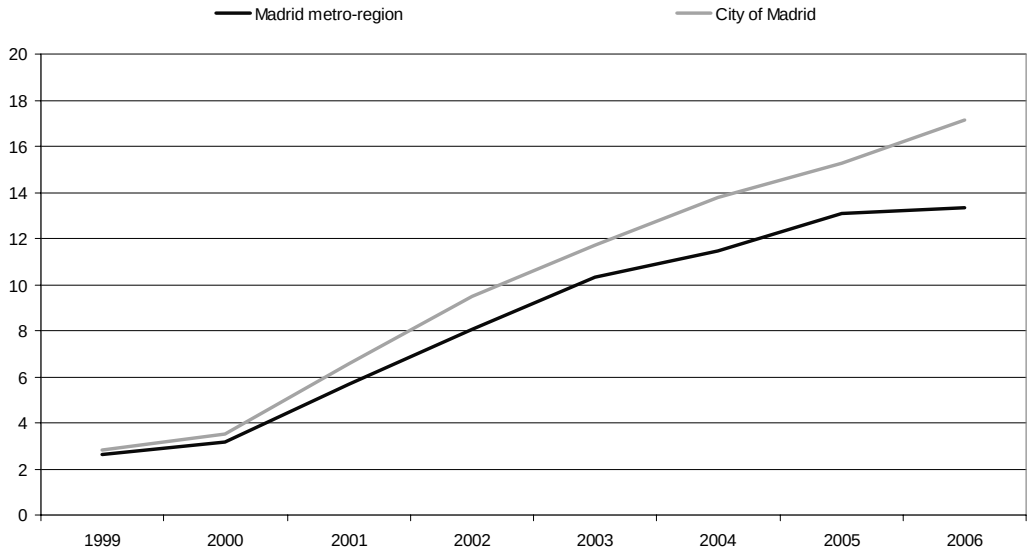
(%)



Source: City of Madrid

Figure 15 – Pecentage of immigrants on total population (2006)

(%)



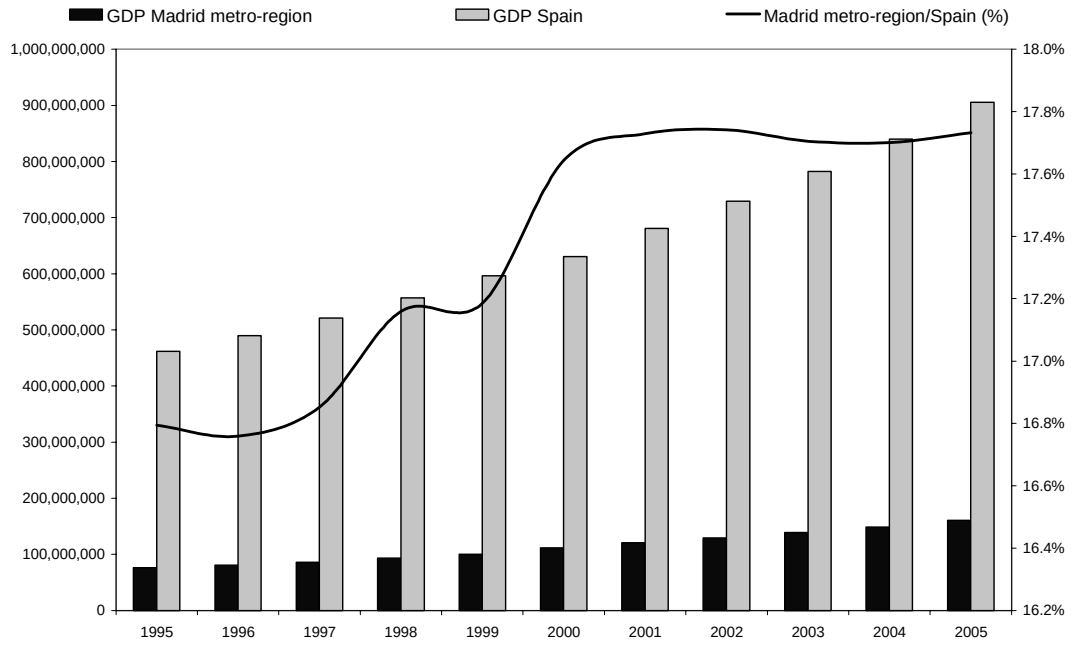
Source: City of Madrid

The richest metro-region in Spain

The Madrid metro-region has a significant share of the national GDP with almost EUR 160 billion in 2005 (at current prices – base 2000). The metropolitan area alone, which is home to 13.52% of national population (2005), accounts for more than the 17% of Spanish gross domestic product (Figure 16). The concentration of national GDP is a typical feature of metro-regions and, within the OECD, metro-regions account for a large share of national GDP. However, Madrid's dominance over the national economy is lower than in some other OECD member countries. The presence of other urban economic poles, such as the metropolitan region of Barcelona and, to a lesser extent, those of Valencia, Bilbao and Seville, acts as a counterbalance to Madrid's economic weight in Spain (Figure 17).

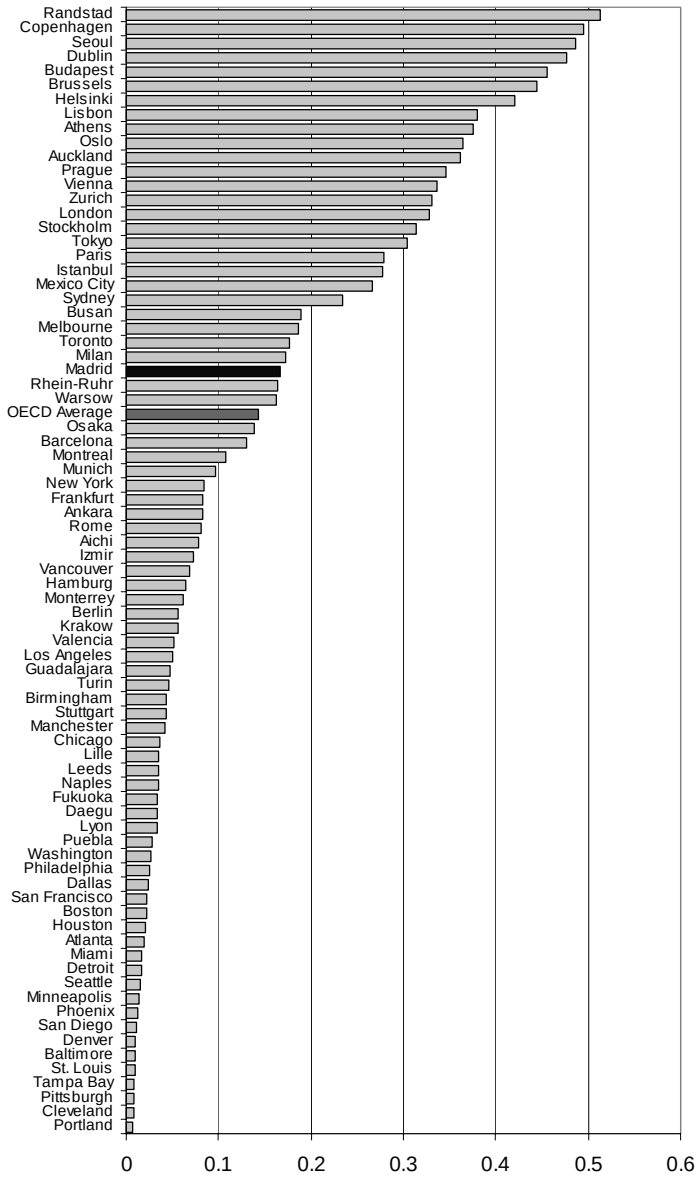
Figure 16 – GDP trend in Madrid metro-region and in Spain (1995-2005)

(Thousands of euros - current prices - base 2000)



Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Figure 17 – Share of national GDP in OECD metro-regions (as of 2002)

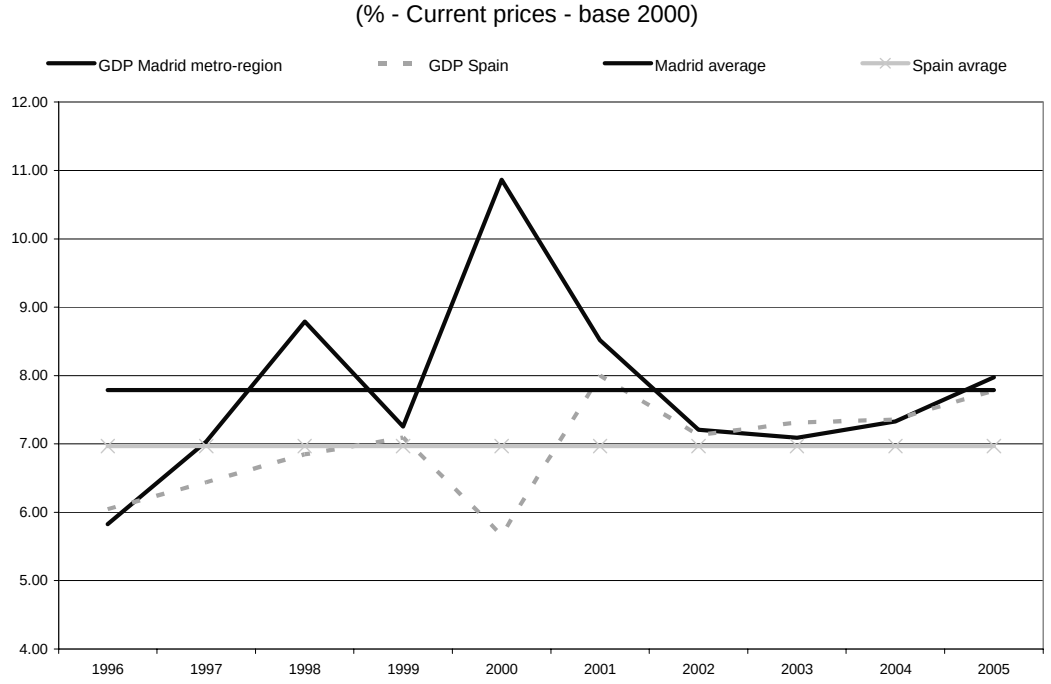


Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

The Madrid metro-region has been growing faster than the country in terms of average GDP from 1996-2005. In fact, the Madrid metro-region has registered an average annual growth rate (in GDP nominal terms) of 7.8 % compared to a 6.97 % national average during this period, while in real terms Madrid has been growing by 3.7% and Spain by 3.3% between 1996 and 2004 (Figure 18). The Madrid metro-region is certainly taking advantage of its position as the capital city of Spain. Capital cities are essentially political products that governments have worked to develop into the communications centres and main showplaces of the country, in many cases for several

centuries. Rail and road networks and major airports tend to be concentrated in them. Major cultural and sporting facilities tend to be built within them. Employment in public administration is by definition centred there, encouraging the location of corporate national headquarters. As a result they have disproportionate shares of educated workforces, good transport links and a high level of public infrastructure (OECD Competitive Cities in the Global Economy, 2006).

Figure 18 – GDP trend in Madrid metro-region and in Spain (1996-2005)



Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

The Madrid metro-region also has the highest GDP per capita in Spain. In term of stocks, with € 27 300 per capita in 2003 (base prices 2000), Madrid is the richest region in Spain and has a GDP per capita above the European average (the GDP per capita in Madrid was 128.5% of the EU-25 average in 2003). This leadership is also confirmed by the evolution of the principal regional magnitudes of the Madrid metro-region compared to the rest of Spanish regions (Table 2). This situation reflects a general trend for large OECD metro-regions which have a GDP per capita greater than the national average (OECD Competitive Cities in the Global Economy, 2006). Madrid ranks 28th out of 78 OECD metro-regions for this indicator, scoring a value well above the OECD average (Figure 19). As far as trends in GDP per capita are concerned, the Madrid metro-region shows positive trend with the exception of the period 2001-2001 (Figure 20). The negative trend during this biennium was more evident in Madrid than in Spain. Such a phenomenon is likely to be related with the high influx of immigrants which is higher in Madrid than in the rest of the country, and the regularisation process that followed. Within the Spanish context, there has been little modification in the relative positions of

each Spanish region during the last two decades. Rich and poor regions maintain their levels and positions when analyzing income per capita which confirms the stagnation process in regional disparities. A similar pattern is observed when analysing regional disparities in unemployment rates (Table 3). The persistence in times of disparities in unemployment within Spain can be explained by a low internal spatial mobility, regional differences in the education and qualification levels of the labour force, and the regional sectoral composition of unemployment (Table 4).

Table 2 – Evolution of basic economic indicators at the regional level in Spain

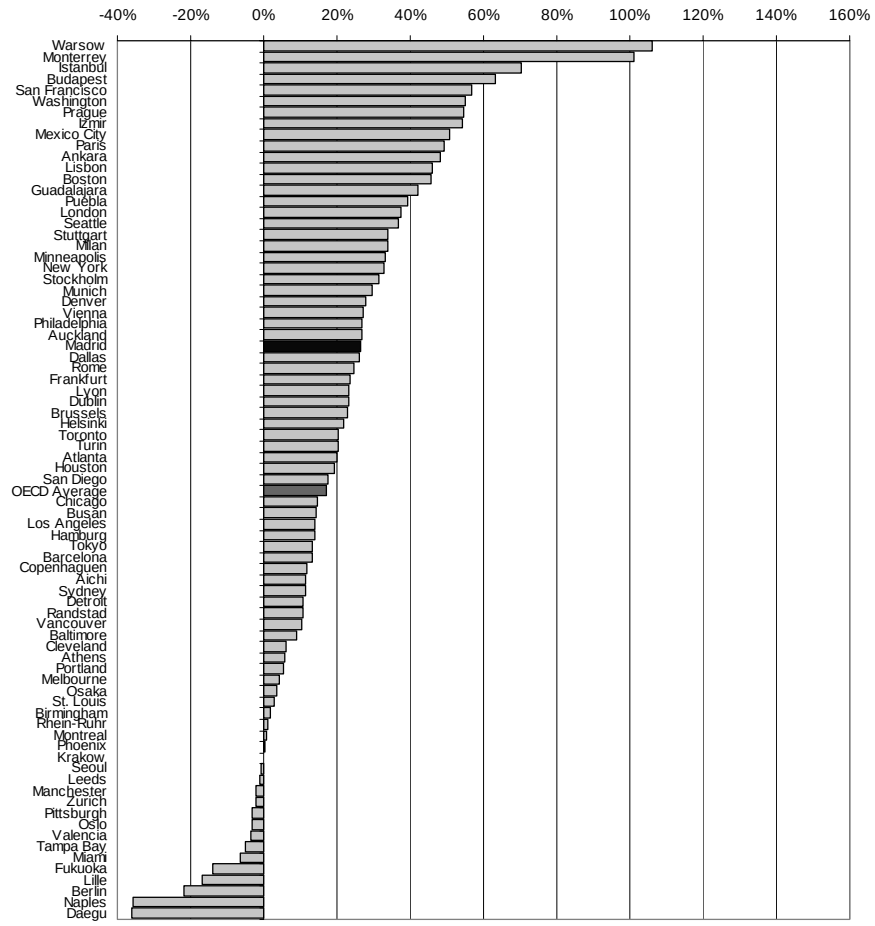
(Annual cumulative rates)

Region	GVA per capita*	Employment	Productivity
Andalusia	2.78	1.656	1.15
Aragon	2.76	0.75	2.03
Asturias	1.36	-0.28	1.69
Balearic Islands	2.87	2.09	0.82
Canaries	3.86	2.35	1.54
Cantabria	2.69	0.48	2.23
Castilla-Leon	1.85	0.18	1.7
Castilla-La Mancha	2.51	0.96	1.54
Catalonia	2.74	1.36	1.38
Com. of Valencia	3	1.87	1.15
Extremadura	3.24	0.84	2.46
Galicia	1.64	-0.04	1.69
Madrid	**3.32**	**1.99**	**1.31**
Murcia	2.89	2.05	0.87
Navarra	2.91	1.23	1.68
Basque Country	2.44	0.73	1.72
Rioja	2.99	0.82	2.25
Ceuta and Melilla	3.96	3.4	0.78
Spain	**2.73**	**1.26**	**1.46**

- Gross Value Added is Gross Domestic Product excluding taxes (fewer subsidies) on products.

Source: Spanish Ministry of Economy

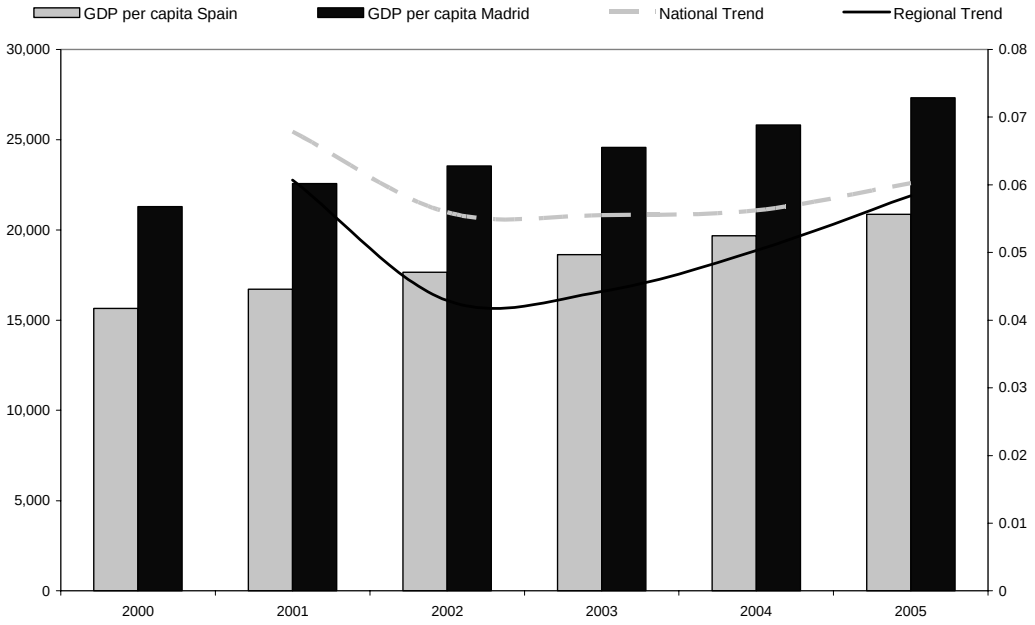
Figure 19 – Differences in per capita GDP of metro-regions and their national level



Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

Figure 20 – GDP per capita in Spain and in the Madrid metro-region (2000-2005)

(Base prices – 2000)



Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Table 3 – Regional disparities in GDP per capita in Spain

(1986-04)

Region	1986	1990	1995	2000	2004
Andalusia	75.26	76.05	74.25	74.19	77.75
Aragon	111.54	115.33	109.75	105.84	107.62
Asturias	98.61	91.63	87.62	84.89	88.19
Balearic Islands	131.98	123.81	118.14	119.67	114.14
Canaries	93.74	88.33	94.28	94.85	97.49
Cantabria	96.57	101.05	93.31	96.51	99.67
Castilla-Leon	94.70	93.26	95.63	93.05	97.19
Casttilla-La Mancha	80.43	89.02	82.51	80.83	80.56
Catalonia	117.41	122.26	122.95	120.04	117.59
Com. of Valencia	101.93	101.18	95.01	95.22	95.17
Extremadura	65.23	67.86	63.31	65.73	69.92
Galicia	78.02	74.75	80.45	80.05	84.22
Madrid	**124.05**	**120.16**	**131.27**	**134.45**	**131.79**
Murcia	95.09	95.13	83.59	84.62	84.62
Navarre	121.86	128.60	128.62	126.50	126.52
Basque Country	124.39	119.71	120.04	123.93	129.63
Rioja	117.63	129.85	115.33	116.80	111.71
Ceuta and Melilla	86.91	88.50	82.27	85.18	90.85
Spain	**100**	**100**	**100**	**100**	**100**

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Table 4 Regional disparities in unemployment rates in Spain

(1986-04)

Region	1986	1990	1995	2000	2004
Andalusia	148.4	160.8	149.6	169.9	141.2
Aragon	72.1	56.6	70.3	53.2	69.0
Asturias	93.1	105.3	81.9	122.8	118.9
Balearic Islands	80.0	73.0	64.5	53.9	67.9
Basque Country	109.0	117.2	97.7	89.1	69.8
Canaries	122.6	142.4	102.9	88.6	83.5
Cantabria	87.9	102.5	103.3	104.0	98.8
Castilla-Leon	84.8	93.6	89.9	97.8	106.9
Casttilla-La Mancha	74.2	78.9	88.0	94.1	91.0
Catalonia	100.0	78.0	87.3	64.2	85.8
Ceuta and Melilla	147.0	196.0	133.2	160.8	102.4
Com. of Valencia	91.1	86.9	94.3	83.9	71.0
Extremadura	129.5	147.2	136.6	174.0	154.9
Galicia	64.1	76.6	80.9	107.1	143.4
Madrid	**86.4**	**70.9**	**91.2**	**83.9**	**43.1**
Murcia	98.5	94.3	96.5	93.1	121.8
Navarre	85.6	72.8	58.1	42.0	60.1
Rioja	73.7	57.8	65.0	55.2	74.7
Spain	**100**	**100**	**100**	**100**	**100**

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Why such a relatively high portion of national GDP is concentrated in the Madrid metro-region? The answer to such question is multifaceted; concentration may depend on: (*i*) the concentration of financial resources (i.e. percentage of national savings in Madrid); (ii) the portion of national R&D expenditure in the Madrid metro-region; (iii) outward and inward FDI; and (iv) the region's proportion of national employment.

- First of all, Madrid plays the role of the Spanish "treasure chest" holding the highest percentage of national financial resources. Deposits in financial entities (a proxy for Madrid's savings capacity) have been increasing rapidly in recent years, doubling its overall terms between 1999 and 2006. The proportion of national savings concentrated in Madrid ranges between 23 % and 25 %, which is much higher than the proportion of regional population (13.3 %), demonstrating Madrid's capacity to attract national financial resources. Madrid is 31.1 % ahead of the region ranked second, Catalonia (data as at March 2005). In addition, the region of Madrid constitutes the main financial centre in Spain. It accounts for approximately 26% of the Gross Value Added (GAV) of the Spanish financial institutions.

- Second, Madrid is the Spanish region with the highest R&D expenditures, and with the highest concentration of researchers especially in the public sector. Approximately 28% of national R&D expenditure was concentrated in the Madrid metro-region in 2005 (Table 5). In the year 2000, the region invested over € 1.5 billion in R&D, which represented approximately 2% of regional GDP, i.e. above the Spanish average (0.9%) (INE – Spanish Institute of Statistics, 2003).

- Third, Madrid plays the role of international gateway by concentrating the bulk of both inward and outward FDI in Spain. Approximately two thirds of Spanish investments abroad originated from the Madrid metro-region in 2004. Madrid has also attracted a similar proportion of FDI into Spain since the turn of the century.

- Finally, the Madrid metro-region generates 15 % of all employment in Spain (second only to Catalonia at the regional level). The City of Madrid alone concentrates more than half of all employment in the region (Table 6).

Table 5 – Indicators of R&D activities in 2005: regional differences in Spain

	Regional investment (million of EUR)	National share (Spain =100)	Workers in R&D (in equivalent hours)	Researchers (in equivalent hours)
R&D expenditure (Total)				
Spain	10 196.8	100	174 772.9	10 9720.3
Madrid (Community of)	2 913.1	28.6	44 480.2	26 553.1
Catalonia	2 302.3	22.6	37 862.3	22 240.1
R&D expenditure (Universities)				
Spain	2 959.9	100	66 995.5	54 028.3
Madrid (Community of)	494.3	16.7	10 743.5	84 02.3
Catalonia	578.5	19.5	12 519.2	9 841.8
R&D expenditure (Public sector)				
Spain	1 738.05	100	3 2076.7	20 445.6
Madrid (Community of)	740.7	42.6	1 3479.9	7 690
Catalonia	263.2	15.1	5 148.8	3 709
R&D expenditure (Private sector)				
Spain	5 498.8	100	75 700.7	3 5246.4
Madrid (Community of)	1 678.1	30.5	20 256.8	10 460.8
Catalonia	1 460.5	26.6	20 194.3	8 689.3

Note: R&D data are not available at the provincial level. This may penalise Madrid (a single province) when compared against Catalonia (4 provinces)

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Table 6 – Employment in Spain, in the Madrid metro-region, and in the City of Madrid

(1st quarter 2005)

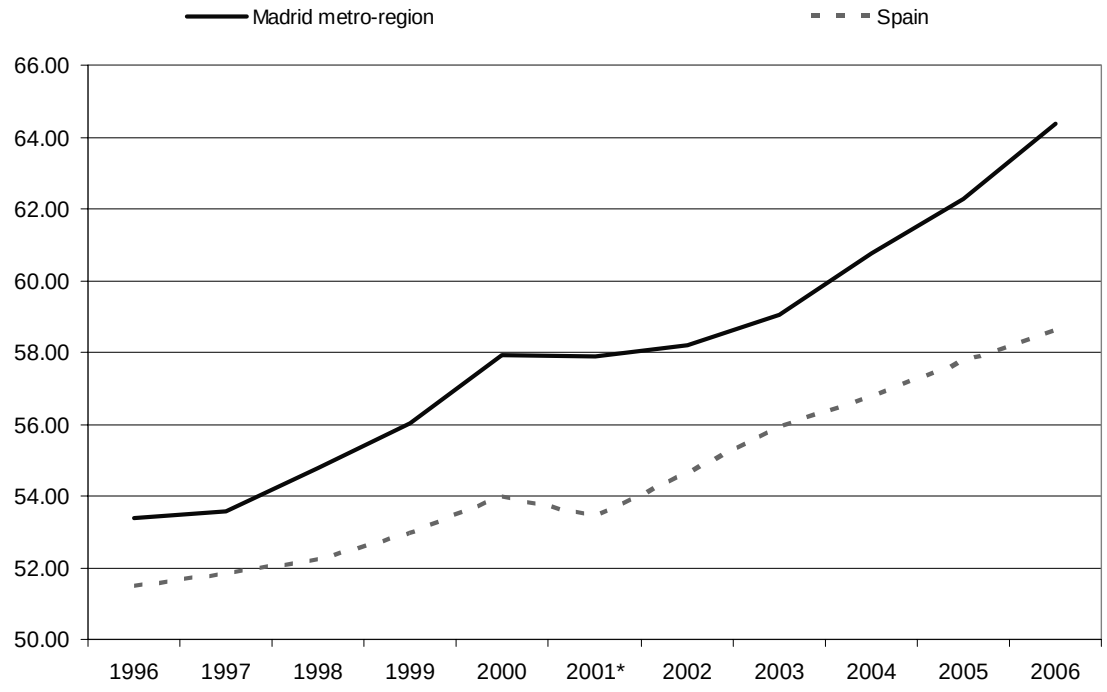
	Employed (thousand)	Percentage of national total
City of Madrid	1 412.2	7.64
Madrid metro-region	2 783.6	15.05
Spain	18 492.7	100

Source: INE - Instituto Nacional de Estadística (Spanish National Institute of Statistics)

Main trends in the regional labour market: Madrid's capacity to generate employment

Strong economic performance in Madrid has impacted its labour market, evidenced by soaring job creation. More than 760 000 new jobs were created between 2000 and 2006, a great part of them in the construction sector, triggered by the booming housing market in the City of Madrid created by the increasing demand of dwellings and office space by homeowners and service providers (financial, retail, and communications). New jobs were created as well with the enlargement of the airport in 2004, now the largest employer in the region of Madrid with more than 40 000 workers. Although still at a relatively low level (64.4% in 2006), the regional activity rate has improved between 1996 and 2006 (Figure 21). Overall unemployment declined from 11.6% in 2000 to 6.5% in 2006 (Figure 22). Such a good result is partially attributed to the female labour market. Both the increased female activity rate (3.2% between 2000 and 2004) and the decreased female unemployment rate (-8.52% between 2000 and 2004) demonstrate the improvement of the regional labour market (Figure 23). From an international perspective, Madrid ranks first among a sample of 38 metro-regions with the highest employment growth from 1999-2002. These positive labour market trends are in line with Spain's overall performance, as the OECD country where such a positive trend has been strongest (Figure 24).

Figure 21 – Activity rate in Spain and in Madrid metro region (1996 – 2006)

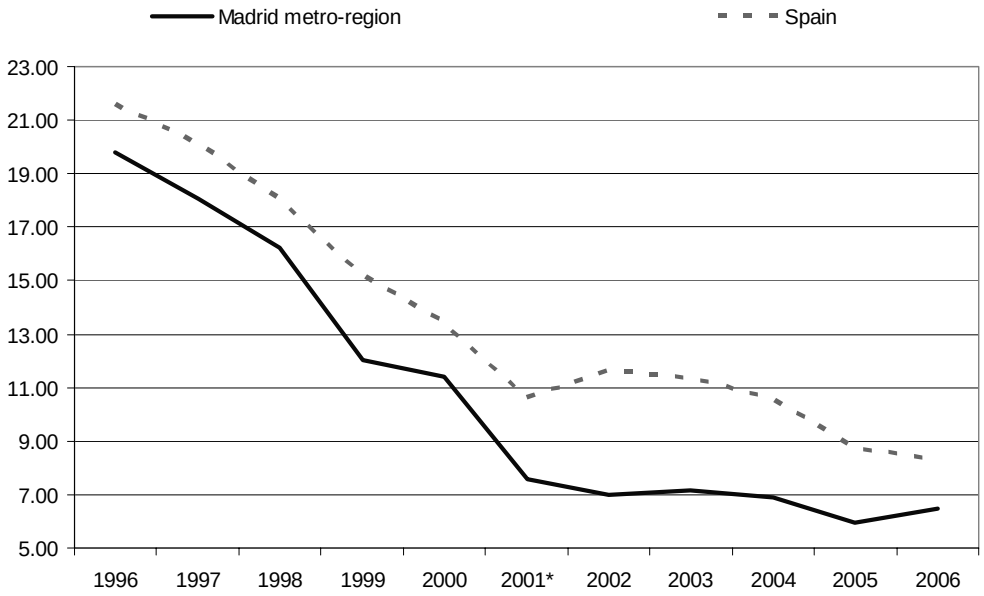


* New definition of activity rate (EU reg. 1897/2000)

Source: Instituto Nacional de Estadística (National Institute of Statistics)

Figure 22 – Trend of unemployment rate in Spain and in Madrid metro-region (1996 – 2006)

(As of the first quarter of each year)

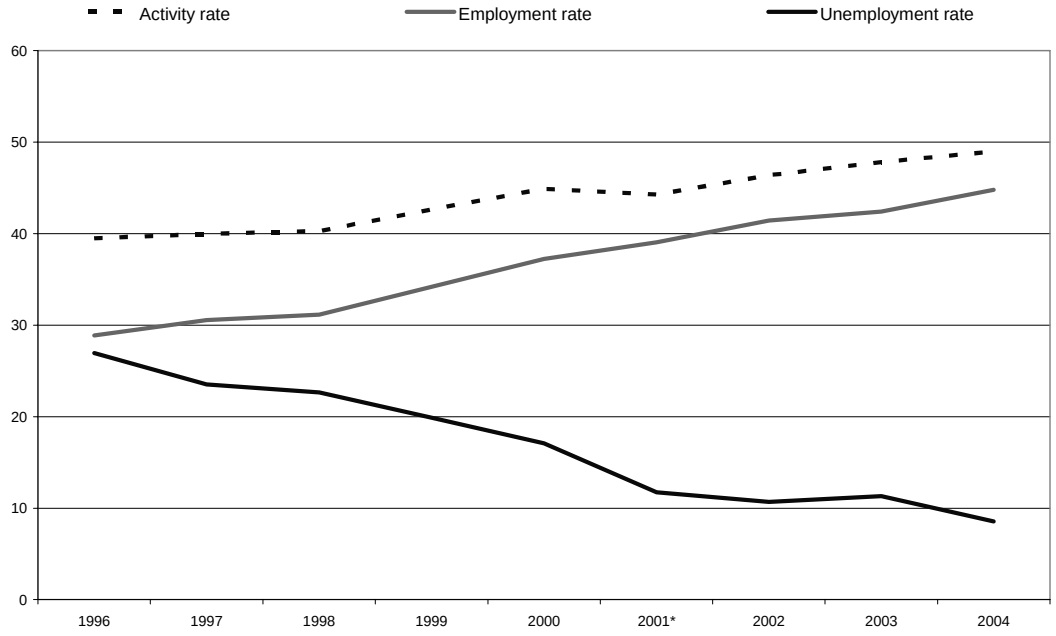


* New definition of unemployment (EU reg. 1897/2000)

Source: Instituto Nacional de Estadística (National Institute of Statistics)

Figure 23 – Female labour market in the Madrid metro-region (1996 – 2004)

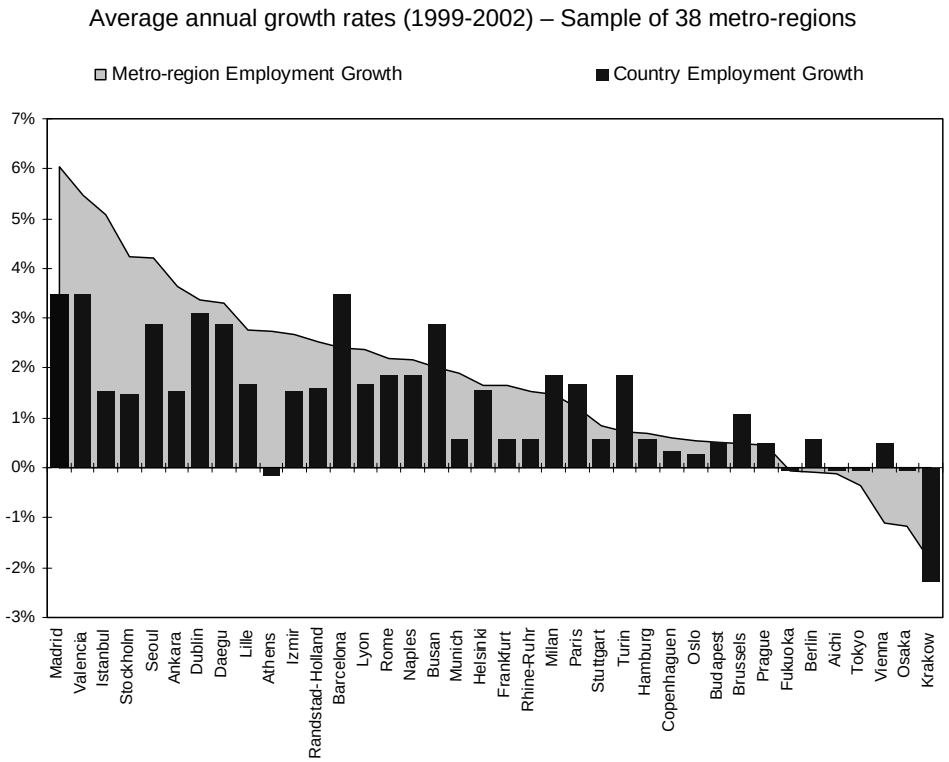
(As of the first quarter of each year)



* New definition according to the EU reg. 1897/2000

Source: Instituto Nacional de Estadística (National Institute of Statistics)

Figure 24 – Employment growth rates in metro-regions and their respective OECD countries



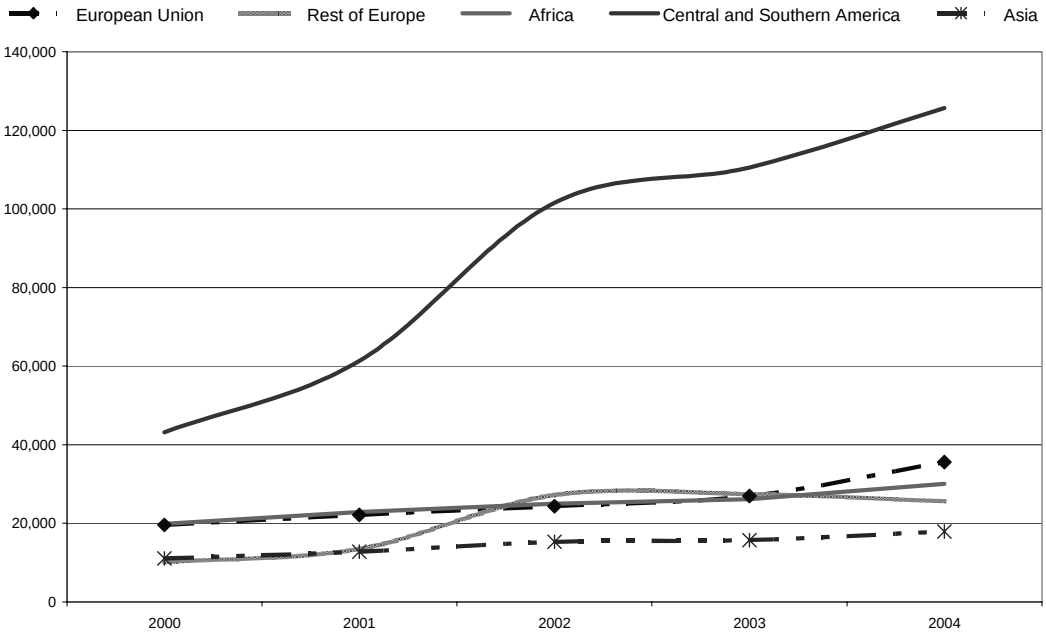
Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

The positive trend of the local economy has made the metro-region a magnet for workers, both at the national and at the international level. At the national level, a 2003 comparison between the workers coming from other Spanish provinces (364 411) and the workers from the Madrid metro-region working in other Spanish provinces (117 615) resulted in a positive balance of 246 796. Madrid is thus an important net recipient of national labour force (Figure 25). At the international level, figures show a booming influx of workers coming from foreign countries, and mainly from South America (with a peak in 2001) (Figure 26). The reason for the influx of these workers into Spain rather than into other European countries can, at least partially, be attributed to the Spanish language and the increasing business flows between Spain and South American countries. The evolution of the labour market, and more precisely of the level of employment, can be analyzed more accurately by the number of Social Security contributors (which is not related to the place of residence of each worker) that has been increasing by 21.1 % from 1999-2004 (Table 7).

Figure 25 – Manpower streams between Spanish provinces

Source: INEM (Spanish National Institute for Employment) (2006), ¿Donde trabajamos? Contratación y movilidad. Geografía de los trabajadores en España. Ministry of Labour, Spain

Figure 26 – Influx of foreign workers* in the Madrid metro-region by area of provenance



* Workers enrolled in the Social Security System. The number of Social Security contributors is representative of Madrid's level of employment, irrespective of each worker's place of residence, therefore accurately reflecting the economic activity developed in the city.

Source: Community of Madrid – Regional Institute of Statistics

Table 7 Social security contributors in the Madrid metro-region

	1999	2000	2001	2002	2003	2004	Δ 04/99 (%)
City of Madrid	1 479 064	1 589 841	1 647 843	1 668 948	1 691 977	1 731 479	17.1
Madrid metro-region	2 200 991	2 352 189	2 442 146	2 510 466	2 568 226	2 66 966	21.1

Source: Community of Madrid - Regional Statistic Institute

Assessing Madrid's international competitiveness

About international competitiveness of regions

The rhetoric of competitiveness brought at the local level has produced a dramatic wave of interest in international benchmarking. Virtually every each large city of the world, on the one hand, is trying to understand its potential in attracting FDI and best factors of production; and, on the other hand, tries to influence investment decisions by topping international rankings. In a globalising economy, territories, and not just firms, increasingly find themselves in competition with each other. But what does it mean competitiveness? As Roberto Camagni stated: "*unlike countries, cities and regions compete, in single currency areas, on the basis of an absolute advantage principle and not a comparative advantage principle*" (Camagni, 2002). That is a way to give theoretical background to the fact that, given the high mobility of factors of production and the global effect of agglomeration economies, best factors of production tend to be concentrated in best locations: The other face of the coin is that, according to such approach, some territories that are not able to maintain the efficiency of their productive framework get excluded by the international division of labour.[40]

The definition of regional competitiveness tends to converge with that of local attractiveness, i.e. the capacity of a given territory (or community) to attract foreign (or external) investment and highly educated workers. Well-known studies have emphasized that successful regions are often characterised by a high concentration of the so-called "creative class". According to the work of Richard Florida (Florida, 2002), for instance, the "creative class" refers not only to highly educated workers (codified knowledge) but also workers who are able to design innovative solutions for complex problems (tacit knowledge). The creative class includes entrepreneurs, public and private managers, researchers, specialised professionals (lawyers, doctors, architects, engineers, etc.), artists, and specialised technicians. A "country effect" exists as the macroeconomic environment depends on national policies (such as immigration rules or R&D investment).

However, the problem of international rankings is about the lack of such specific data as, for instance, the number of workers belonging to the "creative class". Therefore in this essay the main source of data to compare Madrid with the maximum number of other metro-regions in the OECD, which in its work on metropolitan regions has defined a metropolitan data-base measuring the performances of 78 metro-regions, which constitutes the basis of the Territorial Reviews, which the Paris-based Organisation has already realised in 15 different metro-regions.

40 . It is worth recalling that according Ricardo's theory of international specialisation of labour based on comparative advantages at the national level, all the countries will find a place within the global supply chain.

Sources of Madrid's competitiveness

Madrid's ranking on the international scale in terms of GDP per capita among large metro-regions reflects Spain's position. In the Competitive Cities in the Global Economy, OECD, Paris, 2006, Madrid ranks 50th out of 78 metro-regions with approximately 1.5 million inhabitants, in terms of GDP per capita (Figure 27). If one excludes US cities, it ranks 20th out of 31, after such cities like London, Paris, Dublin, Vienna, Stockholm, Helsinki, Copenhagen, and Rome. This standing reflects Spain's income levels as compared to other OECD countries: Spain ranks 22nd out of 30, below the OECD average (Figure 28). Whilst GDP per capita is the most traditional indicators used to assess competitiveness, there are many other factors that need to be taken into account. For instance, a key dimension is the path of economic growth over time and in this respect Madrid has been performing relatively well in recent years (see below). Several city rankings have been developed using different and more complex indicators than GDP per capita.[41] One interesting example of a different way to measure cities' competitiveness comes from the "World Cities Hypothesis" (J. Friedmann 1986). The "World Cities Hypothesis" states that the world urban system is a spatial manifestation of the "new international division of labour". The competitiveness of a given city depends on the level (and the variety) of its productive specialisation within the global context, and on its international accessibility. Following such methodology, Madrid is a "secondary city" (such as, for instance, Milan, Amsterdam, and Vienna) in a "core country" (Europe).[42] Another example of a different way to assess European regions' competitiveness comes from the study carried out by Robert Huggins Associates. This study assesses regional competitiveness according to the capacity of attracting firms with stable or rising market shares in an activity and creating high quality jobs. In this case, Madrid ranks 18th out of 91 European regions.[43] Finally, a promising approach currently held at the national level for OECD countries is indicators that provide alternative measures to well-being (OECD Statistics Brief, 2006, N°11) looking as well to such factors as income distribution, health and social cohesion.

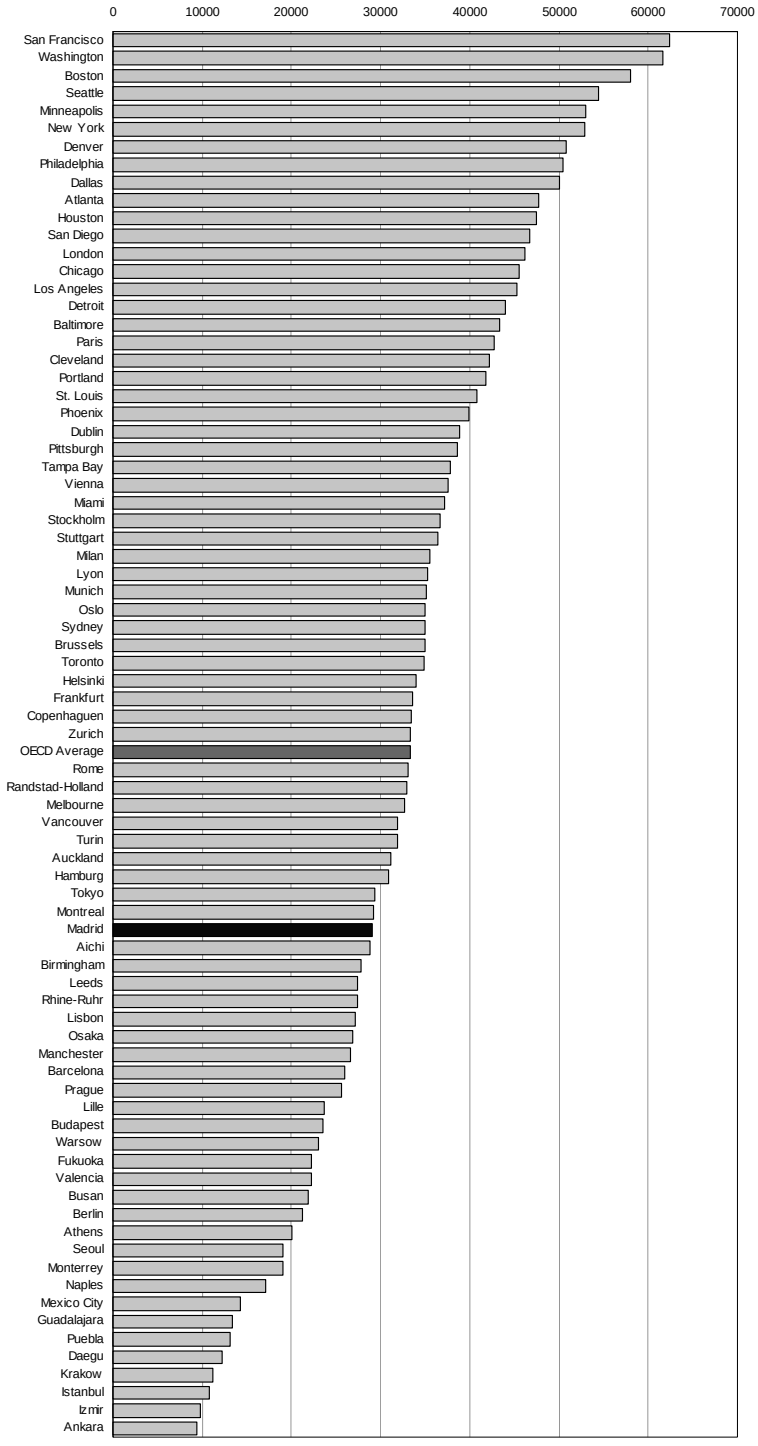
41 . It is worth noting that the more an indicator is complex the more it is exposed to subjectivity. Furthermore, another source of difference among rankings is the territorial scale at which comparison is carried out. Choosing the city boundaries or a larger territory closer to the urban functional area of the city deeply influences the findings.

42 . Friedmann divides the world into three parts: "core countries", "semi-periphery countries" and "periphery countries". World cities are only found in the core and semi-periphery countries. Thus a large portion of the globe is excluded in world city formation (and the world economy). In Friedmann's (1986) formulation, a two-tier system is proposed. All but two primary world cities are located in core countries. There exist three distinct subsystems: an Asian sub-system centred on the Tokyo-Singapore axis, an American subsystem based on the primary core cities of New York, Chicago and Los Angeles, and a West Europe sub-system focused on London, Paris and the Rhine Valley. Friedmann, J. (1986), The World Cities Hypothesis, Development and Change, Vol. 17, No. 1, pp. 69-84.

43 . http://www.hugginsassociates.com

Figure 27 – Ranking by GDP per capita in PPPs

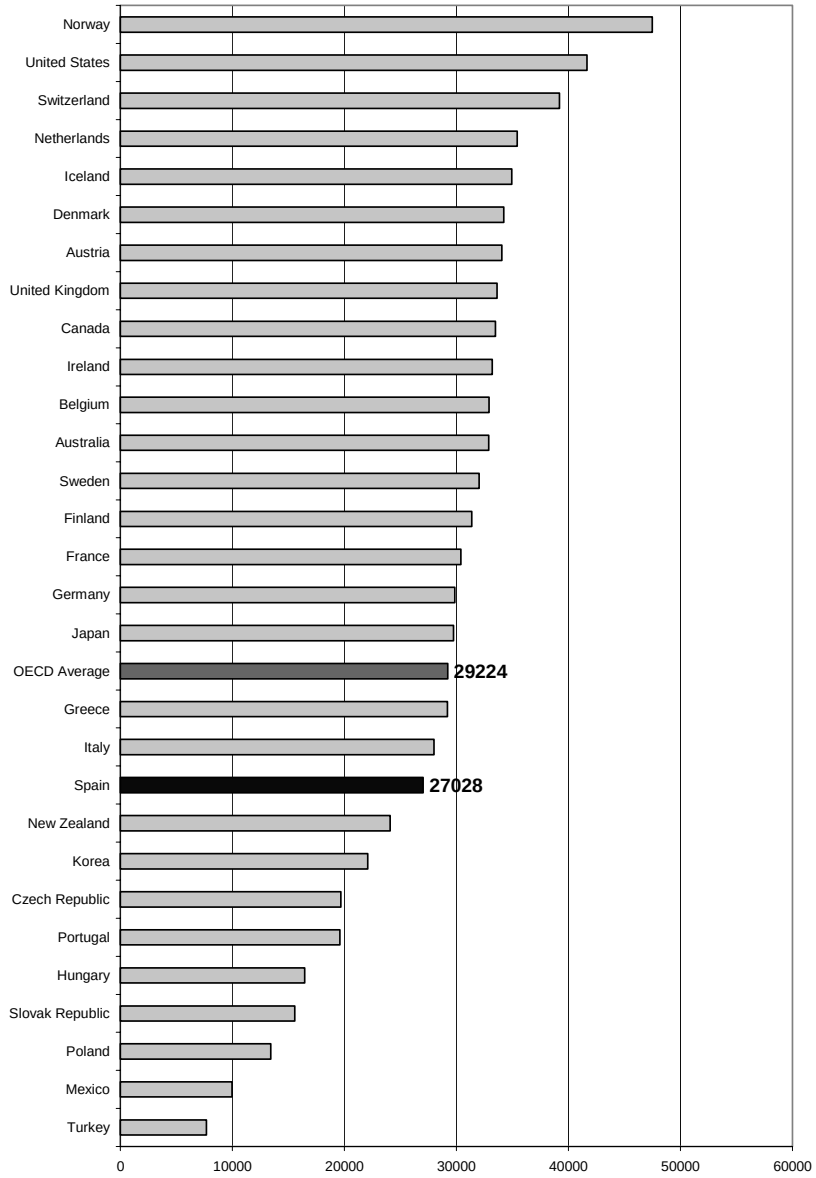
(Thousand USD)



Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

Figure 28 – GDP per capita in OECD member countries

USD, current prices and PPPs, 2005 or latest available year



Source: OECD Factbook 2006

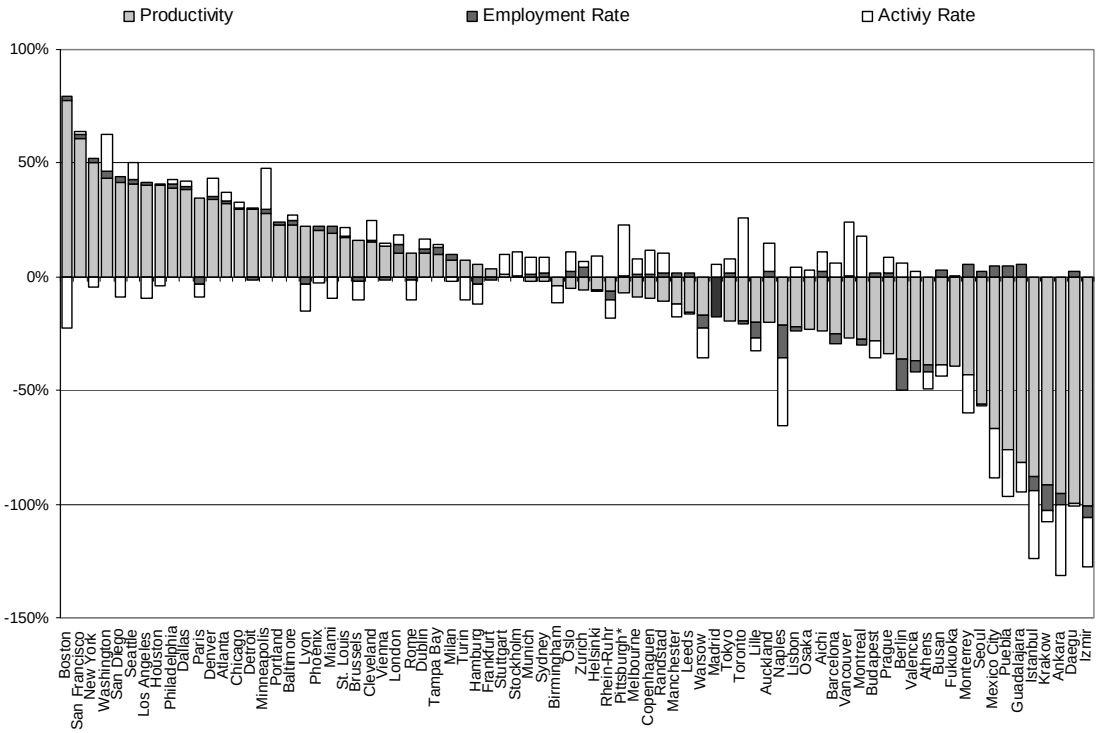
A main challenge for Madrid's competitiveness is to increase its labour productivity level. The latter explains a large part of Madrid's difference in GDP per capita versus the average of OECD metro-regions (Figure 29).[44] Labour productivity growth has been slightly positive on the last decade (on average, it grew by 1% from 1996-2005), and

44 . The OECD uses GDP per capita as one of the indicator of regional competitiveness.

then turned negatively (-0.2%) between 2002 and 2005 (INE – Spanish National Institute of Statistics, Regional Accounts). A common phenomenon in the country, as confirmed by the recent OECD Economic Survey of Spain pointed out (OECD Economic Survey 2006) and the last economic report produced by the Spanish Prime Minister Cabinet (*Informe Económico del Presidente del Gobierno*, 2007). The interpretation of such level of the indicator needs however to be mitigated by a number of factors that are possibly beneficial to future development. For instance, measures to increase the flexibility of the labour market have facilitated the entrance of unskilled workers into the labour market.[45] Moreover, the incorporation to the labour market of large numbers of workers (fundamentally the young and immigrants, who might have lower-than-average productivity) has contributed to a reduction in the overall labour productivity. It is also worth noting that successive regularisations of immigrants have pushed down productivity figures. The official surfacing of illegal immigrants has led to blips in productivity measurements, such as those between 1999 and 2000 as a consequence of the first wave of regularisation in 2000, when local productivity hit record lows (Figures 30 – 31). This can be attributed to the fact that their economic impact was, to a large extent, already included in economic accounts at a time when they were not officially accounted as workers.

45 . Another factor that is likely to explain Madrid labour productivity figures is that most new jobs have been created in the service sector, rather than in industry (industrial employment has contracted as a share of total employment). Productivity in the service sector tends to be lower than in industry, especially if services are not knowledge intensive, as is the case in Madrid, and measuring productivity in most non-market-oriented sectors is notoriously difficult.

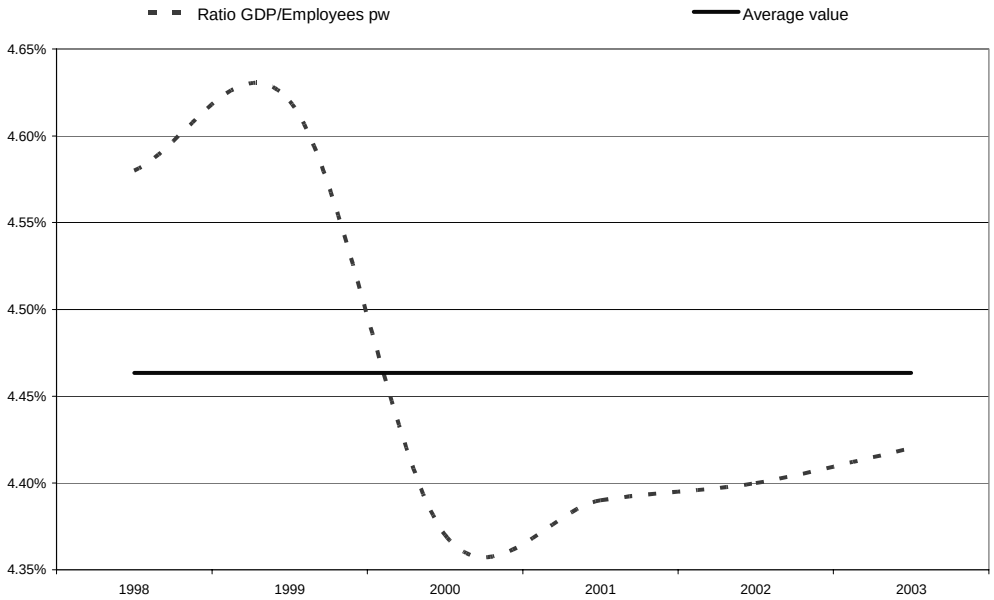
Figure 29 – Main explanations of GDP differentials between OECD metro-regions (2002)



Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

Figure 30 – Annual growth rate of labour productivity in the Madrid metro-region

(1998 – 2003)

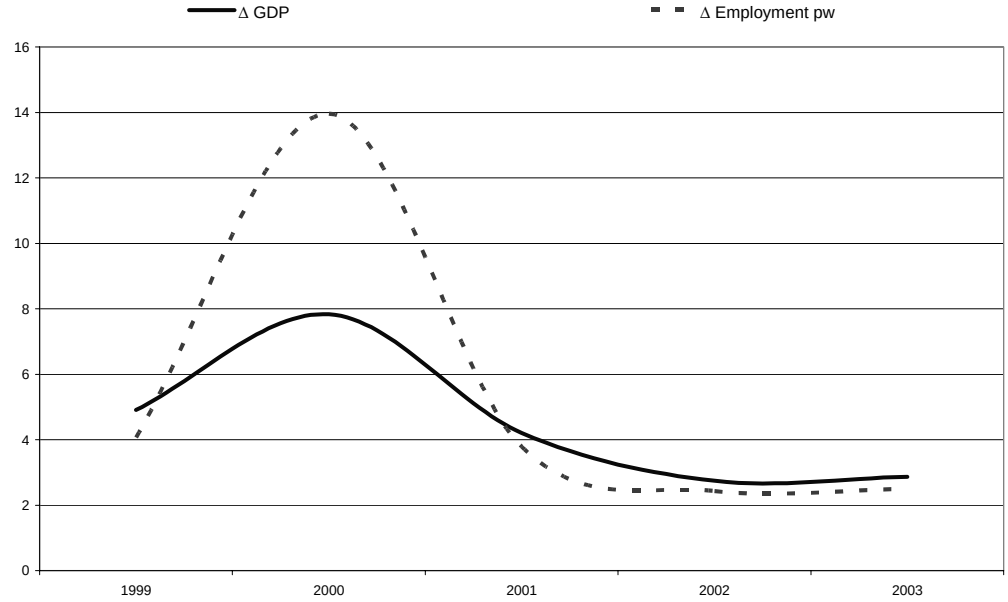


- The low average value is due to a fall in labour productivity between 1999 and 2000, when Spain implemented a large regularisation of illegal immigrants.

Source: OECD metropolitan database - Competitive Cities in the Global Economy, OECD, Paris, 2006

Figure 31 – Annual growth rate of GDP and employment* in the Madrid metro-region

(1999-2003 – %)

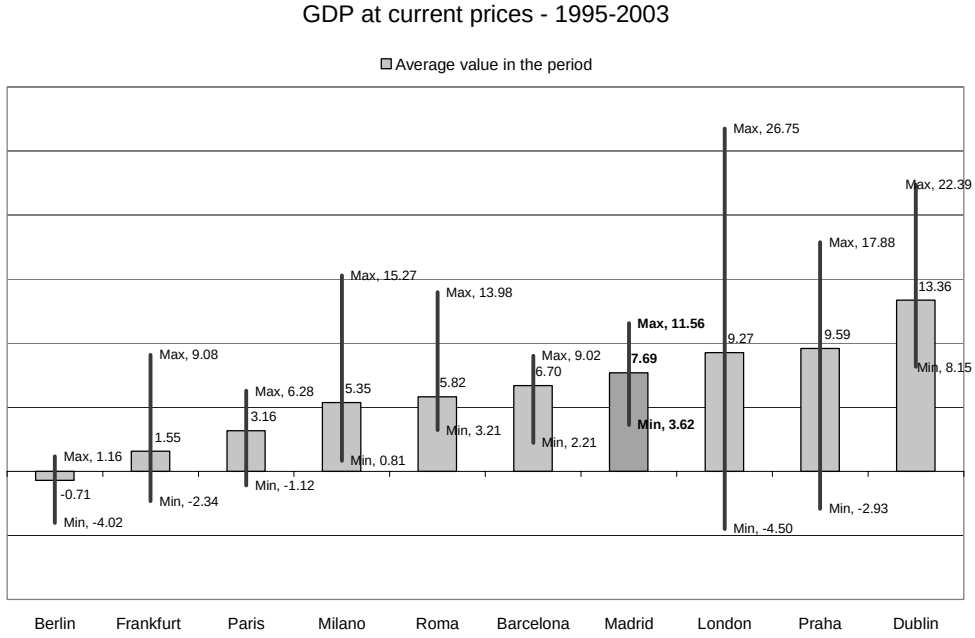


* Employees at their place of work

Source: OECD metropolitan database - Competitive Cities in the Global Economy, OECD, Paris, 2006

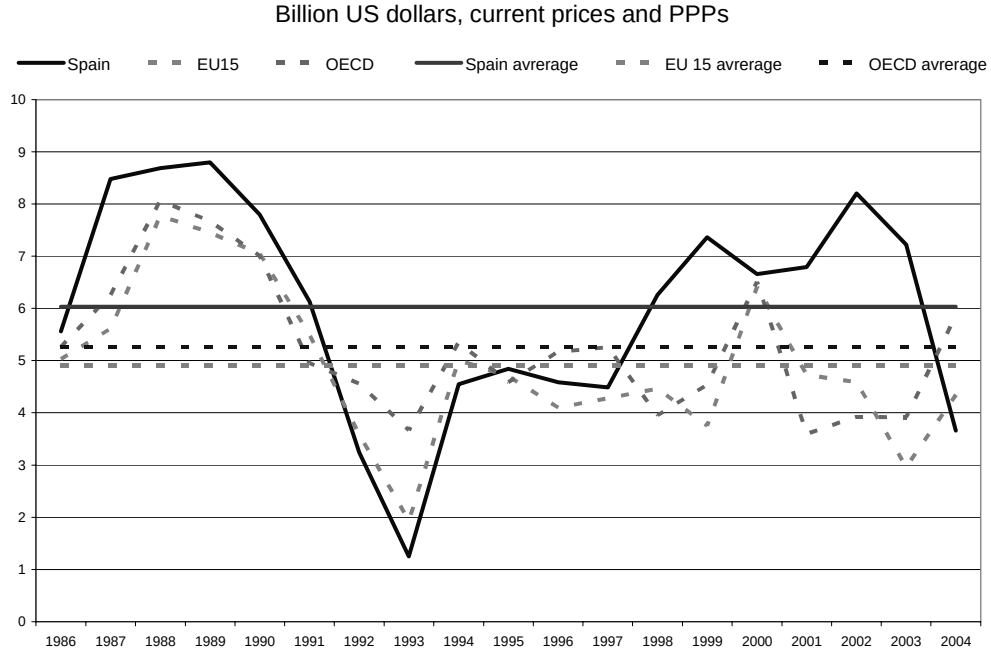
In terms of trends, Madrid has been one of the fastest growing metro-regions in Europe in terms of total GDP, with only Prague, Dublin, and London growing faster from 1995-2003 (Figure 32). Furthermore, when yearly trends are taken into account, Madrid shows consistent performances, demonstrating that the local development path is relatively stable. At the national level (which is an important reference since Madrid accounts for 17 % of Spain's economy) the performance is also positive. Spain has been growing faster than both the OECD and the European averages from 1986, when Spain joined the EU, through 2004. Specifically, since 1997, Spain's growth trend has ceased being correlated with that of the other countries, showing a completely different evolution (Figure 33). Actually, Madrid was one of the faster growing 78 OECD metro-regions in terms of GDP over 1995-2002 (it ranked 16th out of 45 metro-regions, well above the OECD average).

Figure 32 – Average, maximum and minimum yearly growth rate in selected European metropolitan regions



Source: Eurostat, Regional dataset (NUTS 3)

Figure 33 – GDP trend in Spain, EU 15, and OECD (1986 – 2004)



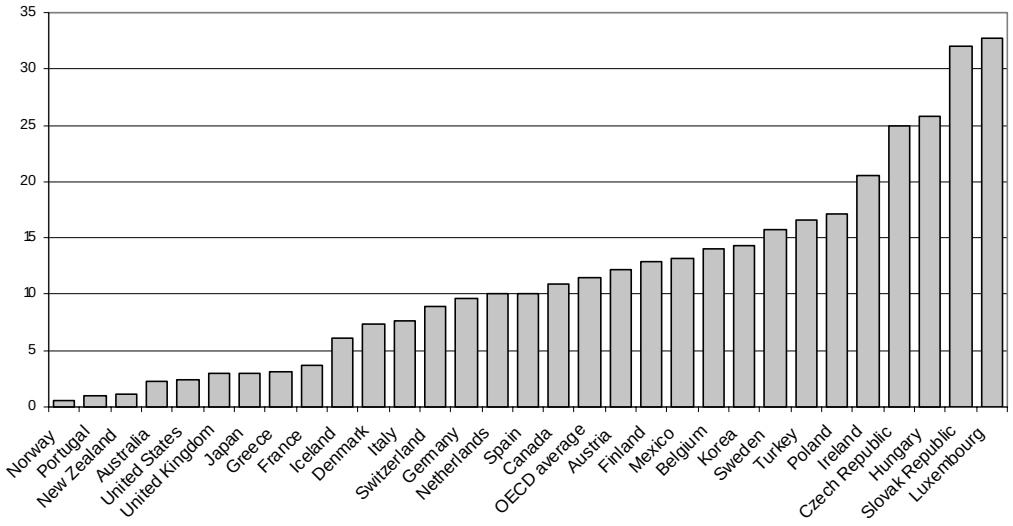
Source: OECD Factbook (2006), Eurostat

An important role in international trade

The Madrid metro-region processes the lion's share of Spain's international trade, acting as the national gateway. After a period of relative isolation, Spain has transformed into an important country with regards to international trade. Past statistics show Spain with trade as a share of GDP below the OECD average. In 2005 Spain was the best performer among the large European countries (in terms both of population and GDP) and, reaching 58% of GDP in 2005, slightly above the average of 51% for all OECD member countries (Figure 34).[46] The Madrid metro-region generated EUR16 billion of exports and EUR 52 billion of imports in 2005, roughly 10% and 22% respectively of the national total. The metro-region's commercial balance is negative with a deficit of nearly EUR 17 800 million (2005), 49.0% of the national deficit, and 5.8 points less than in 2004. It should be noted that these are potentially biased data given Madrid's role as the main administrative centre for Spanish international trade.

Figure 34 – Trade to GDP ratios

Difference between 2004 and 1991 ratios in percentage points



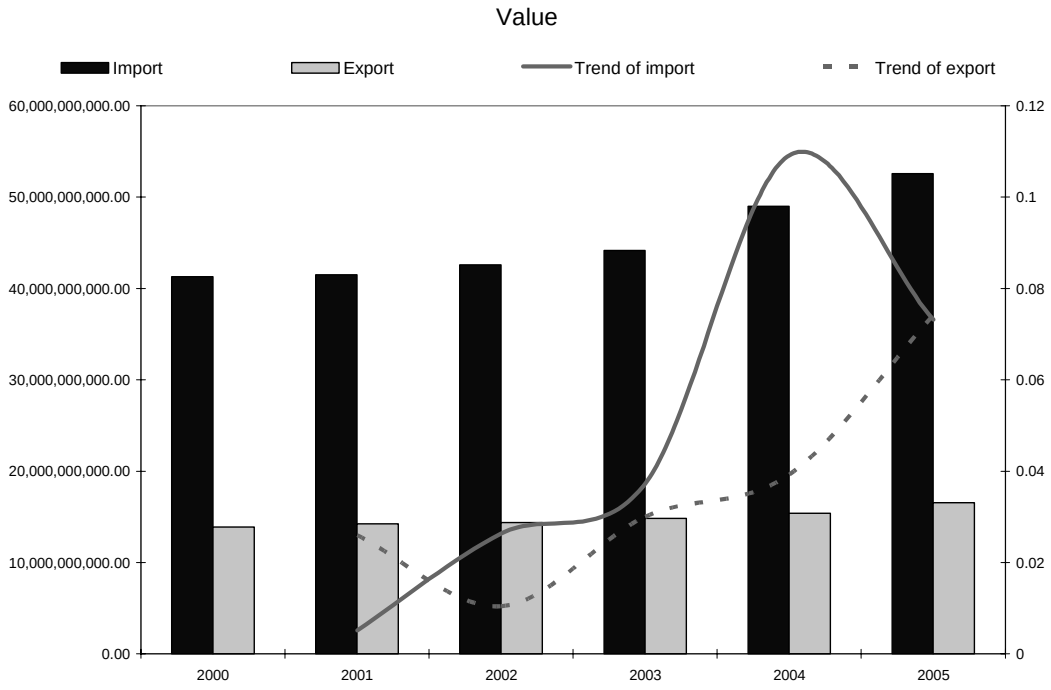
Source: OECD Factbook 2006

In term of trends, the evolution of trade over time is positive both in the case of imports and exports (fluctuating more in the case of imports due to the evolution of petrol prices and the Euro-Dollar exchange rate). Exports have increased by an average

46 . International trade tends to be more important for countries that are small (in terms of size or population) and surrounded by neighbouring countries with open trade regimes, than for large, relatively self-sufficient countries or those that are geographically isolated and thus penalised by high transport costs. Other factors also play a role and help explain differences in trade-to-GDP ratios across countries, such as history, culture, trade policy, the structure of the economy (especially the weight of non-tradable services in GDP), re-exports and the presence of multinational firms, which leads to more intra-firm trade.

of 3.6 % between 2000 and 2005 and imports by 5 % within the same period. The growth rate for exports from Madrid exceeds the rate for Spain as a whole, while imports fall short of this figure, increasing by only a third of the figure recorded for Spain (Figure 35). Although deficits in the commercial balance have been the norm in recent years, it is important to note that (*i*) international transactions have been continuously growing, making Madrid's economy more open, with some predictions of increasing export growth rates and decreasing import growth rates, and (*ii*) if we consider the Madrid metro-region as a "territory" trading with the "rest of the world" (Spain without Madrid, and the other nations) the sectoral decomposition of exports and imports indicates a positive balance in the service sector, particularly in whole retail, communication, and finance (Figure 36). In other words, Madrid imports capital goods and exports advanced services. Finally, Madrid's main commercial partners are EU countries (France, Portugal and Germany, in particular) and OECD member countries (USA and Mexico) (Figures 37 – 38).

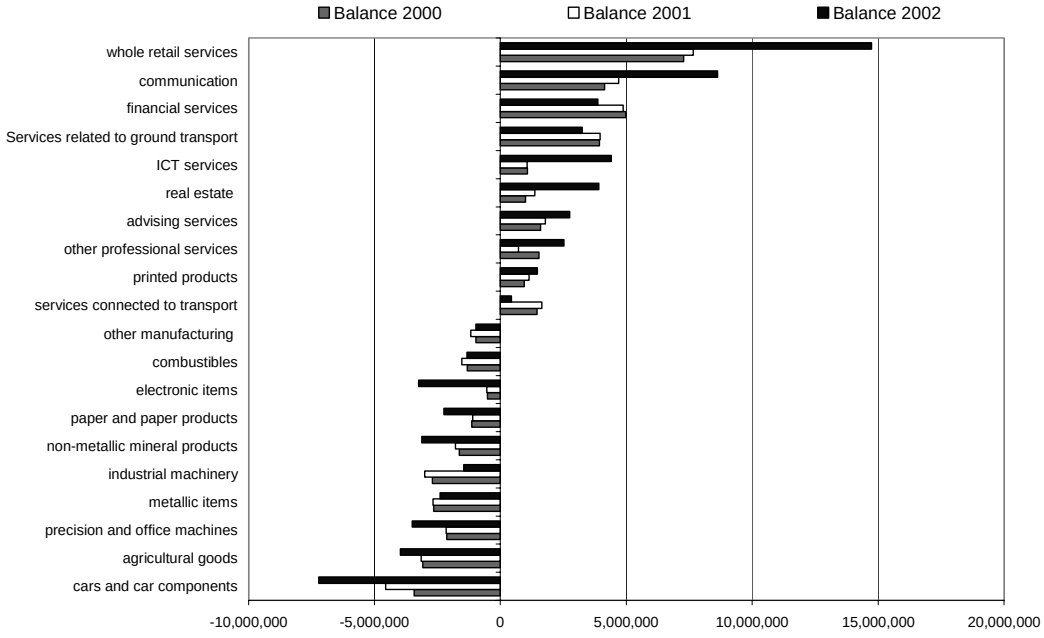
Figure 35 – Commercial balance of the Madrid metro-region



Source: Chamber of Commerce of Madrid

Figure 36 – Recent trends in trade in selected sectors of the Madrid metro-region

(2000 - 2003)

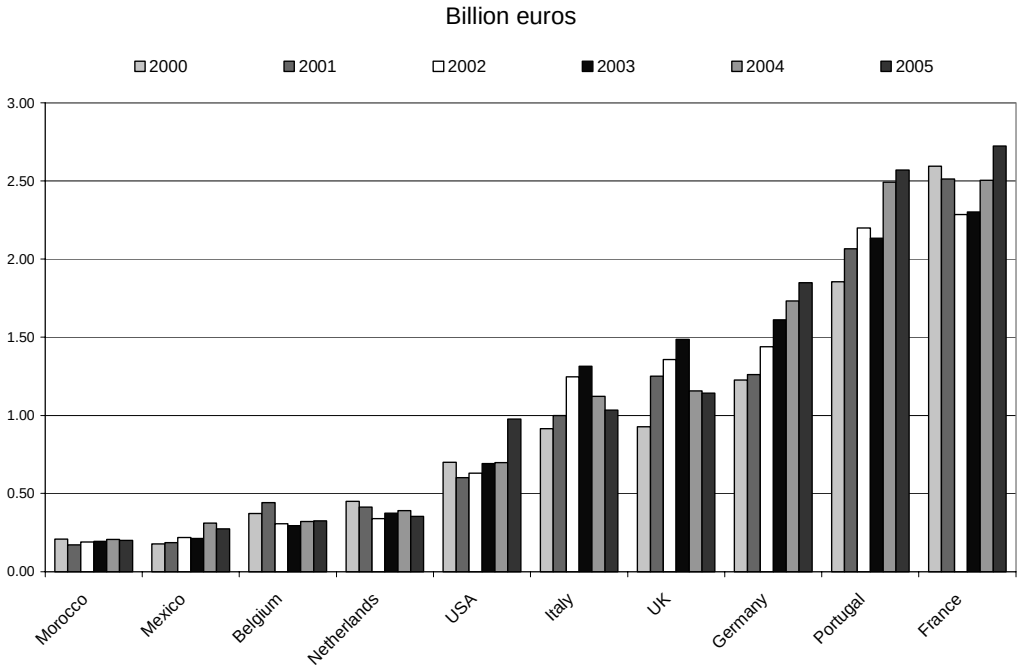


* The first ten sectors in import and the first ten sectors in export

** The Madrid metro-region here is considered as a nation

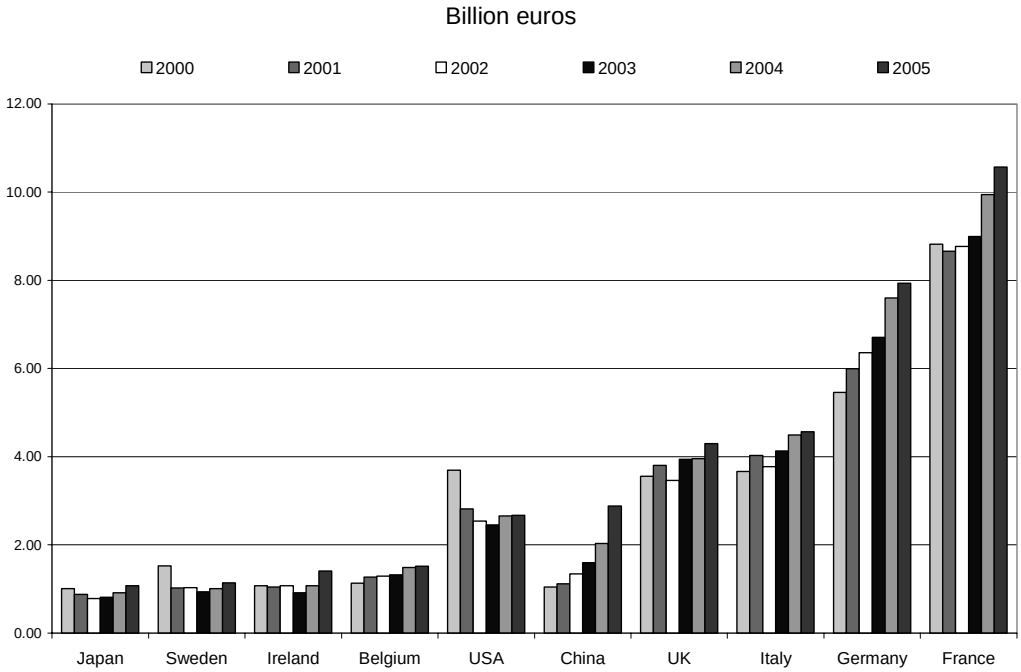
Source: Instituto de Estadística – Comunidad de Madrid (Statistics Office of the Community of Madrid – Elabouration of the Input-output matrix - 2002)

Figure 37 – Madrid's top ten commercial partners - Export



Source: Chamber of Commerce of Madrid

Figure 38 – Madrid's top ten commercial partners - Import



Source: Chamber of Commerce of Madrid

Madrid has an efficient endowment of transportation facilities within its trade hub offerings. The actual comparative advantage of Madrid in logistics is the consequence of: (*i*) major improvement over the last two decades in transportation infrastructure, which has translated into lower transport costs, and (*ii*) the relative availability of land, a scarce resource for many other competitors. Concerning the transportation infrastructure, all major Spanish railroad and road axes pass through Madrid. Furthermore the local Barajas airport is the main national hub and one of the most important airports in Europe. It ranked fifth in Europe in passenger traffic and with the new extension that opened in 2006 – which in effect doubled its size – will allow it to challenge Paris Charles de Gaulle and Frankfurt Main for second place in the foreseeable future (Table 8).[47] The airport, while clearly specialised in passenger traffic, has in recent years also started to focus greater attention on freight, making it the ninth largest airport for freight in 2004 in Europe. The overall competitiveness of Madrid in logistics will probably be further enhanced by the high capacity railroad axis connecting Madrid with Barcelona (under construction), contributing to connecting the Spanish capital to the Mediterranean more efficiently.[48] In addition, the Madrid metro-region also enjoys a privileged position at the international level. The enlargement of the European Union to Central and Eastern European countries opens new opportunities for international trade relationships from which Madrid may benefit, bearing in mind that these countries may also be potential competitors. Moreover, Spain and, in particular, Madrid, have been successful at exploiting the advantage of being considered as the gateway of Europe to emerging international markets in North Africa, Latin America and the Caribbean.

Table 8 – Top 20 EU airports in terms of total passengers and total freight carried in 2004

Passengers			Freight		
Airport	Thousand passengers	Growth rate 2003/2004	Airport	Thousand tons	Growth rate 2003/2004
London Heathrow	67 110	6.2	Frankfurt am Main	1 827.3	11.2
Paris Charles de Gaulle	50 951	6.1	Amsterdam Schipol	1 467.0	8.4
Frankfurt am Main	50 700	5.6	London Heathrow	1 412.0	8.6
Amsterdam Schipol	42 425	6.6	Paris Charles de Gaulle	1 275.8	6.9

47 . The operational launch of "Greater Barajas", in January 2006, has provided the airport with two new runways (18L/36R and 15L/33R) and two new terminals (T4 and a satellite building). With the opening of the expanded airport, it can handle a maximum of 70 million passengers per year. The number of passengers has doubled over the last fifteen years, rising to more than 40 million in 2005.

48 . This is the High Speed Line Madrid - Zaragoza - Lleida (to be extended to Barcelona and the French border). Although the line began operation in 2003 with a system allowing maximum speeds of 200 km/h, it will be able to reach 300 km/h with the introduction of the EMRTS Communications system. In any case, this new line, 55.4 km of which runs through the Community of Madrid, reduces journey times and increase travel options to Zaragoza and Lleida, providing 37 % more capacity than the "conventional line" to Zaragoza, and 238 % more to Lleida. GIF, the state rail infrastructure company, has budgeted EUR 32 million for this line for 2003 for signalling and communications work, and for the refurbishment of Atocha station.

Madrid Barajas	38 155	7.9	Brussels National	660.4	8.9
London Gatwick	31 392	5.0	Cologne-Bonn	621.9	17.3
Rome Fiumicino	27 160	6.6	Luxembourg	616.6	2.3
Munich	26 601	11.1	Milan Malpensa	360.6	13.3
Barcelona	24 354	8.3	**Madrid Barajas**	352.8	19.1
Paris Orly	24 049	7.1	East Midlands	277.2	16.8
Manchester	20 970	7.4	London Stanstead	239.0	17.9
London Stanstead	20 909	11.7	London Gatwick	226.9	-2.8
Palma de Majorca	20 363	6.5	Munich	192.4	17.8
Copenhagen	18 889	7.6	Vienna	158.1	24.5
Milan Malpensa	18 419	5.4	Manchester	153.3	21.9
Dublin	17 032	7.9	Rome Fiumicino	139.6	-14.8
Stockholm	16 467	7.7	Bergamo Orio la Serio	129.6	1.3
Brussels National	15 445	2.3	Helsinki Vantaa	118.0	33.9
Dusseldorf	15 092	6.8	Genoa Sestri	111.4	.
Vienna	14 711	15.7	Athens	104.1	-20.8

Source: Eurostat.

FDI activity and city attractiveness

The largest part of Spanish outward investments comes from Madrid and reflects the sectoral specialization of the metro-region's economy. Between 2000 and 2004, services have been the principal sector of Madrid's foreign investments, with banking and telecommunications making up 27% and 18% respectively. During the same period Madrid's outward FDI in the manufacturing sector has been concentrated in traditional activities, and medium and high technology sectors (26% of the total) (Figure 38). From a geographical perspective, Latin America continues to be the main recipient of Spanish FDI, despite decreasing importance over the last year.[49] The bulk of investment in Latin America is carried out in the banking and telecommunications sectors. Concerning the former, the two largest Madrid-based Spanish banks (Banco Santander Central Hispano, BSCH and Banco Bilbao Vizcaya Argentaria, BBVA) gained a major position in the Latin American market (Table 9).[50] Regarding telecommunications, by 1994, Telefónica de España had become the dominant telecommunications provider in South America, with major holdings in Argentina, Chile, Venezuela, and Peru (The Economist, 1995). Moreover, the company paid USD 142 million for a 79 % share of TLD (*Telefónica Larga Distancia*), the Puerto Rican long-distance operator, to get into the Spanish-speaking market in the United States (Baklanoff, 1996), Of course outward investment from Madrid is influenced by the national trend, given its role as the capital city. Spain was the 4th largest outward investor in the world in 2004, only behind the US, the UK and Luxembourg, and the 2nd largest in Latin America, only behind the US. Approximately two thirds of Spanish investments abroad – reaching 80% in 2005 –

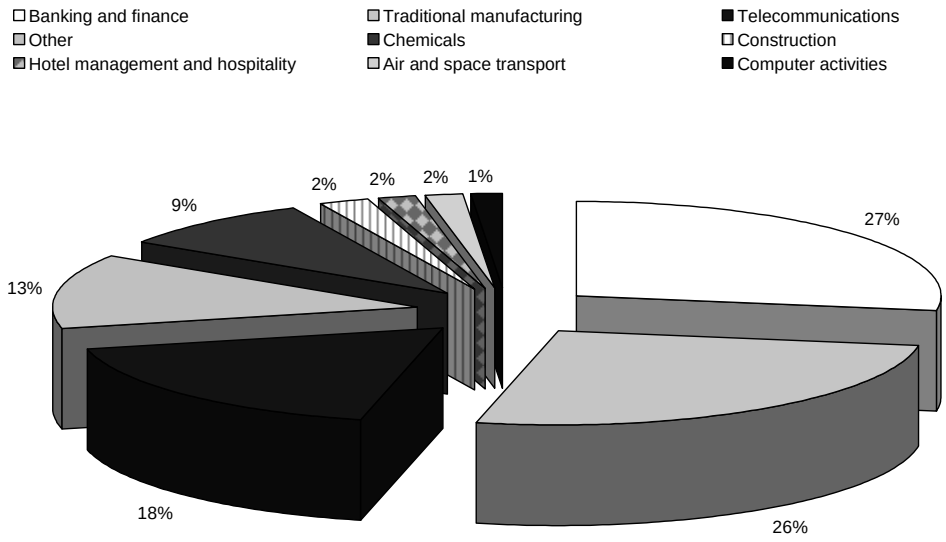
49 . In 1999 Spanish FDI to Latin America reached 4.9% of national GDP compared with the 1.8% to Europe. The wave of large Spanish investment in Latin America finished in 2001, mainly because of the Argentinean crisis.

50 . Banco Bilbao Vizcaya Argentaria's headquarter is still in Bilbao, while all the other functions have been moved to Madrid.

originated in the Madrid metropolitan region (Table 10).[51] Spanish outward foreign investment has soared since 1997, a development that reflects a variety of factors. First, with the deregulation of the Spanish economy in recent years, big companies, many of them previously state-owned companies, have adopted more market-oriented business strategies while seeking to benefit as much as possible from economies of scale. Second, the progress made in real convergence in recent years has narrowed the gap between the level of development in Spain and European standards, both regarding productivity and costs, so that in some ways the domestic market can be regarded as a mature market. Third, once a company is big enough, international expansion is a way of increasing the client base and diversifying risks (M. Sebastian and C. Hernansanz, 2000).

Figure 39 – Sectoral distribution of Spain's outward FDI

(Average 2000- 2004)



Source: Minister of Trade, Spain

Table 9 – Largest foreign banks in Latin America by consolidated assets - First half of 2003

Millions of dollars

Rank in 2003	Rank in 1999	Bank	Country of origin	Assets	Main subsidiaries in*
1	1	**BSCH**	**Spain**	62 894	Brazil, Chile, Mexico, Argentina,

51 . It is worth noting that the percentage of national FDI in Madrid is positively influenced by the fact that the Spanish capital is home to the headquarters of many foreign companies with activities in Spain.

2	3	**BBVA**	**Spain**	61 019	Venezuela Mexico, Argentina, Chile, Peru, Venezuela, Colombia, Panama, Uruguay
3	2	City Bank	USA	59 463	Mexico, Brazil, Argentina, Chile, Colombia, Peru, Venezuela, Uruguay, Paraguay
4	5	ABN Amro Bank	Netherlands	16 174	Brazil, Chile, Argentina. Colombia, Paraguay
5	4	FleetBoston Financial Corp.	USA	13 754	Brazil Argentina, Chile, Uruguay, Mexico, Panama, Peru
6	6	HSBC	UK	12 203	Brazil, Argentina, Panama, Chile, Mexico, Chile,
7	10	Scotiabank	Canada	11 455	Panama, El Salvador, Dominican Republic
8	11	Sudameris	France	5 337	Peru, Argentina, Panama, Colombia
9	**	J.P. Morgan Chase	USA	4 476	Brazil, Mexico, Chile
10	7	Lloyds TSB Group	UK	3 761	Brazil, Argentina, Colombia
		Total		250 537	

* Figures include subsidiaries with assets in excess of US$ 250 million. The countries are ordered according to the assets of their respective subsidiaries.

** In 1999, JP Morgan and Chase Manhattan had not yet merged, so it is impossible to compare the position of the joint enterprise in 2003 with the ranking of the two banks when independent. In 1999, JP Morgan was ranked 21st, while Chase Manhattan was in ninth place.

Source: Foreign investment in Latin America and the Caribbean, ECLAC, United Nations 2004

Table 10 – FDI in the Madrid metro-region and in Spain

Millions of euros

		2002	2003	2004	% 04/03
Madrid metro-region					
	Outflow	15 586	10 795	23 708	120

	Inflow	5 750	6 188	4 475	- 28
	Balance	- 9 836.00	- 4 475.00	- 19 233.00	317.50
Spain					
	Outflow	25 202	18 344	35 406	93
	Inflow	11 428	9 915	11 129	12
	Balance	-13 744.00	- 8 429.00	- 24 277.00	188.00
Madrid metro-region/Spain (%)					
	Outflow	61.8	58.8	67	
	Inflow	50.3	62.4	40.2	
	Balance	71.4	54.7	79.2	

Source: Ministry of Trade, Spain

Madrid concentrates the bulk of inward foreign investment in Spain as well. The metro-region attracted 54% of all foreign direct investment (FDI) coming into Spain in 2005, with percentages that have hovered between 50 and 62% of the total since the turn of the century, with the only exception being in 2004 when it fell to 40 %.[52] The size of this share becomes more relevant when seen in the context that Spain has been the 6th largest recipient of FDI among OECD countries and a selection of emerging countries and the 5th largest in Europe, between 2002 and 2004 (Figure 40). The main investors in Spain are France, the US, the UK and Germany which together account for 60% of the stock held. FDI is fundamentally concentrated in a few sectors: manufacturing, commerce, chemicals, finance and transport and communications which account for the 61% of investment stock (Figure 41). From a purely regional perspective, inward FDI in Spain is mainly concentrated in two regions: Madrid and Catalonia. Since the early 1990s, Madrid's increases have been eroding the share of other regions as it attempts to emerge as the major FDI pole for Spain (Table 11), attracting more than 50% of the total FDI coming into Spain since the turn of the century.

Table 11 Distribution of inward FDI in Spanish regions (1985-2002)

(% of the total)

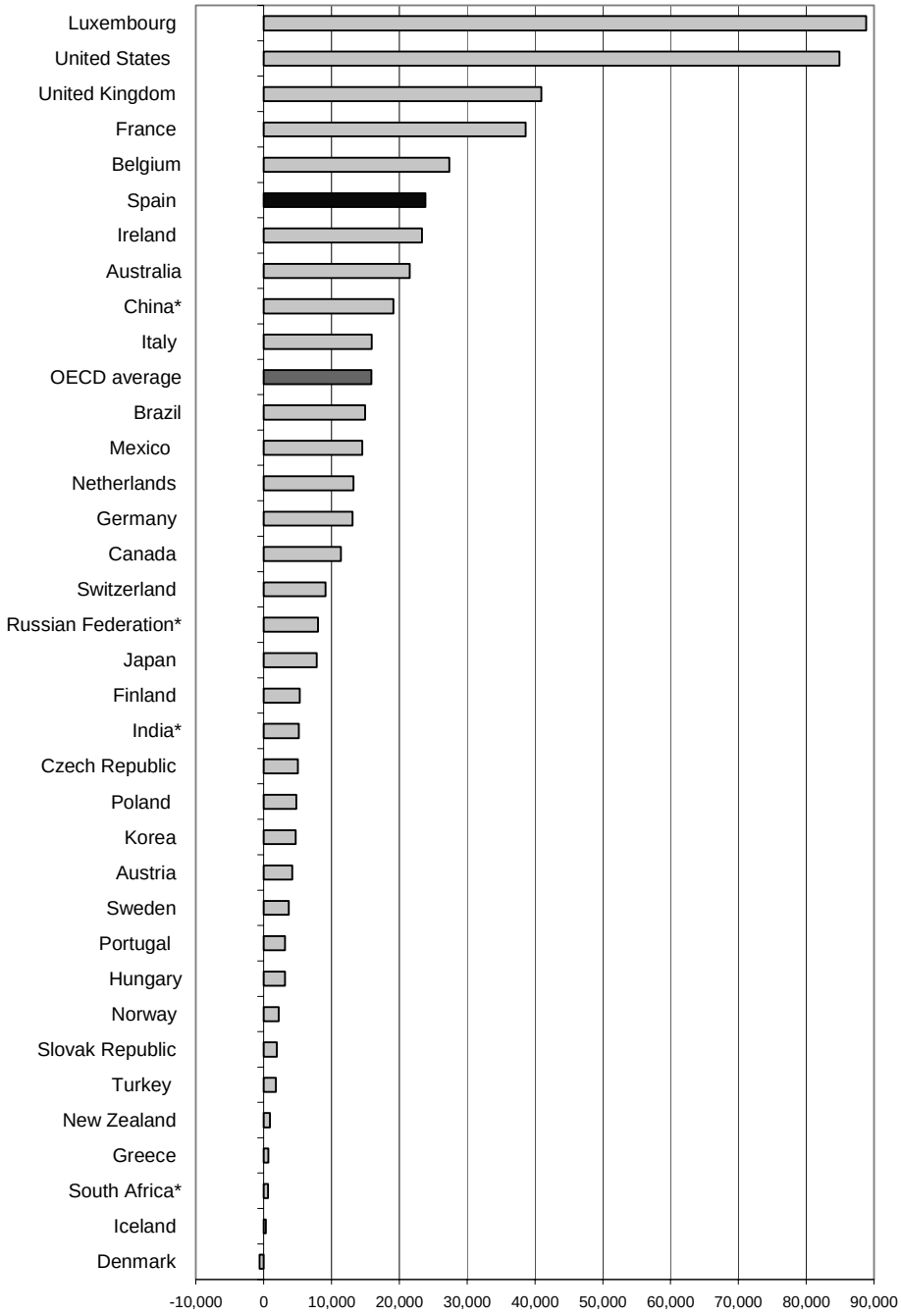
	1985-1992	1993-1999	2000-2002
Madrid	44	54	67
Catalonia	30	25	21
Andalusia	8	3	4
Basque Country	3	5	3
C. of Valencia	3	2	2
Rest	12	11	3

Source: Raquel Diaz Cazquez (2004), Inversion extranjera directa y convergencia regional, Working paper, University of Vigo.

52 . The low trend on 2004 is probably due to the terrorist attacks to commuter trains that left more than 190 people dead.

Figure 40 – Inflows of foreign direct investment in OECD countries and a selection of non-OECD countries

Millions of USD, average 2002-2004

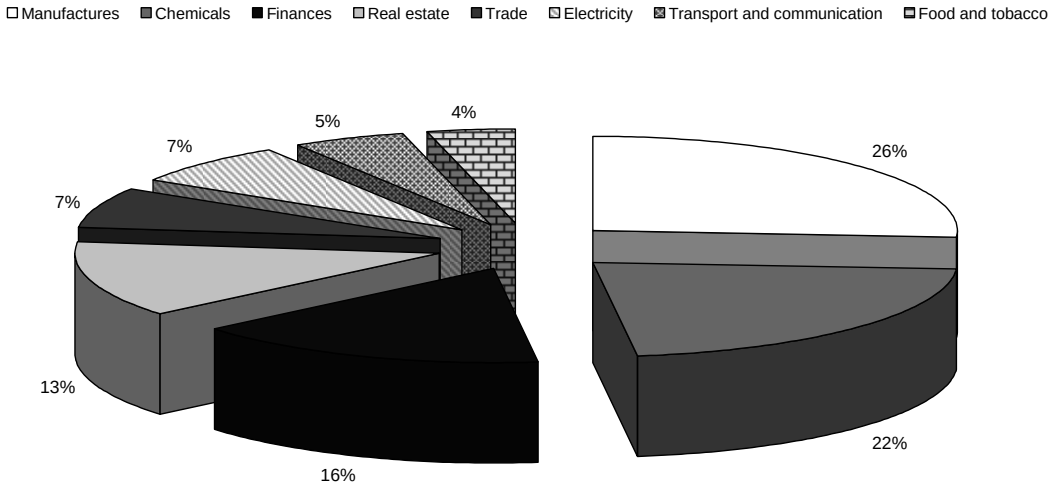


* These countries are not members of the OECD

Source: OECD, Factbook (2006)

Figure 41 – Sectoral distribution of inward FDI in Spain

2004



Source: Foreign Investment Registry, Spain

The importance of inward FDI in the economic structure of Madrid is relevant. In 2002, FDI in Madrid accounted for the 22.14% of its GDP while the Spanish regional average was 5.15%. According to a survey conducted by Cushman & Wakefield in 2005, European firms consider Madrid the seventh best location to make investments in Europe (Table 12). This represents an improvement of ten positions in fifteen years, making it the first investment location outside the thick urban network of Central Europe. This positive trend is also confirmed by the increasing attraction of foreign greenfield investment[53] – according to the *European Investment Monitor*, Madrid gained two positions – rising from 10^{th} to 8^{th} – in the ranking of European regions based on the number of greenfield FDIs between 2001 and 2002 (Table 13). There are several factors behind Madrid's ability to attract inward investments.

- First, with more than 6 million inhabitants (2006) Madrid is the larger consumer market in Spain.

- Second, Madrid offers a modern and extensive network of transport and communication infrastructure (Madrid obtained the highest mark in this category when competing with London, Paris, New York and Moscow to organize the Olympic Games in 2012). The radial shape of the national transport

53 . Greenfield investments include real creation of new investments, co-locations and expansions of existing foreign investments and therefore exclude other forms of FDI such as mergers and acquisitions, joint ventures and/or license agreements.

infrastructure (roads and railroads) makes Madrid a primary logistic platform in Spain. Telecommunications infrastructure improvements (5 000 km of fiberoptic cable and 76% of enterprises have broadband access compared to 65% of the European average) place Madrid 11th in the ranking of telecommunications quality of the *European Cities Monitor 2005* (20th position in 2002).[54]

- Third, Madrid has a well-qualified and relatively inexpensive labour force. The Madrid metro-region ranks 8th among the 78 OECD metro-regions for the share of the population of 15 years and more with a tertiary education (Figure 42). This makes Madrid 2nd in Europe only after London, and preceding cities such as New York, Paris, Berlin, and Rome. Moreover, labour costs in Spain are lower than the European average (Figure 43). In contrast to the overall Spanish trend, in 2006 Madrid witnessed a reduction in the increase of labour costs, contributing to price stability. Moreover, the expected reduction in the corporate income tax from 35% to 25% will position Spain among the European countries with lowest corporate taxes. Finally, the cost of living in Madrid is relatively low compared than other metropolitan regions (Table 14).

- Last, Madrid has an abundant supply of office and commercial space. The large supply of commercial space is helping to keep office and commercial space prices low. For instance office rent prices are lower than in other metropolitan regions (Table 15). Moreover, Madrid provides economic operators with congress spaces and exhibition centres which place the Spanish capital city among the top 10 worldwide places for international conference destinations according to ICCA (International Congress and Convention Association) during the last ten years.[55]

Table 12 – Location preferences of investors, 1990-2005

Cities	Rank			Weighted score
	1990	2004	2005	2005
London	1	1	1	0.87
Paris	2	2	2	0.60
Frankfurt	3	3	3	0.33
Brussels	4	4	4	0.30
Barcelona	11	6	5	0.28
Amsterdam	5	5	6	0.24
Madrid	**17**	**7**	**7**	**0.24**
Berlin	15	9	8	0.19
Munich	12	8	9	0.18
Zurich	7	10	10	0.18
Milan	9	11	11	0.15
Dublin	-	12	12	0.14
Prague	23	13	13	0.14
Lisbon	16	16	14	0.12
Manchester	13	14	15	0.12
Düsseldorf	6	18	16	0.10

54 . http://www.fco.gov.uk/Files/kfile/European_Cities_Monitor_2005_FINAL.pdf

55 . http://www.iccaworld.com.

Stockholm	19	15	17	0.10
Geneva	8	17	18	0.10
Hamburg	14	19	19	0.09
Warsaw	25	20	20	0.09
Budapest	21	23	21	0.09
Glasgow	10	24	22	0.08
Vienna	20	22	23	0.07
Lyon	18	21	24	0.07
Copenhagen	-	26	25	0.06
Rome	-	25	26	0.05
Helsinki	-	28	27	0.04
Moscow	24	27	28	0.03
Oslo	-	30	29	0.03
Athens	22	29	30	0.03

* Base: 501.

** In 1990, only 25 cities were included in the survey.

Source: Cushman & Wakefield (2005).

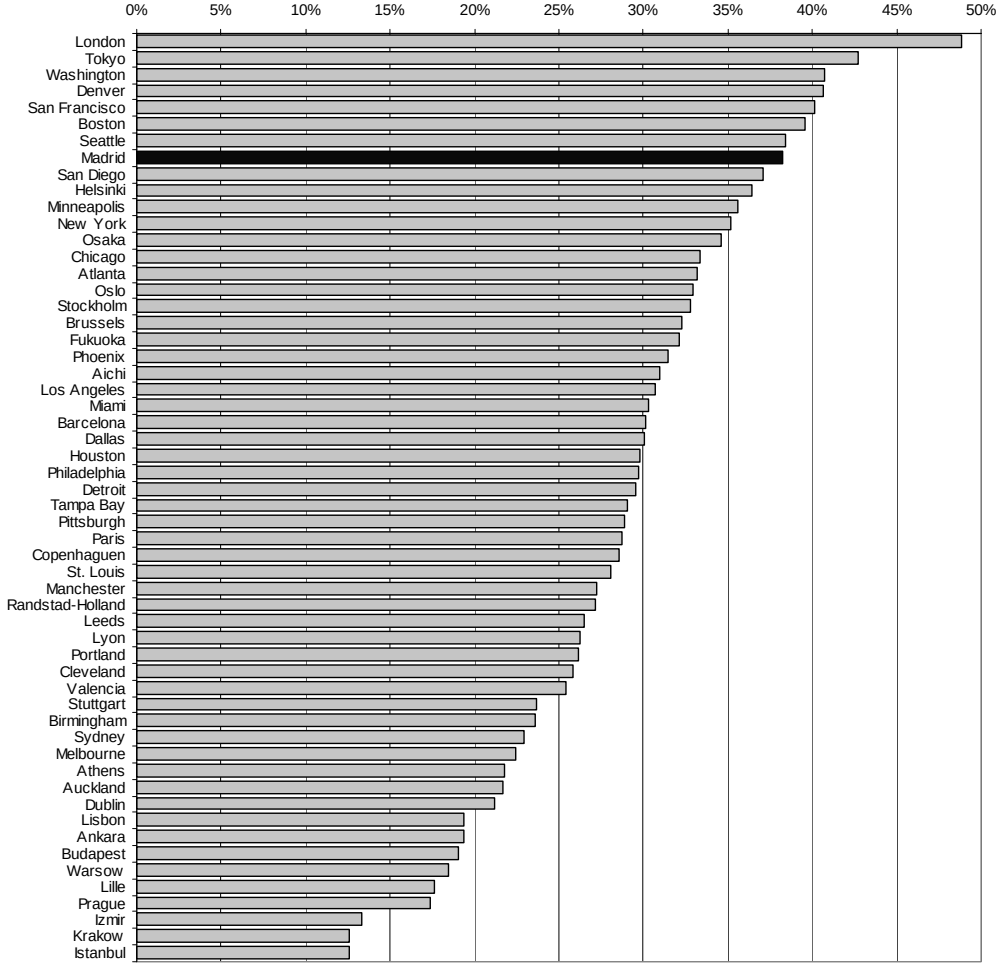
Table 13 European regional ranking based on the number of greenfield foreign investment projects

	Projects 2002	Rank 2002	Projects 2001	Rank 2001	Rank change
Greater London	125	1	94	1	=
Paris	64	2	61	3	+1
Catalonia	61	3	86	2	-1
Rhone-Alpes	41	4	19	21	+17
Stockholm	36	5	56	4	-1
Moscow	36	6	32	5	-1
Provence-Alpes cote d'Azur	31	7	26	11	+4
Madrid	29	8	29	10	+2
Budapest	27	9	23	15	+6
North Holland	26	10	24	13	+3
Severocesky	26	11	13	32	+22
Bavaria	2	12	30	7	-5
Antwerpen	22	13	20	18	+5
Hessen	22	14	32	5	-8
Alsace	20	15	30	7	-8
Istanbul	20	16	6	78	+63
Lithuania	20	17	17	24	+9
Berlin	19	18	15	29	+11
Vienna	19	19	24	13	-5
Bucharest	18	20	12	37	+17

Source: European Investment Monitor

Figure 43. Share of population of 15 years and more with tertiary education

Sample of 56 metro-regions (2004)

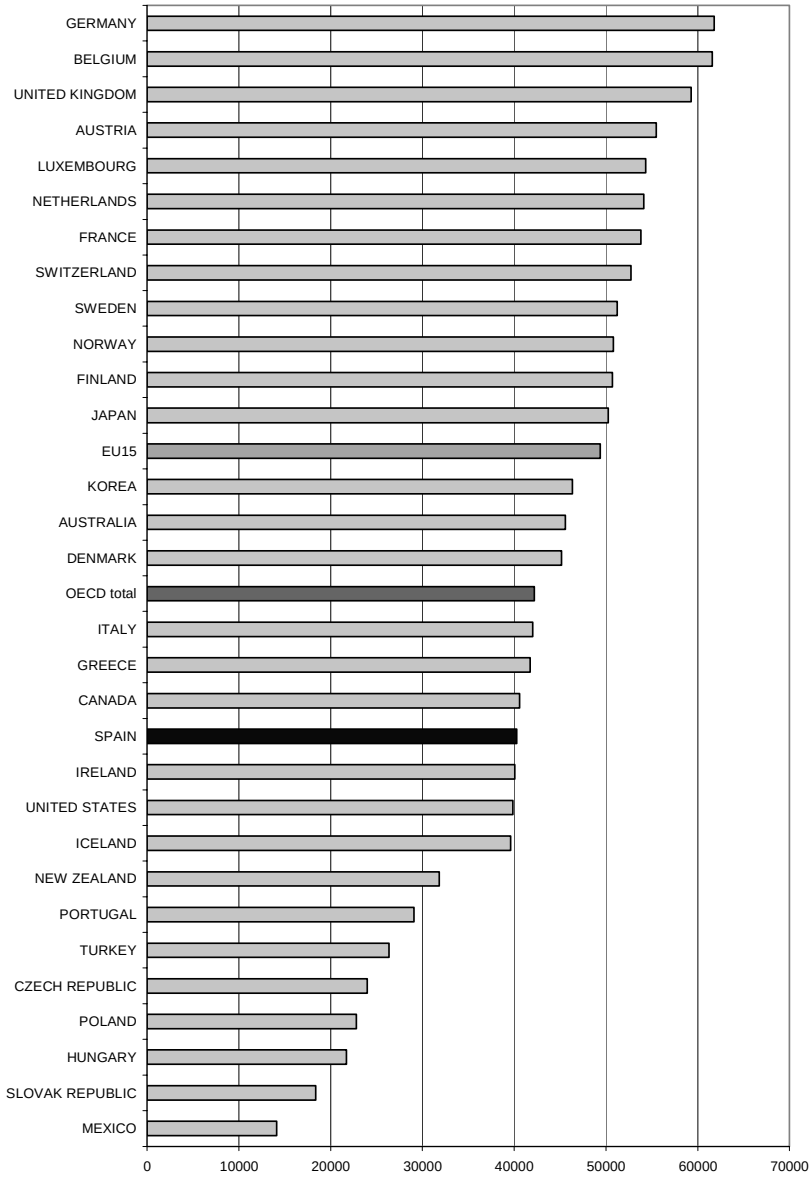


* OECD average refers to the average of OECD metro-regions

Source: Competitive Cities in the Global Economy, OECD, Paris, 2006

Figure 44 – Annual gross labour costs before taxes, in 2005

(US dollars using PPP exchange rates)



Source: OECD Taxing wages database

Table 14. Cost of living in selected European capitals

New York = 100

City	Index, 2004
London	119
Dublin	96.9
Oslo	96.2

Paris	94.8
Rome	90.5
Amsterdam	88.1
Berlin	85.7
Madrid	79.6

Source: Mercer Human Resource Consulting

Table 15. Office rent prices, 2005

Euro/square meter

Place	Price
London (West End)	1 593
London (City)	1 062
Paris	799
Dublin	724
Milan	544
Frankfurt	567
Madrid	472

Source: Global Markets Rents

Madrid's industrial mix

Sectoral composition of the local economy

The Madrid metro-region has become a large service hub while reducing its specialisation in manufacturing. The service sector, which includes a fair share of knowledge intensive activities, alone generated 77% of the regional gross value added (GVA) and employed 78% of the total workforce in 2005. In the same year, the percentage of GVA contributed by manufacturing and construction was 11% and 10% respectively.[56] This specialisation has been increasing slightly over time. Between 2000 and 2004, the service sector and especially the construction sector have been increasing their importance both in terms of employment and contribution to the regional GVA, while manufacturing experienced a loss of more than 16 000 jobs (INE, Spanish National Institute of Statistics).

Although deindustrialisation is a common issue among many OECD metro-regions, in Madrid the decline of manufacturing is concentrated in high-tech activities, while medium-high and medium-low tech activities show a certain degree of dynamism. Between 2000 and 2005, high-technology manufacturing's contribution to the regional GVA has been falling from EUR 2 208 to 1 927 millions, reducing its total contribution from 2.2% to 1.3% (the negative trend is due particularly to the decline of electronics). [57]

56 . Gross value added is the difference between output and intermediate consumption for any given sector/industry. That is the difference between the value of goods and services produced and the cost of raw materials and other inputs which are used up in production.

57 . The most stunning example of the decline of high-tech manufacturing within the Madrid metro-region is that of the electronics sector, which used to be important in Madrid. The sector was characterized by the presence of several small and medium sized spinoff firms that had relatively intense interactions with larger enterprises, specifically the case in Madrid with the

Over the same period, medium-high technology manufacturing has been increasing its contribution to regional GVA from EUR 4 404 to 5 363 millions, yet it has reduced its share from 4.4% to 3.7%. Conversely, knowledge intensive services have been increasing their contribution to the regional GVA from EUR 36 000 to 52 608 millions, thus increasing their percentage from 35.8% to 36.6% of the total (Tables 16-17)

Table 16 – Contribution to the regional GAV - Sectoral decomposition according to the level of technology

Thousand of euros - Current prices base 2000

Technology/Industry	2000	2001	2002	2003	2004	2005
KNOWLEDGE INTENSIVE	**42.615.092**	**47.083.766**	**50.325.222**	**53.036.837**	**56.204.526**	**59.900.028**
Manufactures High Technology	**2.208.731**	**2.219.868**	**1.841.844**	**1.818.054**	**1.867.309**	**1.927.131**
DL Office, accounting and computing machinery	2.208.731	2.219.868	1.841.844	1.818.054	1.867.309	1.927.131
Manufactures Medium-High Technology	**4.404.749**	**4.697.612**	**4.810.909**	**5.060.304**	**5.197.399**	**5.363.905**
DG Chemicals	1.853.350	2.091.597	1.953.297	2.073.309	2.129.480	2.197.700
DK Machinery and equipment	790.311	872.104	1.034.846	1.041.926	1.070.154	1.104.438
DM Motor vehicles	1.761.088	1.733.911	1.822.766	1.945.069	1.997.765	2.061.766
Knowledge intensive Services	**36.001.612**	**40.166.286**	**43.672.469**	**46.158.479**	**49.139.818**	**52.608.992**
II Transport and communications	10.963.804	11.811.541	12.799.683	13.606.556	14.485.392	15.508.033
JJ Finance and insurance	6.788.740	8.092.114	8.642.761	8.756.149	9.321.702	9.979.795
KK Business services	10.282.209	11.575.331	12.943.297	13.540.236	14.414.789	15.432.444
MM Education	3.859.373	4.295.583	4.586.163	4.927.241	5.245.488	5.615.809
NN Health	4.107.486	4.391.717	4.700.565	5.328.297	5.672.447	6.072.911
NON-KNOWLEDGE INTENSIVE	**58.055.342**	**62.591.085**	**67.237.807**	**72.046.916**	**77.195.977**	**83.709.067**
Manufactures Medium-Low Technology	**2.718.981**	**2.823.198**	**3.116.794**	**3.157.597**	**3.242.226**	**3.353.686**
CA+CB+DF Extractives	157.723	171.088	206.509	213.403	218.267	232.851
DH Rubber and plastics products	432.217	463.365	509.138	481.148	494.183	510.015
DI Other non-metallic mineral products	643.157	677.199	679.018	722.490	742.064	765.837
DJ Basic metals and fabricated metal products	1.485.884	1.511.546	1.722.129	1.740.556	1.787.712	1.844.983
Manufactures Low Technology	**5.025.314**	**5.260.899**	**5.398.428**	**5.509.421**	**5.658.684**	**5.839.967**
DA Food products, beverages and tobacco	1.046.775	1.114.971	1.234.416	1.232.733	1.266.131	1.306.693
DB+DC Textiles, textile products, leather and footwear	531.645	550.535	511.211	500.785	514.352	530.830
DD Wood	147.468	160.307	150.991	160.789	165.145	170.436
DE Pulp, paper, paper products, printing and publishing	2.720.960	2.793.498	2.919.809	2.981.090	3.061.855	3.159.945
DN Manufacturing, n.e.c.; Recycling	578.466	641.588	582.001	634.024	651.201	672.063
Non-Knowledge intensive Services	**40.829.425**	**43.818.676**	**46.782.516**	**49.759.320**	**52.973.234**	**56.713.041**
GG Retail and repair	11.607.694	12.572.017	13.025.036	13.669.015	14.551.886	15.579.220

telecommunication sector. At some point in time during the 1980s, this dense network of subcontracting and outsourcing relations even seemed to have stimulated a modest Research and Development effort in the sector that was concentrated within the central territorial economy of Madrid (See Suarez Villa and Ruth Rama, 1996). However, its limited competitiveness, and lack of tradition in international markets, combined with the increasing exposure to foreign rival firms, all lead to a dramatic downsizing and reduction of employment.

HH Hotels and restaurants	6.765.918	7.177.369	7.611.547	8.107.753	8.631.426	9.240.788
KK Real state	9.621.561	10.440.931	11.665.294	12.817.918	13.645.817	14.609.185
LL Administration, defence and s.sec.	7.085.147	7.513.897	7.832.273	8.128.783	8.653.815	9.264.757
OO Other services	4.229.086	4.541.285	4.984.296	5.271.280	5.611.748	6.007.926
PP Private households with employment persons	1.520.019	1.573.177	1.664.070	1.764.571	1.878.543	2.011.165
Other activities	**9.481.622**	**10.688.312**	**11.940.069**	**13.620.578**	**15.321.832**	**17.802.373**
AA+BB Agriculture, hunting and Forestry. Fishing	285.702	258.670	288.839	294.151	288.422	305.891
EE Electricity, gas and water supply	1.815.640	1.960.421	1.972.650	2.258.191	2.309.664	2.463.991
FF Construction	7.380.280	8.469.221	9.678.580	11.068.236	12.723.746	15.032.491
TOTAL	**100.670.434**	**109.674.851**	**117.563.029**	**125.083.753**	**133.400.503**	**143.609.095**

Note: Data for 2004 and 2005 has been partially estimated due to the absence of information in some sub-sectors

Source: INE (Spanish National Institute of Statistics). Data arranged according to the methodology proposed by OECD/STI in 2003 (OECD Science, Technology and Industry Scoreboard 2003)

Table 17 Contribution to regional employment - Sectoral decomposition according to the level of technology

Percentage on the total employment

Technology/Industry	2000	2001	2002	2003	2004	2005
KNOWLEDGE INTENSIVE	**42,3%**	**42,9%**	**42,8%**	**42,4%**	**42,1%**	**41,7%**
Manufactures High Technology	**2,2%**	**2,0%**	**1,6%**	**1,5%**	**1,4%**	**1,3%**
DL Office, accounting and computing machinery	2,2%	2,0%	1,6%	1,5%	1,4%	1,3%
Manufactures Medium-High Technology	**4,4%**	**4,3%**	**4,1%**	**4,0%**	**3,9%**	**3,7%**
DG Chemicals	1,8%	1,9%	1,7%	1,7%	1,6%	1,5%
DK Machinery and equipment	0,8%	0,8%	0,9%	0,8%	0,8%	0,8%
DM Motor vehicles	1,7%	1,6%	1,6%	1,6%	1,5%	1,4%
Knowledge intensive Services	**35,8%**	**36,6%**	**37,1%**	**36,9%**	**36,8%**	**36,6%**
II Transport and communications	10,9%	10,8%	10,9%	10,9%	10,9%	10,8%
JJ Finance and insurance	6,7%	7,4%	7,4%	7,0%	7,0%	6,9%
KK Business services	10,2%	10,6%	11,0%	10,8%	10,8%	10,7%
MM Education	3,8%	3,9%	3,9%	3,9%	3,9%	3,9%
NN Health	4,1%	4,0%	4,0%	4,3%	4,3%	4,2%
NON-KNOWLEDGE INTENSIVE	**57,7%**	**57,1%**	**57,2%**	**57,6%**	**57,9%**	**58,3%**
Manufactures Medium-Low Technology	**2,7%**	**2,6%**	**2,7%**	**2,5%**	**2,4%**	**2,3%**
CA+CB+DF Extractives	0,2%	0,2%	0,2%	0,2%	0,2%	0,2%
DH Rubber and plastics products	0,4%	0,4%	0,4%	0,4%	0,4%	0,4%
DI Other non-metallic mineral products	0,6%	0,6%	0,6%	0,6%	0,6%	0,5%
DJ Basic metals and fabricated metal Products	1,5%	1,4%	1,5%	1,4%	1,3%	1,3%
Manufactures Low Technology	**5,0%**	**4,8%**	**4,6%**	**4,4%**	**4,2%**	**4,1%**
DA Food products, beverages and tobacco	1,0%	1,0%	1,1%	1,0%	0,9%	0,9%
DB+DC Textiles, textile products, leather and footwear	0,5%	0,5%	0,4%	0,4%	0,4%	0,4%
DD Wood	0,1%	0,1%	0,1%	0,1%	0,1%	0,1%
DE Pulp, paper, paper products, printing and publishing	2,7%	2,5%	2,5%	2,4%	2,3%	2,2%
DN Manufacturing, n.e.c.; Recycling	0,6%	0,6%	0,5%	0,5%	0,5%	0,5%

Non-Knowledge intensive Services	**40,6%**	**40,0%**	**39,8%**	**39,8%**	**39,7%**	**39,5%**
GG Retail and repair	11,5%	11,5%	11,1%	10,9%	10,9%	10,8%
HH Hotels and restaurants	6,7%	6,5%	6,5%	6,5%	6,5%	6,4%
KK Real state	9,6%	9,5%	9,9%	10,2%	10,2%	10,2%
LL Administration, defence and social sec.	7,0%	6,9%	6,7%	6,5%	6,5%	6,5%
OO Other services	4,2%	4,1%	4,2%	4,2%	4,2%	4,2%
PP Private households with employment Persons	1,5%	1,4%	1,4%	1,4%	1,4%	1,4%
Other activities	**9,4%**	**9,7%**	**10,2%**	**10,9%**	**11,5%**	**12,4%**
AA+BB Agriculture, hunting and Forestry. Fishing	0,3%	0,2%	0,2%	0,2%	0,2%	0,2%
EE Electricity, gas and water supply	1,8%	1,8%	1,7%	1,8%	1,7%	1,7%
FF Construction	7,3%	7,7%	8,2%	8,8%	9,5%	10,5%
TOTAL	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Note: Data for 2004 and 2005 has been partially estimated due to the absence of information in some sub-sectors

Source: INE (Spanish National Institute of Statistics). Data arranged according to the methodology proposed by OECD/STI in 2003 (OECD Science, Technology and Industry Scoreboard 2003)

Main regional productive specialisations

As most metropolitan areas, Madrid has some specialisation in productive activities that tend to be have a spatial pattern of concentration. A particular feature in Madrid is that the regional clusters are not characterised by local interactions among a series of small and medium sized enterprises as is common in many other OECD metro-regions. Madrid, like, for instance, Seattle, is characterized by the important presence of a series of medium-large enterprises (with more than 250 workers), with interfaces far beyond the local territory, absorbing 37% of regional employment.[58] In this respect, Madrid can be considered like a *hub and spoke economy* (A. Markusen, 1999) (Figure 45).[59] Although the *hub and spoke* model can only be looked upon as a stylized representation of a particular regional economy, some observations should be made regarding its applicability to the economy of Madrid. First, the Madrid economy has an important concentration of organisations with an international focus (for instance, UNWTO), headquarters or regional offices.[60] A second characteristic of the Madrid economy that

58 . Community of Madrid, Regional Institute of Statistics.

59 . The rise of hub and spoke economies is due to the global process of fragmentation and subcontracting that is taking place in specific production chains. The local territory of a particular city may be considered an important hub/platform for some entrepreneurial functions of larger enterprises, and in that way might be linked to territories of other cities. Moreover, the vertically integrated model is increasingly being replaced by a segmented and more fragmented production chain, whereby specific activities and managerial functions, such as manufacturing, distribution, research and development, marketing and finance, are located.

60 . The World Tourism Organization and the Latin American Capital Cities Organisation are based in Madrid. On top of concentrating the headquarters and main offices of a large proportion of Spain's leading firms, more than 3,500 foreign companies have established their Spanish, Iberian, European or Mediterranean offices in Madrid. Some of the companies that have set up regional decision centres in Madrid are Altran, BP, BT, IBM, Pemex, Software AG and Thyssen Krupp. Moreover, some of the enterprises that have installed an R&D centre in Madrid metro-region are: Boeing, BT Ignite, BP Solar, Janssen-Cilag, Lucent and Motorola. Finally, there are

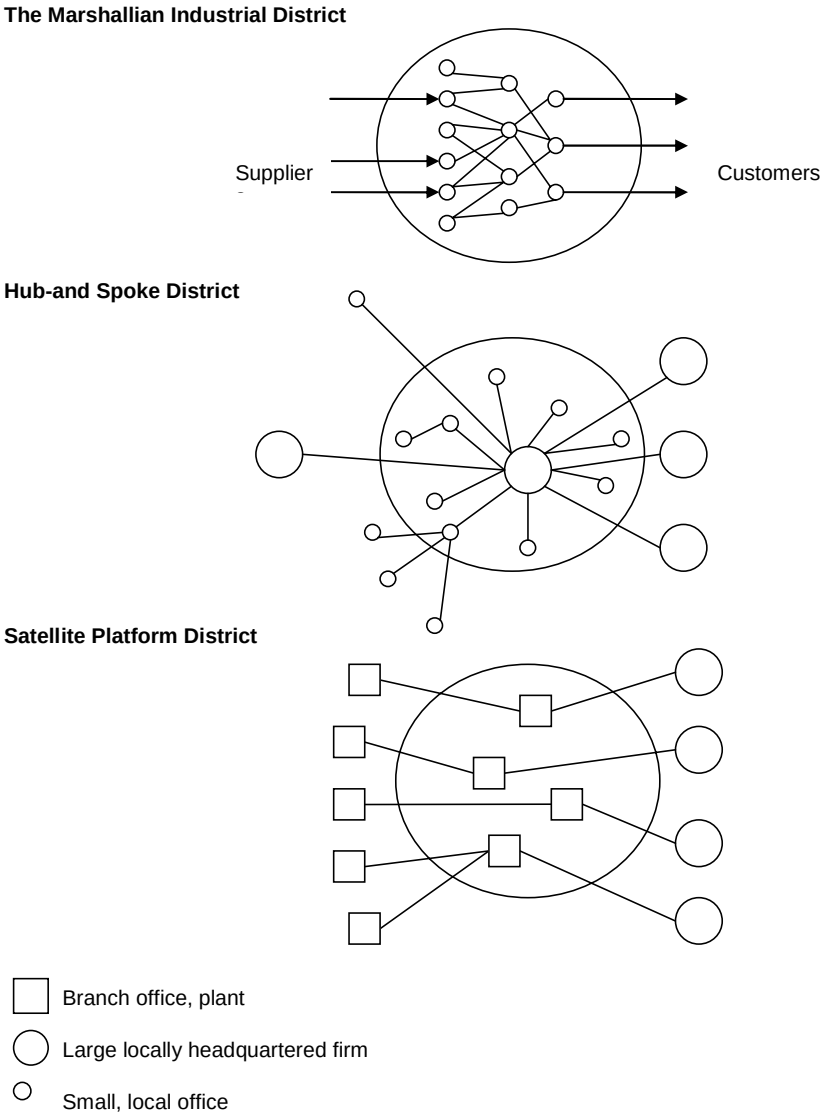
resembles the hub and spoke model is the relative absence of strong intra-urban and territorial links between the small and medium sized firms, on the one hand, and the larger enterprises. They do not seem to be connected through market relations of contracting and subcontracting, or by means of tacit norms and conventions aimed at establishing cooperation among these firms. Thirdly, as pointed out by a study of the Madrid Institute of Development (IMADE, 2004), in addition to the presence of a dense concentration of larger enterprise headquarters, and the relative weak territorial articulation between SME and these larger firms, with a few exceptions, the socioeconomic fabric of SME in Madrid is relatively weak and disarticulated from the broader tendencies of managerial and productive restructuring that are taking place in the main hubs of the Madrid economy. Based on a recent 2005/06 survey undertaken on SME,[61] the same study reveals that SMEs in Madrid will face enormous challenges once the Spanish economy will be further exposed to the international standards of competitiveness and of the speed of technological upgrading, and therefore should broaden and intensify their strategies towards internationalization and managerial modernization (IMADE, 2004).[62]

more than 25 centres which are responsible of the areas of finance (60%), human resources (36%) and ICT (24%). This concentration of finance activities comes from Madrid's attempt to develop itself as an international finance centre. Some examples of enterprises with RSS in Madrid are: Cigna, Deloitte & Touche, DaimlerChrysler, Ericsson and IBM.

61 . Using a sample of 764 establishments from a universe of over 427 000 enterprises.

62 . Instituto Madrileño de Desarrollo (2006), PNDP - Plano de Detección de las Necessidades da la PYME Informe Final 2005/06 Madrid

Figure 45 – Types of districts



Source: Markusen A., Lee Y. S., and Di Giovanna S. (eds) (1999), Second Tier Cities. Rapid Growth Beyond the Metropolis, University of Minnesota Press, Minneapolis, London

The financial cluster

Madrid is the financial capital of Spain and its financial services sector has recently undergone a rapid process of internationalization. Madrid is home to an important financial marketplace and stock exchange (Bolsa de Madrid), which now ranks fourth in Europe, just after London, Paris and Frankfurt (Figure 46). This is also in a relevant position at the global scale, in which, according to the network connectivity indexes built by the Globalization and World Cities Network (GaWC), Madrid appears in eighth

position in the international banking connectivity ranking (Table 18).[63] When the long-term evolution of European financial centres is considered, Madrid has only recently acquired such a relevant international position, as, prior to 2000, the city did not appear in any of the top positions in the rankings of world financial centres elaborated by the GaWC for the entire 20th century (Table 19).

Competition in the finance sector is fierce which means for Madrid to find its market niches. The considerable distance within the leader metropolitan regions (especially London) and the others, could be a hint of the existence of strong centripetal forces (or a lock-in dynamic) concentrating the whole sector in a few given regions across the globe. In Madrid there are some 91 000 financial intermediary jobs which compose 3% of the overall local workforce. Comparatively, in Paris-Île-de-France there are 274 000 finance jobs (6% of the local workforce); in London 326 000 workers are related to finance (8% of local workforce); and in Frankfurt 73 000 (16% of local workforce).[64] Madrid wholesale finance alone may be worth EUR 2.6 billion, which makes up 27% of the total finance sector in the city.[65] Over a quarter (26%) of Spain's wholesale finance activity is located in Madrid, yet this share appears low when compared to the other three locations used as benchmarks, particularly given Madrid's population and economic size. London concentrates 77% of national wholesale finance, Frankfurt 25%, while 90% of France's output related to wholesale finance is produced by Paris-Île-de-France (CEBR 2006). London is by far Europe's largest cluster of wholesale finance jobs, while Frankfurt is the most specialized city (Figure 47). The equity market, international banking, and the bond market are the largest employers within Madrid wholesale finance. Such specialisation of the labour market appears also in London (at a greater scale though): nearly half of wholesale jobs are in international banking and equities. In Paris-Île-de-France and Frankfurt, the largest employer is the bond market (in relative terms, the domestic bond market in both clusters is larger than London's). Fund management is relatively more important for Frankfurt than for the other clusters, while Paris-Île-de-France has roughly as many employees in investment banking as in London. The vast majority of derivatives and foreign exchange jobs in these four clusters are in London (Figure 48).

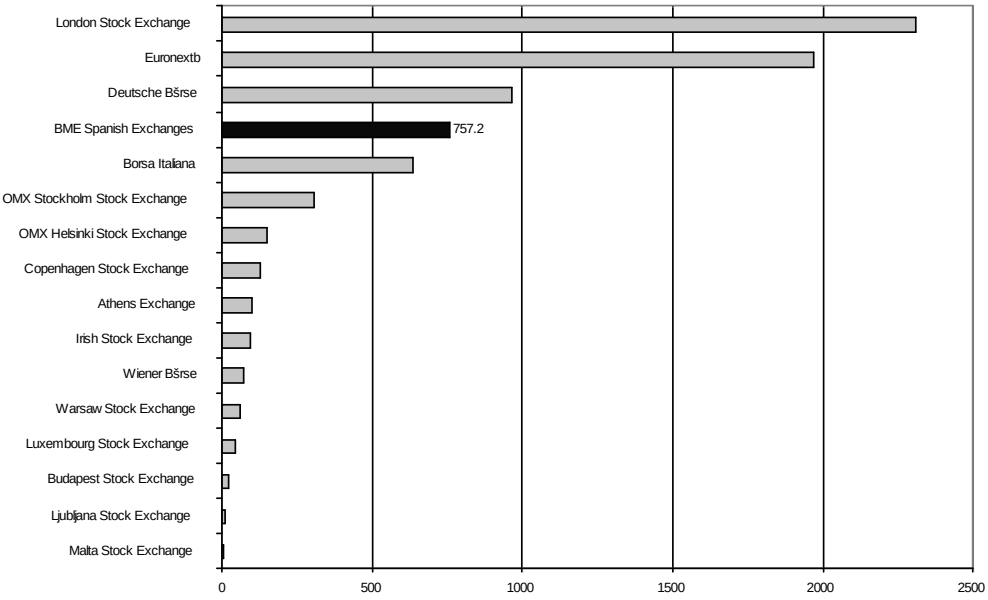
63 . The international banking connectivity ranking is based on the international banking connectivity index which measures the importance of agents (firms) located in a given city in the banking sector on the global scale. This index is computed for a universe of 315 cities across the world and 100 global service firms. For a more detailed explanation of the index see also: Globalization and World Cities - Study Group & Network (http://www.lboro.ac.uk/gawc/index.html).

64 . CEBR (2006), The Importance of Wholesale Financial Services to the EU Economy 2006, City of London.

65 . Wholesale banking activities are: establishments primarily engaged in accepting time deposits, making loans (mortgage, real estate, commercial, industrial, and consumer), and investing in high-grade securities. Savings and loan associations, savings banks, and commercial banks are also included in this industry.

Figure 46 – Domestic stock market capitalisations (equities)

Billions of euros - 2005



Source: CEBR (2006), City of London, The Importance of Wholesale Financial Services to the EU Economy 2006

Table 18 – Global and Banking Network Connectivity

2002

	Banking network connectivity	
City	**Rank**	**Score**
London	1	1
New York	2	0.984
Tokyo	3	0.943
Hong Kong	4	0.854
Singapore	5	0.804
Paris	6	0.789
Frankfurt	7	0.698
Madrid	**8**	**0.686**

Source: Taylor, Peter J. (2004), World City Network: A Global Urban Analysis, London: Routledge, p99

Table 19 – Time evolution of the European financial centres ranking

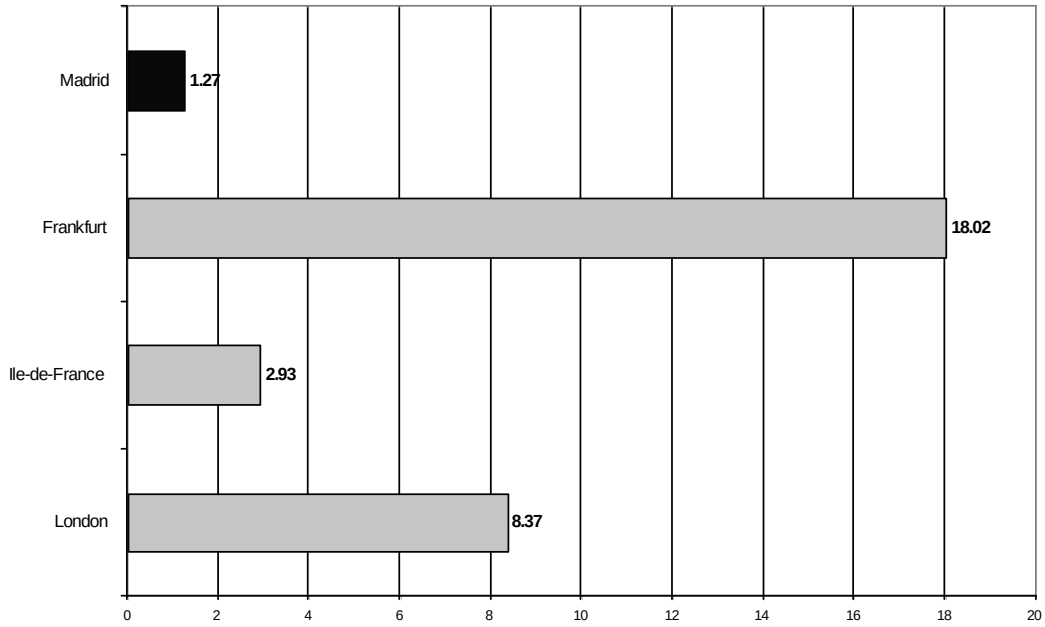
(In brackets is the city international position)

1900	1920	1940	1960	1980	2000
London (1)	London (1)	London (1)	London (1)	London (1)	London (1)
Paris (3)	Paris (3)	Paris (3)	Paris (3)	Paris (3)	Paris (5)
Berlin (5)	Berlin (4)	Berlin (4)		Frankfurt (4)	Frankfurt (6)
Frankfurt (9)	Amsterdam (9)	Amsterdam (5)		Hamburg (6)	Madrid (7)
Amsterdam (10)	Moscow (10)	Milan (6)		Zurich (9)	
		Hamburg (8)			

Source: Globalization and World Cities Network (GaWC) - http://www.lboro.ac.uk/gawc/index.html

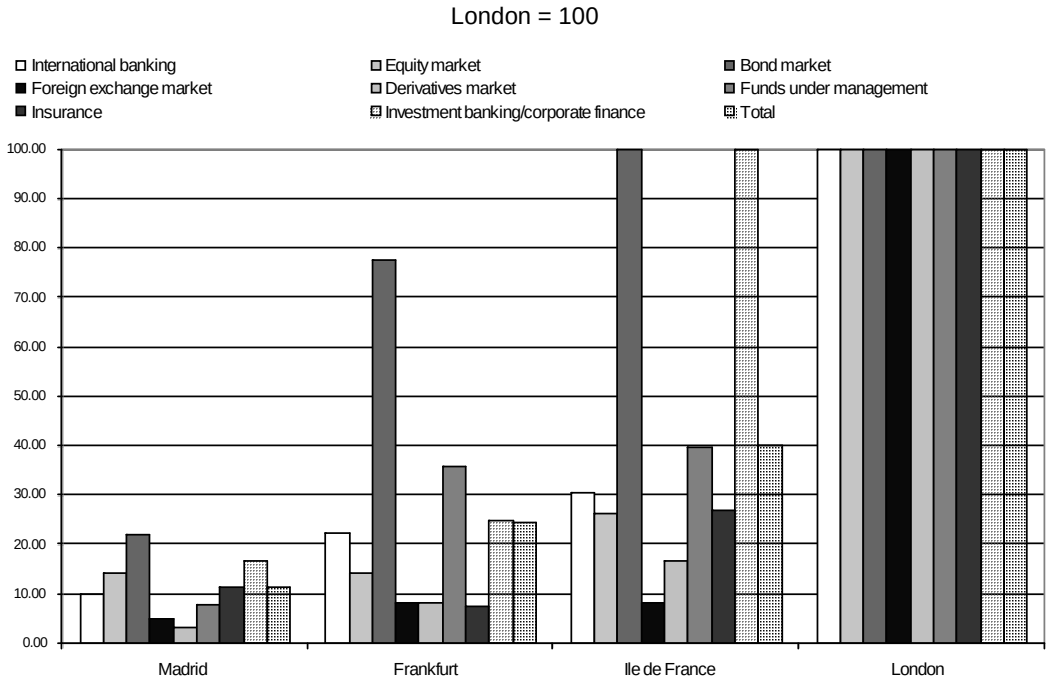
Figure 47 – Location quotients of the financial clusters compared to the EU average

2005



Source: Elaboration on CEBR (2006), City of London, The Importance of Wholesale Financial Services to the EU Economy 2006.

Figure 48 – Estimates of job numbers in each financial market* (2005)



* Excluding Central banking

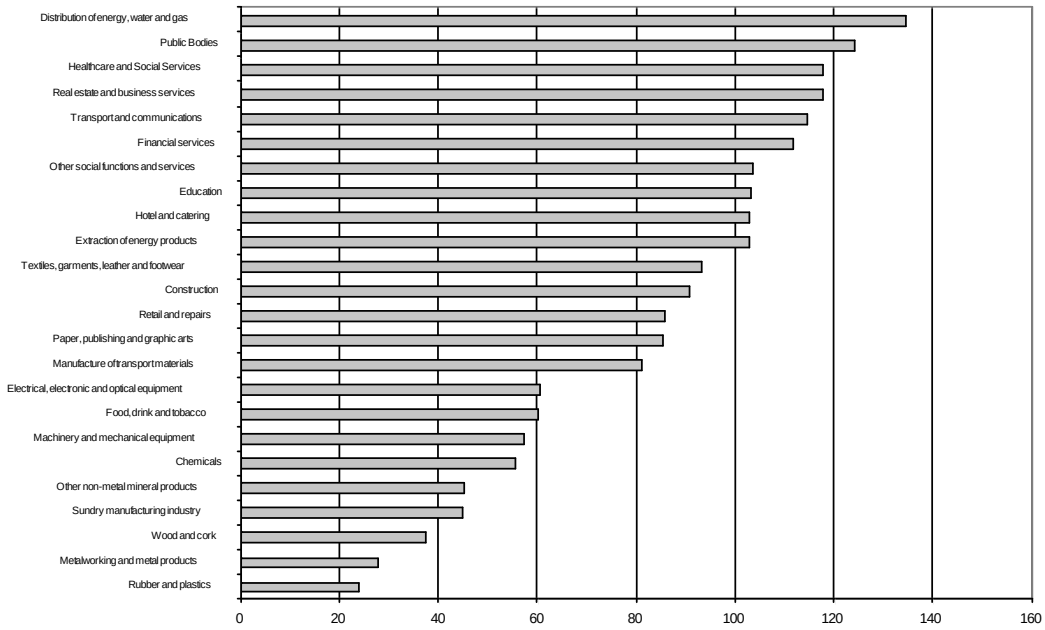
Source: Elaboration on CEBR (2006), City of London, The Importance of Wholesale Financial Services to the EU Economy 2006.

The City of Madrid concentrates the bulk of banking and financial activities within the metropolitan region. The financial sector is ranked 6th in terms of share of local employees within the City of Madrid (Figure 49). The localisation of the financial cluster in the inner city is a common pattern among OECD metropolitan regions. Moreover, to support the process of spatial concentration of the financial firms, Madrid has undergone a project aimed at realising a financial district (CTBA – Cuatro Torres Business Area) within a large area in the northern neighbourhood of the City of Madrid — formerly owned by the worldwide known Real Madrid local football team. It is undeniable that successful flagship developments linked to the attempt of concentrate knowledge intense activities, such as the financial sector, have produced remarkable achievements within metro-regions. For example, Canary Wharf in the London Docklands, together with other deregulatory changes in the financial and stock market, contributed considerably to the strengthening of London's status as a world class financial centre.[66] However, it has been noted that private developers, especially international developers, are not particularly

66 . At a smaller scale than London, also in Madrid private agents are promoting the specialisation of some areas in finance. For instance, the Santander Bank has built a big financial city in Boadilla del Monte, where they have located all their functional services for their world wide activity This Financial City –Ciudad Financiera- is located less than 20 km from Madrid centre, in a large real state project.

interested in developments in cities at the lower end of the scale of the urban hierarchy, such as regional and provincial centres (Ward, 2002). This shows that projects are very much dependant on the economic potential of the project location or of the city where they are located, a potential that Madrid has started to exploit.

Figure 49 – Specialisation of the City of Madrid in terms of employment *



* City of Madrid/Madrid metro-region * 100

Source: Directory of Local Units of Economic Activity, 2004

The logistics cluster

Thanks to the large endowment of transportation infrastructure, the Madrid metropolitan region has become an important logistics hub. The sector has witnessed an annual growth rate of 5% in the last decade, and on average represents 10% of the regional GDP. Madrid receives 60% of the international goods arriving in Spain, and 33% of the national flow. Of the total goods, 49.1% go to other parts of the Iberian Peninsula (including Portugal). In terms of employment, 5.7% of the labour force in Madrid is in the transport sector while the national average is 4.6%. Madrid is the central node of the radial structure of the road and rail networks (standard and high speed train), thus it is well connected with the three principal distribution areas of Spain: the Cantabric area (Basque Country) with connections to the north of Europe; the Mediterranean area (Catalonia and Valencia), which connects it with Asia through maritime routes; and the southern ports (Algeciras and Cadiz) which connect with the African continent and the naval routes passing through the strait of Gibraltar. Moreover, Madrid hosts the main

airport in Spain (Madrid-Barajas airport). The combination of these factors makes Madrid an important international distribution hub for South-western Europe and Northern Africa.

Besides the endowment of transportation infrastructure, another comparative advantage underpinning Madrid's logistics is the availability of land within the metro-region. Overall Madrid has 7.2 million square meters for warehousing, transport and logistics businesses, all of which are distributed among nine specialized logistics platforms. Four logistics infrastructures stand above the rest. These are:

- Madrid-Barajas Airport Freight Centre Barajas: 40 hectares with a capacity of 750 000 tons per year and an expansion project of 12 hectares. After the expansion it will become the first integrated logistic park inside an airport.

- Puerto Seco (The Dry Dock). It is an infrastructure that offers the same services as a maritime port, with an overall extension of 120 000 square meters it connects the four principal maritime ports of Spain (Valencia, Bilbao, Barcelona and Algeciras) through the railway network.

- International Transport Centre of Madrid. With 110 firms in transport and logistics established in this infrastructure.

- Mercamadrid. The largest physical wholesale market for food in Spain, the second largest in Europe and the largest fish market in the world after Tokyo. It has more than 600 businesses and has a daily flux of over 15 000 vehicles and the enlargement of Mercamadrid facilities will provide an additional 450 000 new square metres.

Concerning the localisation of the logistics centres within the metro-region, they are generally placed in the outskirts of the urban core. These centres include:

- The east area: The main logistics zone within the region accounting for 65% of the total sector. It contains the largest number of logistics infrastructure (Coslada Transport Centre, Madrid Dry Dock, Barajas Logistic Zone and the International Logistic Centre, among others). Businesses located in this area belong to the distribution and transport sectors, including international mail companies, and logistics centres of companies, such as Aitena, DHL, TNT, UPS, Salvesen, Logista, Leroy Merlin and SGEL.

- The south and south-eastern zone is the second area of importance. Its logistic infrastructures include the Transport Centre of Madrid and Mercamadrid. Some of the businesses established in this area are: Mercadona, Seur, Transcamer, UMD and Gefco.

- The north area is the least developed area because of its physical development constraints (the presence of the Montes del Pardo Natural Park and its proximity

to the Guadarrama mountain range). The main enterprises located in this area are Bridgestone, Fiege, Ivestronica and Johnson & Johnson.

The aerospace cluster

The Madrid aerospace cluster is home to many different activities related to the aerospace supply chain. Madrid concentrates more than the 60% of the national turnover and employment of the Spanish aerospace industry (EUR 2 400 millions and 15 000 jobs in 2003), and the 3.3% of the overall European aerospace business (EUR 2.5 billion out of a total of EUR 75 billion in 2003). The aerospace cluster of Madrid is vertically integrated and organised into "tiers". The first tier is comprised of two tractor firms, EADS-CASA and Airbus-España, which assemble and sell the final product. The second tier is made up of specialised suppliers: contractors that are specialised in engineering and R&D activities.[67] The third tier is mainly comprised of manufacturing SMEs. The City of Madrid and its outskirts concentrates the bulk of aerospace industry's firms (final and phase), most specifically in: (1) Tres Cantos; (2) Getafe, Parla, and Mostoles, which have the most important concentration of firms; (3) and close by the Barajas airport, in the so-called Henares Corridor (Figure 50) (IDR, 2005).

Despite the availability of a large pool of skilled workers and the presence of a world-class airport (all factors underpinning the competitiveness of the regional cluster), Madrid has to face fierce international competition. Particularly, Madrid's main competitors are Toulouse and Seattle, where the headquarters of the two leader aerospace companies are located. Given the influence of national investment on the localisation choice of aerospace firms, it is not easy to assess the comparative advantage of this Madrid based cluster. The industry success relies more on the government support for corporate R&D (to generate rapid technological progress), than on the local industrial tradition. The Madrilian aerospace cluster, in fact, largely relies on the public sector.[68] According to a recent survey carried out within the region (IDR, 2005), the aerospace industry identifies the central government (50%) and the business associations (43 %) as key actors.[69] Moreover, 25% of the local firms consider the role of the regional government as being very important.[70] This is a shared characteristic of the overall aerospace industry. Knowledge is codified and face-to-face interactions play a limited role in sharing and spreading knowledge (Storper, Venables, 2003). Accordingly, the supply chain can be widely dispersed in terms of location. Also, transportation cost of components is not relevant in overall aircraft costs and the demand (the market) is not

67 . The main contractors specialised in engineering and R&D activities are Hexcel Composite, CESA, Gamesa Aeronáutica, SENER/Bóreas, CRISA, AICSA y ICSA

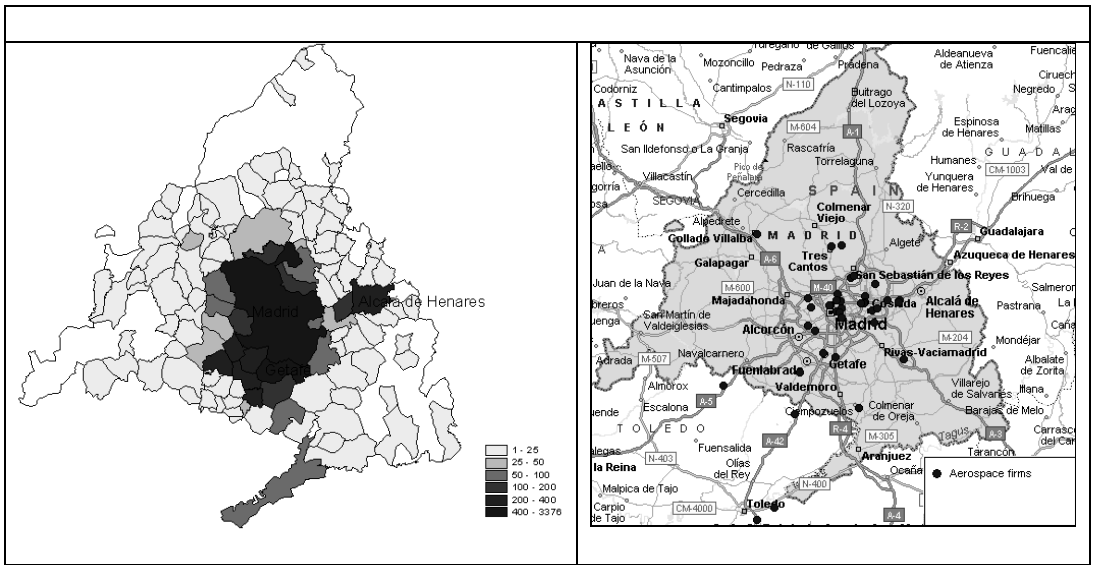
68 . Public R&D expenditure in aerospace within the Madrid metro-region was 5% of the overall Spanish R&D public expenditure in 2003.

69 . The business associations are ATECMA (Spanish Society of Aeronautic Engineers), and the Chamber of Commerce of Madrid.

70 . The same research explains that in Andalucía, around 72% of the aerospace cluster identifies the regional government as the most important agent for its development.

geographically bounded. The persistent increase of R&D costs has been the major centrifugal force for the aircraft global decentralization. Part of the production has been delocalised in low labour cost countries in order to reduce R&D costs. The result of this combination of centripetal and centrifugal forces applied at the same time is the actual shape of the global production framework of the aerospace sector, which is scattered throughout Western Europe and North America, suggesting that intellectual spillovers are not as important at the local base, as is the case in other industry clusters (Niosi, Zhegu, 2005). In other words, it is not clear whether clustering has some positive influence in industry performance or not (C. Beaudry, 2001 – A.E. Lublinski, 2003). For Madrid to exploit its existing potential in aeronautics would require a fine tuning strategy aimed at promoting local specialisation in a market niche where global lock-in dynamics are still weak, for instance material engineering.

Figure50 – Localisation of the aerospace industry



Source: INE (Spanish National Institute of Statistics)

The creative cluster

With almost 200 000 workers (15.4% of Spain in the same sector), creative activities form another important industrial cluster in the Madrid metro-region.[71] Dividing these creative industries in traditional and non-traditional (Lazzeretti, Capone, 2006), the former employs 128 000 workers, while the rest of the jobs of the cluster are in the latter.[72] Creative industries account for 8.5% of total employment in the Madrid metro-

71 . The creative cluster has been defined following the definition of P. Hall. Hall, P. (2000), Creative Industry and Economic Development, Urban Studies 37(4), pp. 739-649.

72 . According to Lazzeretti and Capone (2006), the creative industries can be divided into traditional and non-traditional. The former includes: music, film and video; architecture and

region: 5.3% in traditional creative industries and 3.2% in non-traditional creative industries. This puts the Madrid metro-region in the lead as the most specialized region in creative industries, traditional and non-traditional, in Spain (Table 20). The editing and publishing industry has the lion's share of the regional creative industries. The Madrid metro-region is home to some 2 500 firms (22 % of the Spanish editing and publishing sector), involving 24 000 workers within the region (27 % of the national employment figure for the sector). The bulk of the local firms (more than 1 400) are publishing houses (32.6% of the national total) and their turnover amounts to EUR 4.23 billion (59.7 % of the national total). Many large publishing houses belong to foreign groups, demonstrating a good level of attractiveness for Madrid in this field. The creative cluster is localised in the very centre of the metro-region (Figure 51). The City of Madrid alone concentrates close to 60% of the regional employment in the industry (122 000 jobs). A high concentration of workers in the creative industry can be observed also in some other neighbourhood municipalities, localised in the urban outskirts, as Alcorcón (5 800 jobs and 2.8%), Móstoles (5 800 jobs and 2.8%), Leganés (4 700 jobs and 2.3%), Getafe (4 200 jobs and 2.1%).Nevertheless, the actual shape of the interaction between creative industries and territories is not well-know.

The presence of specialised schools training local workers and the fact that Spanish-language products have a potential market of more than 500 million people, are the main comparative advantages of the Madrid-based creative industries. Regarding the schools, various levels and types of "creative" training can be detected in Madrid. A distinction can be made between formal training and refreshment courses. In terms of formal training, besides the Madrid Institute of Fine Art (*Escula de Bellas Artes*) and the Architecture School, there exist state-funded schools (Islas Filipinas and La Paloma), those funded by the regional government (Puerta Bonita), and private institutions (Salesianos, Lasalle and Tajamar). Professional courses are organised in schools such as Salesianos and Tajamar. The potential of the Spanish-language products is wide. Spanish language is spread around the world and is present, to a greater or lesser degree in the Americas, Europe, Asia and Africa. It is the official language of more than 20 countries and frequently used in other countries in a non-official way (e.g. in the United States, 25% of the population will speak Spanish by 2050 according to UNESCO. This economic, social, and political potential represents an opportunity that Madrid is starting to exploit.

Table 20 Distribution of the creative industry in the Spanish regions

Employment

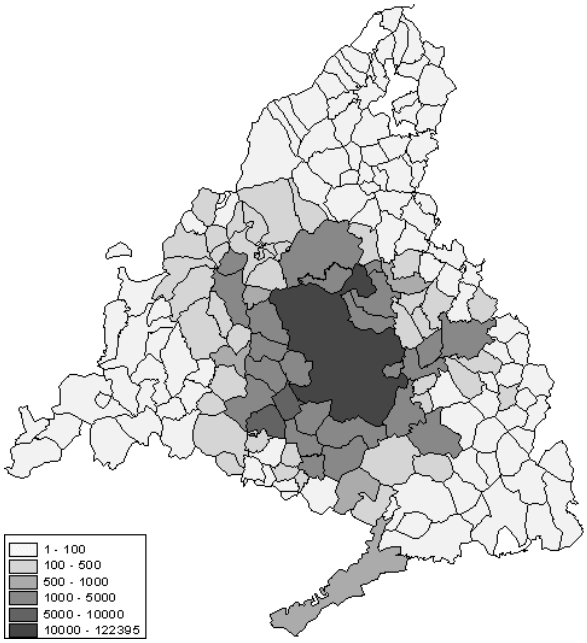
	Total jobs			Percentage of the regional employment		
	Traditional	Non-traditional	Total creative	Traditional	Non-traditional	Total creative
Madrid	**128.429**	**78.299**	**206.728**	**5,3%**	**3,2%**	**8,5%**
Cataluña	112.446	48.212	160.658	4,0%	1,7%	5,7%
País Vasco	28.590	12.741	41.331	3,3%	1,5%	4,8%

engineering studios; and film, video and performing arts. The latter refers to: R&D in architecture, graphic design and fashion; software and computer services; and advertising.

Spain	**457.864**	**215.499**	**673.363**	**2,8%**	**1,3%**	**4,1%**
Navarra	7.396	1.907	9.303	3,1%	0,8%	3,8%
Aragón	10.108	4.789	14.897	2,0%	1,0%	3,0%
Valencia	36.896	14.303	51.199	2,2%	0,8%	3,0%
Balearic Islands	7.814	3.223	11.037	2,1%	0,9%	3,0%
La Rioja	2.590	891	3.481	2,2%	0,8%	3,0%
Asturias	7.694	3.250	10.944	2,0%	0,8%	2,9%
Castilla y León	16.846	7.043	23.889	1,8%	0,8%	2,6%
Cantabria	3.699	1.668	5.367	1,8%	0,8%	2,6%
Galicia	20.010	6.646	26.656	1,9%	0,6%	2,6%
Canarias	12.506	5.168	17.674	1,8%	0,7%	2,6%
Andalucía	41.428	18.338	59.766	1,7%	0,7%	2,4%
Castilla-La Mancha	9.475	4.283	13.758	1,5%	0,7%	2,1%
Murcia	7.263	2.888	10.151	1,5%	0,6%	2,1%
Extremadura	4.196	1.709	5.905	1,2%	0,5%	1,7%
Melilla	228	77	305	1,1%	0,4%	1,5%
Ceuta	250	64	314	1,1%	0,3%	1,4%

Source: Elabouration on INE (Spanish National Institute of Statistics) – Census 2001

Figure 51 – Location of jobs in creative industries within the Madrid metro-region



Source: Elaboration on INE (Spanish National Institute of Statistics) – Census 2001

The life science cluster

Madrid has the largest concentration of life-science industry in Spain: 32% of firms, 61% of national turnover, 50% of national employment, and 31% of biomedical and health science publications. The R&D expenditure in this field in regional academia adds up to EUR 400 millions, equivalent to the 79% of the Spanish private investment in biotechnology companies. Life-science is a multifaceted industry that includes a number

of private and public organizations (Table 21). The most important segment of the life science cluster is pharmaceuticals. Madrid is home to 26.3% of the pharmaceutical companies in Spain, 35% of the total employees and 45.54% of all laboratories. Spanish subsidiaries of multinational (the so-called *Big Pharma*), alone generate 70% of the turnover, 60% of exports, and 50% of the private R&D expenditures in pharmaceuticals (despite their main research centres are located elsewhere). Therefore, despite the concentration of firms, Madrid is more a large final consumer market than a region specialised in pharmaceuticals.

The Madrid life science cluster is not as competitive at the international level as at the national level though it is gaining importance. However, the sector has grown, albeit from a reduced base, by 350% in the last four years and is starting to become a relevant international player in R&D, spin-offs, and research and collaboration. Spain ranked fourth in Europe in biotechnology-related activities from 2000 to 2003 according to Genoma España (Ministry of Health, Science and Technology, Spain). At the national level, the high competition among regions in the biotechnology field makes it harder and harder to achieve a high regional specialisation in such an advanced sector. Spain has not promoted the concentration of this sector in a given region, and biotechnology policies are left up to the regional initiative instead of being organised and led by the central government, as is often the case in the development of this sector in others countries. Furthermore, the Madrid metro-region lacks a structure for agents, institutions and knowledge base which are all critical to achieving results in a highly technical and scientific innovative sector (Cendejas, Encinar, Munoz, 2006).

Although life science entities are located in many different areas within the Madrid metro-region, the most important concentrations are in the City of Madrid and in the north-eastern area of the region. The City of Madrid brings together the bulk of research centres and the largest company headquarters. Private research centres and the productive plants are located in the north-eastern area of the metro-region (i.e. the municipalities of Tres Cantos, Colmenar Viejo, Alcobendas, Alcalá, and the so-called Henares corridor, close to Barajas airport and a number of logistics centres). Minor concentrations are to the south (the municipality of Leganés) where mainly low value added activities are located.

Table 21 – Main organizations within the Madrid life science cluster

Universities	Autonomous University of Madrid (biotechnology, molecular biology and biomedicine) Universidad Complutense de Madrid (genomics and proteomics) University of Alcalá Polytechnic University of Madrid;
Research Centres	Severo Ochoa Molecular Biology Centre Alberto Sols Biomedical Research Institute Ramón y Cajal Institute of Neurobiology Institute of Pharmacology and Toxicology Institute of Industrial Fermentations National Cardiovascular Research Centre IMIDRA (the Spanish National Cancer Research Centre) INIA (the Astrobiology Centre).
Hospitals	"12 de Octubre" University Hospital

	San Carlos Clinical Hospital "Gregorio Marañón" General University Hospital La Paz University Hospital La Princesa University Hospital Ramón y Cajal University Hospital
Largest bio-tech and pharmaceuticals companies	Agrenvec – Bioalma – Biotecnologías Aplicadas – Bionostra – Biotherapix – Biotools – B&M Labs – Cellerix – CircaGen – Coretherapix – Genómica – GlaxoSmithKline – Genetrix – Ingenasa – Integromics – Neuropharma – Pharmamar – Plant Bioproducts – Zeltia Group - ZF Biolabs. The multinational *big pharmas*: MSD, Lilly, Roche, Serono.
Corporate associations	The Spanish Biocompanies Association (ASEBIO) The Association of Biotechnology Companies of the Region of Madrid (BIOMADRID).

Source: Elabouration on Genoma Spain

Other non-clustered productive specialisations

Tourism

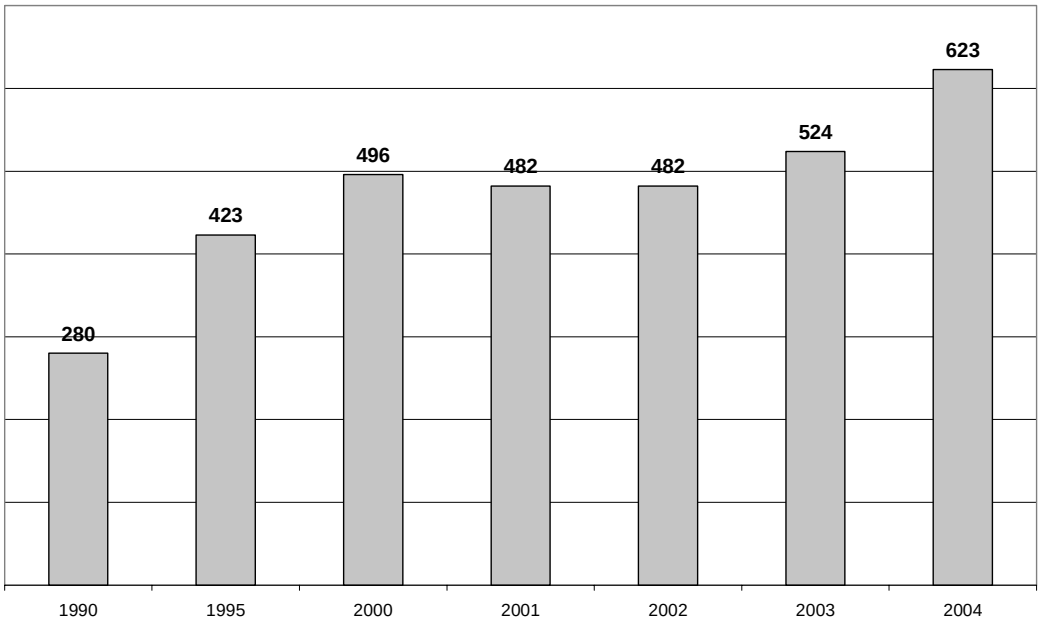
With a capacity to host 65 000 visitors per night, Madrid is one of the most attractive destinations in Spain, only after the Mediterranean regions of Catalonia and Andalusia. Such a competitive advantage comes from the local endowment of cultural and natural amenities as well as from the economic role of Madrid, which also attracts business visitors. From a European perspective, Madrid is also one of the most popular tourism destinations, ranking fourth in 2004 only behind London, Paris and Rome, and ahead of cities, such as Barcelona, Berlin and Amsterdam (UNWTO, 2005). Tourism is becoming one of the leading industries in the world economy. Since the end of the 1990s, international tourism receipts have more than doubled reaching USD 623 billion in worldwide totals (Figure 52). The general trend seems to have recovered from the slowdown of the first years of the millennium (probably due to the "9/11" attack). Spain has a lion's share in this global market.[73] The nation ranks second both in terms of arrivals and revenues, only after, respectively, France and USA (with an average revenue of roughly USD 750 per tourist) (Table 22). Because of the large commercial deficit, the tourism industry is vital to the national economy, accounting for about 11 % of gross domestic product (2004).[74]

73 . It is worth noting that Spain, in spite of the strong euro and of the tragic events of 11th March in Madrid, saw tourist arrivals grow by more than 3% also in 2005.

74 . INE (Spanish National Institute of Statistics), Tourism Satellite Accounts.

Figure 52 – Overall tourism receipts in world economy

Billions of US dollars



Source: UNWTO (2005)

Table 22 – Tourism arrivals and receipts in the world

	International Tourist Arrivals (million)							International Tourism Receipts (US$ billion)					
				Change (%)		Share				Change (%)		Share
		2003	2004	2003/2002	2004/2003	2004			2003	2004	2003/2002	2004/2003	2004
1	France	75	75.1	-2.6	0.1	9.8	1	USA	64.3	74.5	-3.4	15.7	12
2	**Spain**	**51.8**	**53.6**	**-0.9**	**3.4**	**7**	**2**	**Spain**	**39.6**	**45.2**	**4.4**	**3.8**	**7.3**
3	USA	41.2	46.1	-5.4	11.8	6	3	France	36.6	40.8	-5.4	1.5	6.6
4	China	33	41.8	-10.4	26.7	5.5	4	Italy	31.2	35.7	-2.1	3.8	5.7
5	Italy	39.6	37.1	-0.5	-6.4	4.9	5	Germany	23.1	27.7	0.4	8.9	4.4
6	UK	24.7	27.8	2.2	12.3	3.6	6	UK	22.7	27.3	2.1	7.5	4.4
7	Hong King (China)	15.5	21.8	-6.2	40.4	2.9	7	China	17.4	25.7	-14.6	47.9	4.1
8	Mexico	18.7	20.6	-5.1	10.5	2.7	8	Turkey	13.2	15.9	10.5	14.3	2.6
9	Germany	18.4	20.1	2.4	9.5	2.6	9	Austria	14	15.4	3.8	0.4	2.5
10	Austria	19.1	19.4	2.5	1.5	2.5	10	Australia	10.3	13	0.8	10.7	2.1

Source: UNWTO (2005)

Building and construction

The building and construction sector has contributed to the recent boom both of the Spanish and Madrid economies. In 2005, the sector represented 8.8% of the gross value added of the region's economy, with more than 300 000 registered construction workers in the region and 150 000 just in the City of Madrid. These numbers denoted a growth

rate of 8.7% in the region and 7.1% in the City of Madrid with respect to 2004. Part of this recent boost was due to the 2005 process of regularisation of migrants, many of whom were already working prior to 2005 in the sector.[75] In the first nine months of 2005, more than 73% of the 42,000 new jobs in the sector were taken by foreign migrants, raising the participation of foreigners to 24% of the total workforce.

Madrid is home to a number of large and deeply specialised construction companies competing on the international market. Once a non-tradable sector, construction has become a globalised market in which a number of large companies compete in selling their products and their services. The development of the construction sector in Madrid has been related fundamentally to two factors. First is the significant expansion of building and construction activities not just in Madrid, but also in the rest of Spain. The expansion of the new building stock and of rehabilitation of buildings experienced in Madrid and elsewhere in Spain in the recent building boom has been accompanied by huge public investment (by local, regional and the national administrations and the EU) in transport and other forms of infrastructure. The sustained rise in property prices experienced by Spain since the late 1990s has also contributed to attracting investment into the sector. The second factor is that, despite the fact that the sector is dominated by SMEs, Madrid is home to a number of large construction firms that have a large share in the Spanish market and are able to compete internationally. Large firms originated through processes of internal restructuring, and mergers and acquisitions of foreign firms.[76] According to the 2006 McGraw-Hill Engineering News Record (ENR) ranking of top global contractors, Spain had six construction firms among the top 50 global contractors. All six firms had their headquarters in Madrid. No other city in the world, with the exception of Tokyo-Yokohama, with eight, had such a high concentration of construction firms among the top 50.

Main regional weaknesses

Low labour productivity

Madrid has a relatively low level of labour productivity in comparison to the leading OECD metropolitan areas: 18 % less than the average of the 78 OECD metropolitan regions (Competitive Cities in the Global Economy, OECD, 2006). While, the

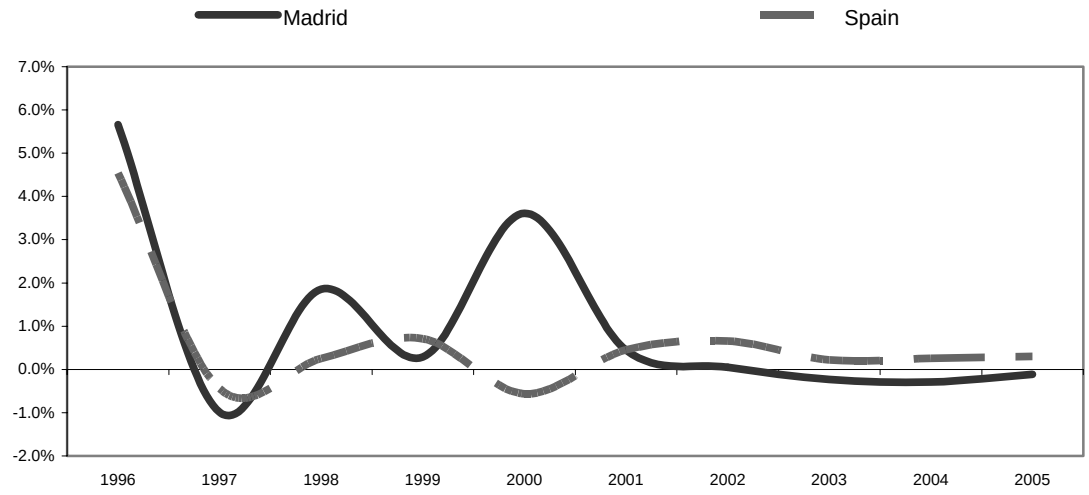
75 . In the Madrid metro-region, non-EU workers are employed mainly in construction and proximity services

76 . The restructuring of the sector that allowed the emergence of such a regional specialisation of truly global firms in Madrid started in the early 1990s and was founded on a favourable regulatory framework and on the emergence of a competitive financial sector. The fact that most large construction firms in Madrid were already relatively specialised since their foundation also contributed to the growth of firms that were not necessarily competing for the same national contracts. Finally, the need to diversify in what is traditionally a very volatile sector also acted to spur the rounds of mergers and acquisitions. Today, Madrid's large building and construction firms are competitive on a global scale, bidding for and winning numerous projects around the world and with an increasing diversification of activities, which may help them to fend off any potential downturn in their core business in the Spanish market.

interpretation of such data should be evaluated carefully due to the reasons mentioned previously (including the regularisation of a large number of immigrants in 2001), Madrid still has been under-performing in terms of labour productivity growth as compared to the national average since 2001 (Figure 53). As mentioned before, relatively low productivity level is a national issue: over 1998-2002, the average increase of labour productivity within the OECD was at 2.12 % against only 0.8 % in Spain (OECD Factbook, 2007). Factors such as the relative decline of the high-tech manufacturing and a high creation of jobs characterised by impermanence, low earnings, and the low returns to education or experience should be addressed to increase the productivity level in Spain, and in Madrid (OECD, Economic Surveys, Spain, 2006).

Figure 53 – Annual productivity growth (per worker)

(Deflated values – 1995-05)



Source: INE (Spanish National Institute of Statistics)

The reducing weight of high-tech manufacturing has partly contributed to Madrid's relatively low productivity. As assessed above, between 2000 and 2005, high-technology manufacturing contribution to the regional GVA has been falling from 2 208 to EUR 1 927 million, reducing its total contribution from 2.2% to 1.3% (INE – Spanish National Institute of Statistics). A main reason for this trend is linked with the low level of R&D. As will be demonstrated below, the level of R&D expenditures is higher in the Madrid region than the national average; yet it remains relatively low as compared to other metro-regions. Actually, low R&D investment seems to be a national problem. Despite improvements in recent years and the most generous R&D tax break system in the OECD,[77] Spain is still close to the bottom of R&D rankings with a spending-to-GDP

77 . In Spain R&D tax breaks includes: (i) a full write off for R&D-related investment in fixed assets, (ii) deductions for R&D-related spending (30 per cent), (iii) deductions on incremental spending (50 per cent of spending above the average of the previous two years), and (iv) an additional 20 per cent on researchers' wages. However, these incentives are not used much.

ratio of just 1.1 %, against an EU average of 2 % and 2.8 % in the United States (2004). New EU member states, which have much lower per capita GDP than Spain, are close to Spain at 0.84 %. Almost half of spending (48%) is carried out by the public sector (universities and government institutions), meaning that 52 % of spending comes from the private sector. This is low considering that many EU countries' private spending accounts for 65 % of total spending while this is 70 % in the United States. Moreover, despite the aforementioned increased importance of knowledge intensive services (which has increased productivity over the last decades, primarily because of the uptake of ICT[78]) within the regional economy, a large part of the new jobs has been created in community, social and personal services, all activities in which labour productivity was low.

The dual labour market of the Madrid metro-region may also have affected labour productivity. The Madrid metro-region, like the rest of Spain, has a dual labour market shared between highly protected permanent workers and people engaged in fixed-short term contracts (Figure 54). Fixed-short term contracts have been introduced in Spain in 1984 to reduce the negative impact of the high protection of workers with open-end contracts, which in Spain is one of the highest in the OECD (Figure 55). Although the reforms have promoted the creation of many new jobs, the excessive use of fixed term contracts (currently accounting for about a third of all employees in Spain, and some 28% in Madrid, [79] compared to an OECD average of 13 %. Legislation which came into force in mid 2006 introduced, among other things, some restrictions to the successive use of temporary contracts as well as temporary incentives for the conversion of temporary contracts to permanent ones. This legislation has lead to a modest decline in the proportion of workers on temporary contracts.), may have caused an unbalance in the labour market reinforcing the traditional *insider-outsider mechanism* and promoting the creation of *low-skilled employment*.

- The introduction of fixed-term contracts has reinforced the traditional insider-outsider mechanism associated with strict *employment protection legislation* (EPL) by adding a sort of "third group" of workers (temporary workers), which raises the effective protection of permanent workers. Accordingly, the latter enjoy job stability beyond the protection given by firing costs, since temporary workers are the subject of employment adjustments at the margin in case of a

Only 15 per cent of companies which innovate benefit from the tax breaks (COTEC, 2004). Note that a reform to the corporate tax went into effect in 2007 and some of these deductions may have been modified.

78 . Most service innovations are not technical and involve small and incremental changes in processes and procedures which do not require significant amounts of R&D. Traditional measurements of R&D such as patents do not capture these non-technical innovations very effectively. Regulatory reform, increased exposure of service activities to international competition, the growing tradability of services and higher levels of investment and application of ICT are contributing to an increase of productivity in some service sectors such as financial services, communication and public administration services

79 . INE, Spanish National Institute of Statistics

negative business cycle.[80] In such a situation permanent workers could have low incentives to redline their job performance. In addition, workers with fixed-term contracts might lower their work efforts if they know that their contract will not be renewed. The final effect is probably a reduction of the overall productivity of labour (Dolado *et al.*, 2002). Although temporary contracts should only be used for a limited duration (they can be renewed at most three times to a maximum of two years), they are widely used beyond the legal limit (OECD, Economic Surveys, Spain, 2005).

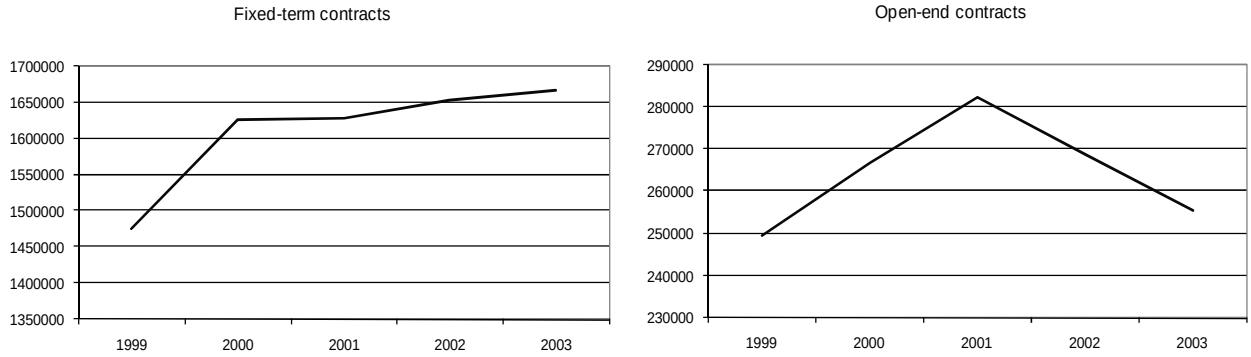
- The over-use of short term contracts has encouraged the creation of low skilled employment, especially in the service sector and in construction, which has been absorbing the bulk of non-EU workers in Spain, as well as in Madrid: a phenomenon that is likely to have affected labour productivity.[81] Moreover, many of these jobs are on the frontier between the informal and the formal economy. Therefore, the lower growth rate of GDP compared to that of the employment rate between 1998 and 2002 may be partially explained by the regularisation of these workers, who had contributed to the local economy but were not taken into account when labour productivity was calculated because they participated in the informal sector. Finally, although the high responsiveness of the labour market to the business cycle is positive from many viewpoints, in case of a long negative business-cycle, many of the workers with low productivity could lose their employment, causing a growth of the informal economy (especially in the case of foreign workers), or a general decrease in regional wealth due to a reduction of the local activity rate.

80 . This could justify the insurgence of high wage inflation, despite high unemployment (Bentolila and Dolado, 1994).

81 . The sectors which saw a larger number of fixed-term contracts in 2003 in the Madrid metro-region were “other business activities” (36.23%), “recreational, cultural and sporting activities” (14.16%), and “construction” (13.21%) and hotels and restaurants (8%). Regarding occupational contracts, elementary plant workers in manufacturing (9.75%), administrative occupations (9.68%), elementary storage workers (7.37%) and sales occupations in retail (6.07%) were the most hired occupations in 2003

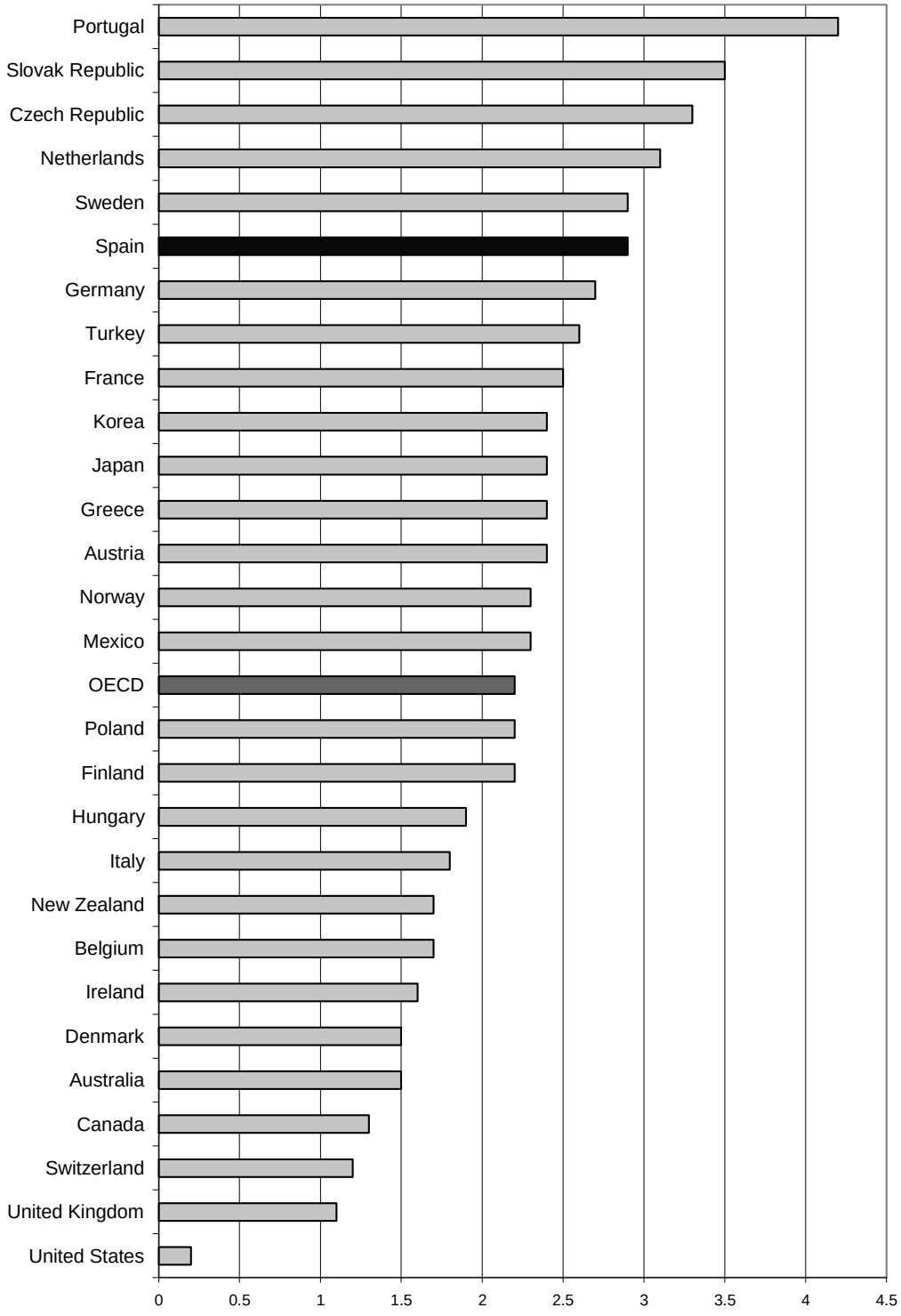
Figure 54 – Evolution of the contracts by type in Madrid

1999- 2003



Source: INEM (Spanish National Institute for Employment)

Figure 55 – Index of overall strictness of protection in the national labour market *



* The overall indicator takes into account other variables, like procedural barriers, notice periods for dismissal and difficulty of dismissals. Scores can range from 0 to 6 with higher values representing stricter legislation.

Source: OECD Economic surveys Spain (2005)

Decreasing innovation capacity

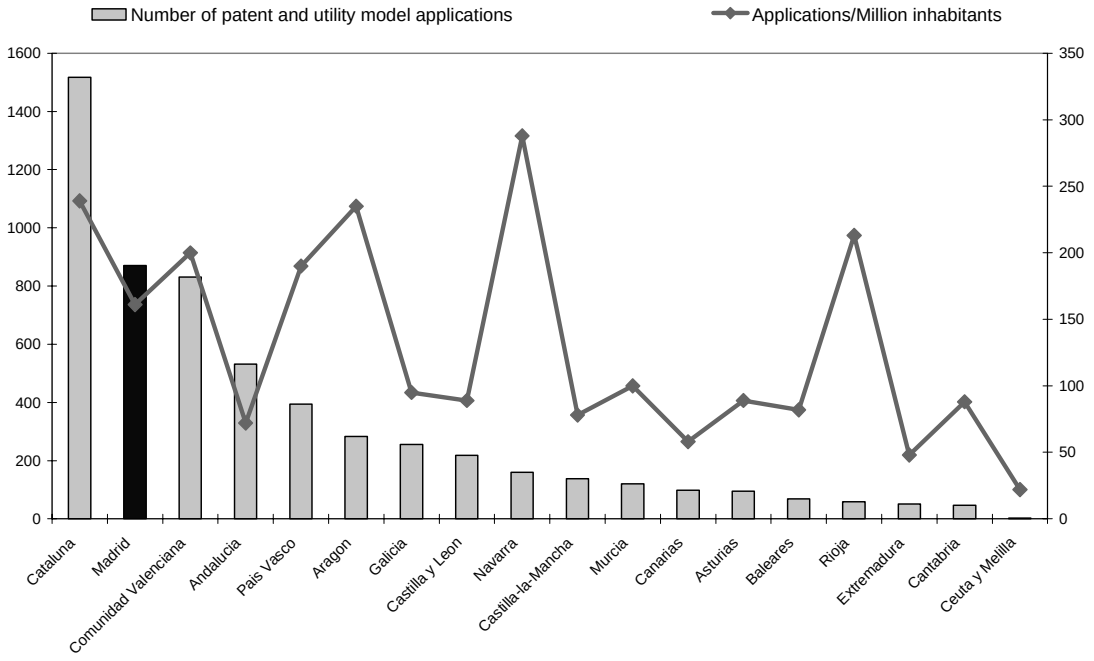
The Community of Madrid produces less innovation than others leading European metropolitan areas. At the national scale, approximately 30.5% of private R&D expenditure and 26.8% of the total public R&D expenditure were concentrated in the Madrid metro-region in 2005. In the same year, 1.82% of the regional GDP was invested in R&D activities, *i.e*. above the Spanish average of 1.13%.[82] Moreover, Madrid is home to 30% of all researchers in Spain belonging to public bodies (46 centres operated by the Higher Counsel for Scientific Research). Moreover, looking at output data on innovation activity the panorama is somewhat different, with Madrid punching below its economic weight and significance in measures such as patents, utility model applications, and research output.[83] In 2005 Madrid was ranked second – behind Catalonia – at the national level in terms of patent and utility model applications (Figure 56). Yet, when these data are normalised to population size, the Madrid metro-regions produces a number of patent applications only slightly above the national average, ranking behind other regions such as Aragon, the Community of Valencia, Navarre, Basque Country, Rioja, and Catalonia. At the European level, taking into account ICT and biotechnology, two sectors in which innovation capacity is a competitive advantage itself, the performance of the Spanish metro-regions in terms of patent applications are among the lowest within a selected sample of seven leading European metro-regions (Figure 57-58). Finally, at the international level, looking at the World Knowledge Competitiveness Index in 2004, Madrid appears neither in the ranking of the 50 most knowledge competitive regions, nor in the 50 most knowledge intensive regions of the world. Improving the local capacity to innovate is likely to have a broader impact at the national level, since these sectors have a "cross-sectoral" effect and can fertilise the average labour productivity.

82 . Elaborations on the basis of INE (Spanish National Institute of Statistics)

83 . A utility model is a registered right which gives its owner exclusive protection for an invention, similar to a patent. In general, an invention must be new, involve an inventive step, and lend itself to industrial application to be protected by a utility model. The level of inventiveness required is generally lower than that for a patent. Also, utility models may be granted without examination to establish that these conditions have been met. This means that protection could be obtained more quickly and at less cost than with a patent, but on the other hand it would have less legal certainty and the term of protection is usually shorter than a patent.

Figure 56 – Number of patent and utility model applications in a selection of Spanish regions

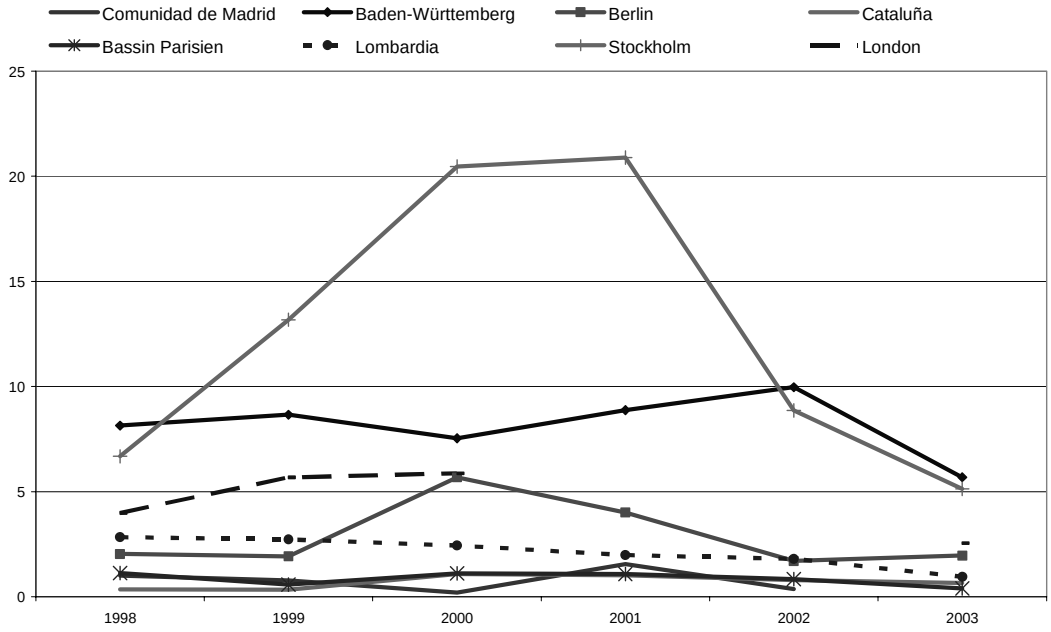
(2005)



Source: Avance de estatisticas de propriedad industrial, Ministerio de Industria, Turismo y Commercio (2006) (Summary of Industrial property statistics - Ministry of Industry, Tourism and Trade)

Figure 57 – Patents applications in ICT Consumer electronics

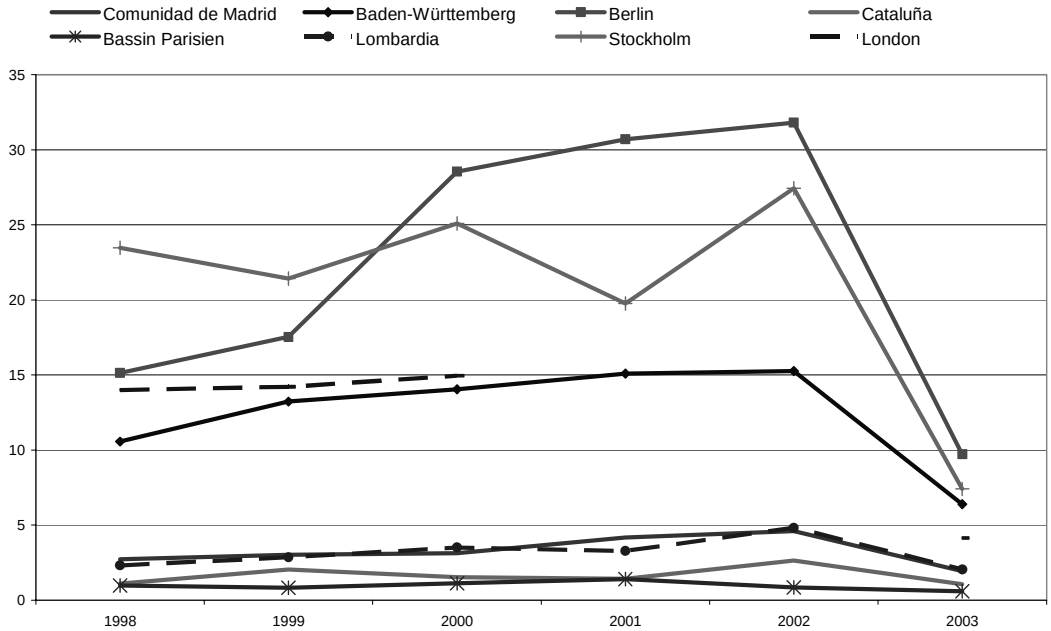
(Applications per million inhabitants)



Source: Eurostat

Figure 58 – Patents applications in Biotechnology

(Applications per million inhabitants)



Source: Eurostat

Such a limited effectiveness of regional R&D expenditures in generating innovation may be explained by a number of different factors that makes the environment less conducive to innovation, including the following:

- Although being of a high quality, there are some weaknesses in the overall education framework. The Madrid metro-region enjoys a dense system of universities and hosts three of the 20 best internationally recognized business schools (Financial Times, 2006). However, although there are no international comparisons in the form of test results, Madrid's universities, on the whole, provide education to a large number of students in large classrooms, with a high student/staff ratio in most disciplines.[84] Survey information shows that the teaching of Spanish graduates does not correspond well to labour market needs, with a low weight on practical skills such as the use of computers, oral communication and planning skills, ability to solve practical problems and ability to work under pressure (COTEC, 2004). As the last *OECD Economic Survey on Spain* highlights, student mobility across universities in Spain is low, in part because of the low level of specialisation across them and the lack of discrimination in quality by the system and by employers, all of which discourage mobility. In addition, the external control of the selection system for professors has left a lot to be desired, resulting in problems of endogamy, whereby jobs primarily went to internal candidates. The recent modification of the selection system towards the implementation of a habilitation system before vacancies are filled by university departments has, in some cases, resulted in a decline in the number of vacancies, as university departments fear that they may not be able to place their own candidates (OECD, Economic Surveys, Spain, 2005). More recently (2007), another national reform of the university framework took place (Ley Organica de la Universidad). The reform deals with three issues. First of all, it gives universities greater autonomy in defining teaching programmes and to recruit professors. Of course, this increased autonomy will be coupled with a strengthening of the monitoring and assessment of the quality of the university system. Second, to enhance linkages with the private sector, professors will be allowed to take a voluntary leave of absence for a five-year maximum period to develop more applied projects in firms. Universities and public research centres will also be able to create joint research institutes with businesses in order to forge closer links and facilitate personnel exchanges. Third, and last, the reform creates sectoral commission including both representatives of the Ministry of Education and of the autonomous communities to better co-ordinate university management. Students will also participate more formally in the university organisation.

84 . Only two out of 14 Madrid-based universities (242 756 students in attendance representing 16 % of the national total84) are included among the 100 First European of the Academy Ranking of World Universities elaborated by Shanghai Jiao Tong University.

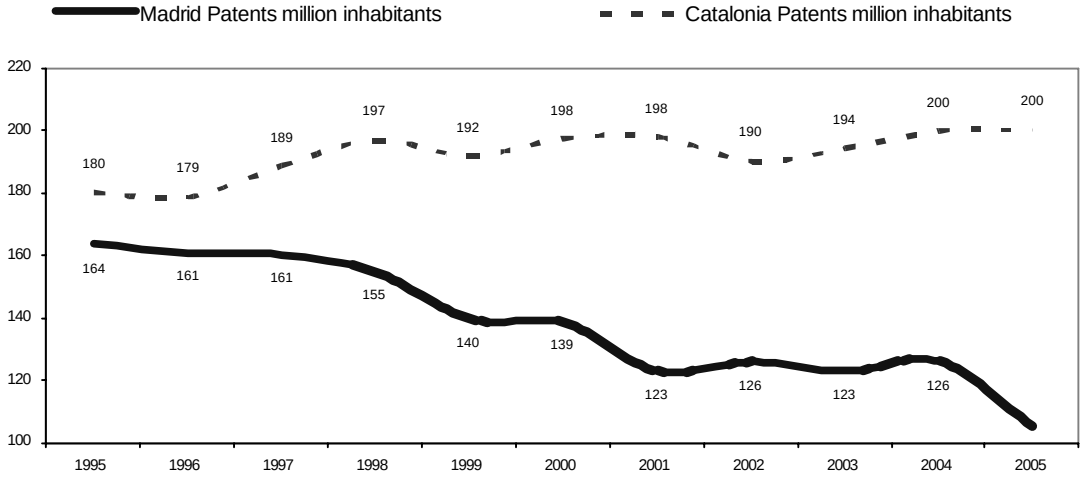
- Researchers in the public sector have traditionally had low incentives to increase their production, or to keep on working in the region or in the country. Most researchers, in science related sectors are concentrated in the Spanish public sector. Researchers in private firms earn between 20-30 % more than researchers in University and public sector labs (ASEBIO 05, 2006). This is particularly relevant because there are legal restraints on the transfer of researchers and knowledge from the public to private sector, severe restrictions which impede the appropriate management of the innovation system. Technology-based firms generally operate in Spain within a very rigid legal framework. Legislation regarding intellectual property and the jurisdiction on biotechnology-based elements also adversely affects the appropriability of researchers' results. Legal restrictions condition the labour framework and discourage or even prevent the collabouration of highly qualified researchers working in different research centres, universities and companies, thus limiting the development of cooperation networks (it is worth noting that the aforementioned reform to the framework law on universities does include some measures to better integrate research activities to the private market. For example, it will be easier for faculty to take a leave and work in a firm). Another limitation is the fact that scientists that become entrepreneurs can only hold 10% of the stock capital if they wish to continue collaborating with their original department or centre (Ullastres, 2004). The situation is even worse for young scientists. Work conditions for young researchers during and after their post-graduate studies are far from optimal, as salaries are low and sometimes they have no access to some social security benefits. Researchers trained abroad often have difficulties in finding a job in Spain as the selection process of personnel in some universities suffers from endogamy, although a number of special programmes to facilitate their return have been recently implemented (OECD, Economic Surveys, Spain, 2005).

- Last, in Spain, like in many OECD countries, linkages between public research institutions and private business, which are another sign of a dynamic business R&D environment, are not well exploited, in part because of a managerial culture of firms that are reluctant to embark on R&D projects. In this respect, programmes that foster the participation of public researchers in private firms are useful to increase the absorption of R&D and new technologies by firms, but their budget allocation is small. Business-funded research in universities and public R&D centres is rare, and only 36% of Spanish companies consider cooperation as part of their innovative strategy, against 48% in the European Union (OECD Economic Survey, Spain, 2005).

The result is a overall decreasing innovation capacity as can be assessed by looking at patents and utility models per million inhabitants, which figure is actually converging with the national average (in controtendency in respect to the trend in the Catalunya region) (Figure 59). Of course, a key indicator is represented by the regional investment in R&D, which is higher than the national average but still far from the Lisbon objective (Figure 60).

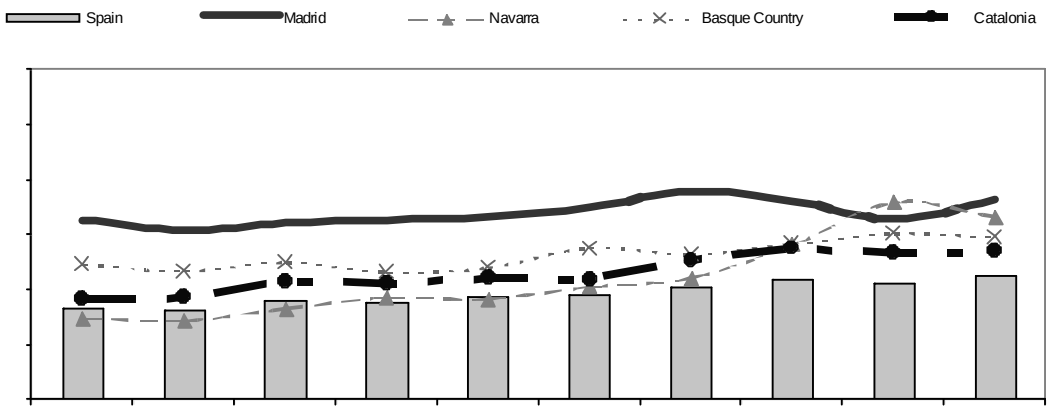
Figure 59 - Patents and utility models per million inhabitants in the Madrid metro-region and in Catalonia

(1995-2005 – Spain = 100)



Source: OEPM, EPO, Sp@cenet, UPSTO and WIPO

Figure 60 – Percentage of GDP invested in R&D in the most innovative Spanish regions



Increasing spatial disparities due to the concentration of immigrants

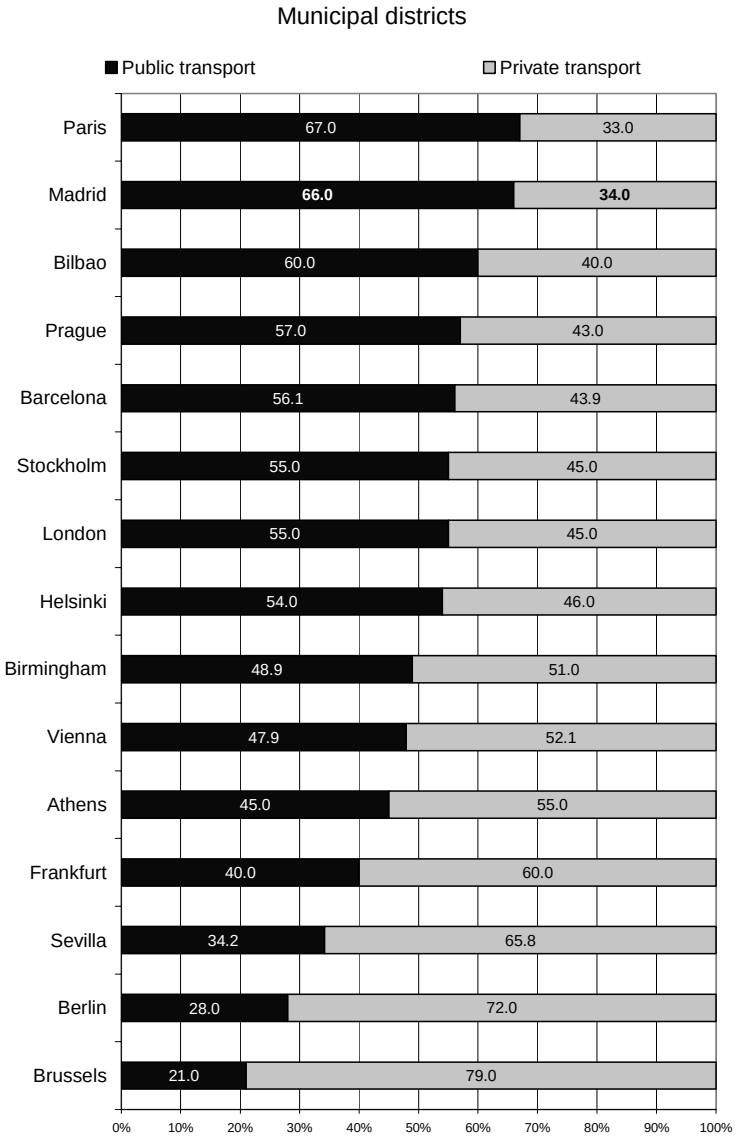
Promoting regional accessibility and housing

Madrid's regional accessibility has been decreasing in the last decade because of the traffic congestion due to fast urbanisation and rapid urban sprawl. In spite of significant efforts to improve transport accessibility in the region, the Madrid metro-region has still a *mononuclear* and *radial shape.* The bulk of the administrative functions and a large part of the economic activities remain localised in the very centre of the region (City of

Madrid) which is home to the largest labour market of the metro-region. On average, the overall regional population made 8.4 million trips per day in 2004; this was 38% more than the average value in 1996. Because of the urban sprawl, the largest improvement is concentrated in the use of private cars in which the total number in the metro region has been increasing by 5.3% between 1996 and 2004. Traffic congestion has been soaring in the last decade and this is in spite of the good endowment of public transportation facilities characterising the City of Madrid and its outskirts. According to the European Metropolitan Transport Authorities (EMTA) the City of Madrid has the second highest percentage of users of public transport just after Paris and behind other metropolitan areas like Barcelona, London, and Frankfurt (Figure 61). The fact is that many commuters come from the ring belt of the metropolitan region. The demand for public transportation is dispersed and placed in locations distant from the core of the metro-region. Therefore, private transportation is a rational choice for commuters.[85] Moreover, because of its centrality within the radial national transportation framework, Madrid also attracts the "in transit" traffic originating in other Spanish regions. Addressing this issue will be a key challenge for Madrid in the future to maintain its level of attractiveness and its potential to position as a leading logistics platform.

85 . The subway is the most effective public transportation facility, yet its competitiveness with private transportation means decrease sharply if the time that the trip takes is longer than 1 hour.

Figure 61 – Percentage of public transport and private motor vehicle trips



Source: European Metropolitan Transport Authorities (EMTA, 2005)

Madrid is increasingly facing pressures on its housing market, which has led to significant and consistent price increases, in spite of a large production of dwellings.[86] The net result of this trend of rising prices is worrying for Madrid, particularly from the point of view of access to affordable housing for the most vulnerable segments of the city, but also for its capacity to attract foreign students and skills. For instance, about

86 . The large production of new dwellings is a national characteristic. More than 490 000 new properties were produced in Spain in the 2004, a higher number than in Germany, France and Italy combined, and an increase of 17 % when compared to 2003 (La Caixa, 2005).

22% of Madrid's 20-34 years olds still live with their parents (Strasser, 2005), and housing represent almost 40% of annual household expenditures in Madrid (Table 24). In addition, the increasing flow of immigrants is also likely to face growing pressure in terms of housing affordability. From the systemic point of view, in addition to the detrimental effects of housing escalation on the general level of prices and the competitive position of the overall Spanish economy, in the worst case scenario it might mean that a gradually overheating economy of Madrid might be facing bottlenecks in attracting the labour supply in light of the pressing constraints in its land and housing markets. This is all the more worrying in light of the fact that many young people and immigrants will also enter the labour market through temporary contracts, implying a vulnerable position to negotiate long term mortgages. There are two main reasons behind this escalation of real estate prices:

- First of all, the Spanish housing system has traditionally been excessively dependent on owner occupied housing, while the rental sector covers only a marginal part of demand (Table 25). The low level of supply of private rentals in Spain is mainly due to (i) low rent levels that are insufficient to offset the apparent associated costs (damage, unpaid rent, etc) and (ii) obstructive or outdated regulatory obstacles.[87] Such conditions encourage owners to keep their property unoccupied. Therefore, the paradox is that, despite general increases in housing prices in Spain, and more particularly in Madrid, this is accompanied by large numbers of empty units. Spain's capital is one of the cities with the highest rates of vacant dwellings in Europe. The City of Madrid had 24.4% empty conventional dwellings per total number of dwellings during the period 1999-2003 while figures for Milan and London were 5% and 2.5% respectively (Eurostat, Urban audit)[88]

- Second, escalation in housing prices has been induced by the (regressive) tax deductions which are a part of the prevailing mortgage system that has introduced additional pressure on the market from the demand side and relatively low interest rates (Figure 62).

87 . In order to protect the sitting tenants against rent increases, the Spanish government decided to freeze all rents between 1946 and 1964. This stimulated many landlords to sell their dwellings. As far as this is concerned, the strong rental protection also played an important role. In case of non-payment, eviction procedures generally took many years. Consequently, homeowners became more and more reluctant to rent their vacant dwellings, and landlords cut back on their investments in maintenance and renovation. Even though the Spanish rent regulation was considerably liberalised after 1964, the Spanish government has not yet been able to reverse this trend. This is probably due to the fact to the rental protection of tenants is still rather high; also today the eviction of non-paying tenants requires long juridical procedures (Circulo de Empresarios, 2005). And since non-paying tenants might occur more frequently in Spain than in many other countries (Periodico El Mundo, 2004), there has emerged a culture in which letting a dwelling is equated with asking for problems. Consequently, many Spanish homeowners are very reluctant to let their vacant dwellings. J. Hoekstra, C.Vakili Zad (2006), High vacancy rates and high prices of housing: A Mediterranean paradox, working paper.

88 . http://www.urbanaudit.org/DataAccessed.aspx

Table 24 – Yearly householders' expenditure

	1999	2000	2001	2002	2003
Average yearly individual expenditure (€)	6 812.29	7 889.00	8 159.9	8 429.35	8 929.32
Average yearly household expenditure (€)	21 631.69	24 449.15	24 713.57	25 094.14	26 534.95
Index of individual expenditure	113.3	123.1	118.8	117.7	119.0
Structure of the expenditure (%)					
Housing and heating	38.1	35.0	36.3	37.5	39.2
Food drink, and tobacco	15.2	16.6	16.8	17.4	16.9
Transport	10.7	11.1	10.2	8.9	8.4
Hotel and restaurants	8.8	9.7	9	7.9	8.6
Clothing and shoes	6.8	6.8	6.4	6.2	5.6
Entertainment and culture	5.8	6.2	5.8	6.4	5.7
Furniture and furnishings	3.9	4.2	4.6	4.3	4.3
Communication	2.1	1.8	2	2.3	2.4
Health care	2.2	1.7	1.8	1.9	1.9
Education	1.7	1.5	1.5	1.7	1.6
Others	5.0	5.2	5.5	5.6	5.4

Source: Community of Madrid - Regional Institute of Statistics

Table 25 – Households by Spanish regions and tenancy regime of the main dwelling

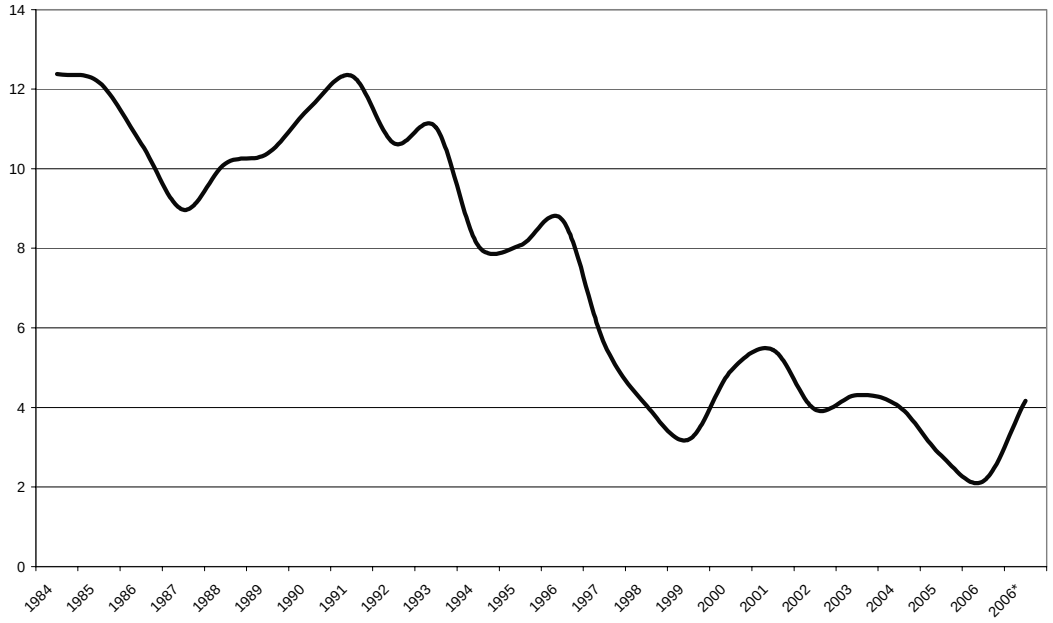
Unit: total number of households (thousands) and horizontal percentages

	Property	Rent at market prices	Rent below the market price	Free of charge
Spain	**82.0**	**7.7**	**3.8**	**6.5**
Andalusia	80.6	4.5	5.1	9.8
Aragon	83.4	6.8	2.4	7.3
Asturias	82.6	7.1	4.0	6.3
Balearic Islands	73.9	17.9	4.9	3.3
Canaries	70.3	11.4	5.7	12.6
Cantabria	84.5	5.0	1.9	8.6
Castilla y León	87.4	4.8	2.4	5.5
Castilla-La Mancha	86.7	5.0	1.0	7.4
Catalonia	79.3	11.8	4.6	4.3
Com. of Valencia	84.8	6.4	2.1	6.7
Extremadura	80.3	6.3	3.6	9.9
Galicia	84.1	5.8	2.0	8.1
Madrid	**82.4**	**9.6**	**5.3**	**2.8**
Murcia	78.8	8.9	2.2	10.1
Navarre	88.0	7.2	2.0	2.8
Basque country	88.5	4.5	3.2	3.9
Rioja	82.3	8.0	2.5	7.3
Ceuta and Melilla	58.7	12.9	16.3	12.1

Source: INE (Spanish National Institute of Statistics) 2004 Living Conditions Survey

Figure 60 – Mortgage market reference rates – Rates at issue (Mortgage certificate)

(% -- as of January of each year)



* As of December 2006

Source: Banco de España (Bank of Spain)

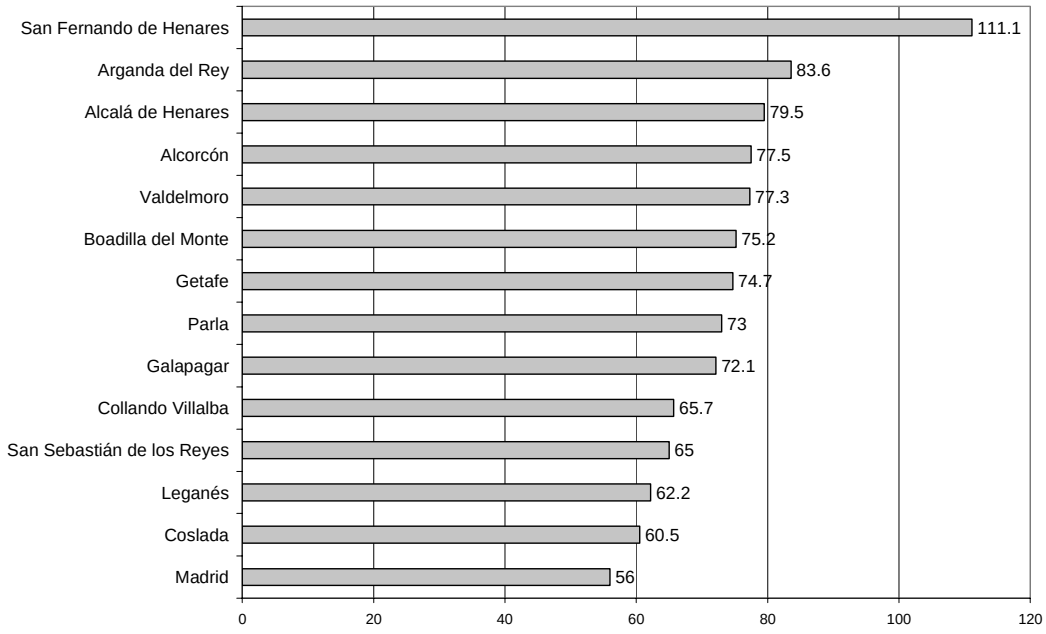
Integrating immigrants

Immigration has been one of the regional driving forces, yet like many others OECD metropolitan regions, Madrid might face some problems related to the large influx of migrants. Therefore measures should be taken to avoid what has been the common trend in large OECD metro-regions, *i.e*. the strong spatial concentration of migrants in the poorest areas. Over 16% of the local population is foreign born, mostly non-EU workers. The number of foreign population in the Madrid region has increased from 282 870 people in 2000 to 446 893 in 2002 (162 023 a difference of foreign inhabitants in just 2 years). According to a recent survey (A. Garcìa-Balleseros, B. Sanz-Berzal, 2004) the majority of immigrants (56.4% of the sample) considers Madrid their final destination. Although recent quantitative data are not available, the dramatic influx of immigrants might have increased disparities within the Madrid metro-region in last years. For instance, the municipalities with the highest increase in foreign inhabitants are all concentrated in the southeast and in the south and of the region, the poorest and most densely populated of Madrid (Figure 63), Conversely, the higher concentration of income per capita is located in the north-western area of the Madrid metro-region, in the sector of considerable recent urban growth. The north-western area of the metro-region is largely

typified by its high social level, youthfulness, recent demographic dynamism and low-density residential nature. Therefore, whilst Madrid is often quoted as having so far managed to avoid wide spatial disparities and a limited trend of ethic concentrations in some neighbourhoods, there is a natural gentrification tendency in the region in which affluent people are leaving the centre and the south of the region to go to live in the most attractive suburbs of the Madrid metro-region. The increasing spatial/income disparities due to the influx of migrants has inverted a positive trend started at the end of the 1970s in which the income distribution was becoming more egalitarian.[89]

Figure 61 – Municipalities of the Madrid metro-region with the highest increase of foreign population

(2000-02)



Source: A. Garcìa-Balleseros, B. Sanz-Berzal, Immigración y Sistema Productivo en la Comunidad de Madrid (Immigration and the Productive framework of the Community of Madrid), Comunidad de Madrid, 2004.

89. Some riots involving immigrants from Latin America in the southern area of the metro-region (the Municipality of Alcorcón) could be the signal that a level of attention has just been surpassed and that the metro-region need to re-equilibrate its spatial development in order to avoid ghettoization and the insurgency of large deprived areas within the Madrid metro-region.

EMPIRICAL ASSESSMENT OF REGIONAL AGGLOMERATION DYNAMICS

Madrid's agglomeration dynamics at the industry-level

Introduction

This part of the essay uses the input-output tables (I-O tables, here after) produced by the Community of Madrid between 1999 and 2002 to further assess that regional economy. As discussed in chapter one, I-O tables are powerful instruments for economic analysis. Especially at the regional level and over limited time-line (as in this case, 3 years) we can consider I-O tables a reliable source of information that can be used with two different aims. First of all, it is possible to detect the existence of local productive specialisations. In this case, when a sector acts as a driver to the local economy, the other sectors (tradable or not) are somehow connected with it and participate to enhance local specialisation. Local employment is concentrated as well, even though the quantity of jobs in non-tradable sectors overcomes those in the "base-sector" (Alexanderson, 1947). Through the I-O tables one can move further the sectoral analysis of the economy and may start looking at integrated supply chains that support regional economy.

The second possibility offered to economic analysis by I-O tables is to assess the trajectories of the local economy in case of a specific change of the present local equilibrium due to an exogenous shock, an endogenous improvement, or a policy. Through the I-O tables it is possible to evaluate ex ante the impact of a specific policy to support one given sector, or assess the change of local output due to variations of factors productivity, or to variation or local demand.

This section will focus on the inter-sectoral linkages within the regional economy. It will discuss the possibility of detecting local industrial specialisation through the I-O matrix by taking into account the case of the Madrid metro-region. Broadly arguing empirical evidence demonstrates that regional economies may present either a given specialisation in a single supply-chain or hosting a diversified economy. Usually, small regions tend to be specialised in a single supply chain. Because of the relatively small dimension of their labour market, the local human capital as well as the investment must be concentrated in a single supply chain (or product) to generate an optimal level of positive externalities (Marshall, 1890). When this happens, i.e. when local resources are *specialised*, the small region can compete on the international market regardless of its dimension, as, for instance, in the case of Italian Marshallian industrial districts. It is worth noting that besides manufacturing, industrial districts are home to high qualified services that support firms' competitiveness. Such finding goes against the theories of the "traditional economic geography" underlying the biunivocal relation between dimension

and specialised services' location (i.e. hierarchical position of a region/community) (Christaller, 1933; Losch, 1944).

Larger regions may present a diversified economy, where thanks to the large labour supply of labour and the large investment capacity, the local economy can have multiple specialisations and export many different kinds of goods and services. The multiple-specialisations are supported by the so-called *urbanisation economies* (Jacobs, 1969) that are common and intense in large FURs (functional urban regions).[90]

Measuring the productive specialisation of the Madrid FUR

Numerical solution for cluster analysis: the de-specialised Madrid FUR

The department of statistics of the Community of Madrid produced a 61 branch I-O matrix in 2000 and 2002. A larger matrix is also available for 1999.[91] That's a considerable amount of data available at the regional level. Such data can be used to verify the productive specialisation of the metro-region by measuring the linkages among the different braches within the local economy. This will help us to verify the findings presented in chapter two about Madrid's clusters, i.e. that the metro-region does not present a strong specialisation in one single supply chains, yet seems to be home to a complex productive framework in which, besides a relevant economic growth, there is a transition from a traditional economy based on informality (families producing their own domestic services), to a market economy where low value added services are provided by immigrants (Mingione, 1999).

The regional economy is characterised by the presence of expanding knowledge intensive sectors and a large service sector dominated by domestic services and business services.[92] There is also a very large *wholesale and retail* "cluster" whose role is to connect the different sectors of local economy (through intermediate goods) as well as to satisfy the soaring demand of goods and services coming from citizens.

A cluster analysis of the Leontief inverse matrix (LIM, here after) for 2002 is the first numerical instrument implemented in this essay for detecting the existence of local clusters through the I-O tables. Cluster analysis is an exploratory data analysis tool which aims at sorting different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. Given the above, cluster analysis can be used to discover structures in data without providing an explanation/interpretation. In other words, cluster analysis simply discovers structures in data without explaining why they exist.

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90 . For a definition of FUR (functional urban region) see pag. 32.

91 . Input-Output tables referring to the Community of Madrid are available on the site of the Instituto de Estàdisticas de la Comunidad de Madrid (http://www8.madrid.org/cerrar_apli/apli-iestadis-migrada.htm)

92 . It must recalled that a large part of business services are cleaning services, see chapter two.

The general logic of the clustering algorithm implemented in this essay (*K-means*) is to verify whether there are detectable clusters in a given dataset. In this method of clustering the number of clusters is determined *ex ante* and the algorithm forms the clusters that are to be as distinct as possible. It should be mentioned that the best number of clusters *k* leading to the greatest separation (distance) is not known as a priori and must be computed from the data. In other words, in this method it is important to set the hypothesis about clustering before starting the cluster analysis. The means on the different measures of distances for each cluster would represent a quantitative way of expressing these hypothesis or intuition. Computationally, this kind of cluster analysis is a sort of analysis of variance (ANOVA, here after) "in reverse". The iteration will start with *k* random clusters, and then move objects between those clusters with the goal to: (*i*) minimize variability within clusters, and (*ii*) maximize variability between clusters. In other words, the similarity rules will apply maximally to the members of one cluster and minimally to members belonging to the rest of the clusters. This is analogous to "ANOVA in reverse" in the sense that the significance test in ANOVA evaluates the between-group variability against the within-group variability when computing the significance test for the hypothesis that the means in the groups are different from each other. In *k-means* clustering, iterations try to move objects (e.g., cases) in and out of groups (clusters) to get the most significant ANOVA results. Usually, as the result of a *k-means* clustering analysis, the analysis will focus on the means for each cluster on each dimension to assess how distinct the *k* clusters are. Ideally, the output will be very different means for most, if not all dimensions, used in the analysis. The magnitude of the *F* values from the analysis of variance performed on each dimension is another indication of how well the respective dimension discriminates between clusters.

As it is shown in the tables below, the local economy does not have any specific specialisation in a given sector (branch) that can be considered relevant vis-à-vis the others (a part of the branches that are part of the *wholesale and retail* sector). In the first step of the cluster analysis, three numerical clusters are taken into account. In the tables below (Table 25) one can see that there are stable centres of the cluster, and the ANOVA values are quite low, thus showing a homogenous productive framework with multiple specialisations.[93] This preliminary conclusion is coherent with our hypothesis that a large metropolitan region may present multiple specialisations thanks to a large labour market and a high investment capacity. Iterations are run at three different levels of aggregation.

In the first iteration three centres of the LIM are taken into account.

93 . It is worth recalling that in this methodology the centres of the clusters are pre-determined by the software SPSS. This is the reason why the number of clusters has been changed in three different interetions. The aim was to force the sw to detect any significant centre for the given matrix

Table 25 - Notes of the iterations

Output Created		01-JUL-2007 13:56:31
Comments		
Input	**Filter**	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	61
Missing Value Handling	**Definition of Missing**	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any clustering variable used.
Syntax		QUICK CLUSTER v2 v3 v4 v5 v6 v7 v8 v9 v10 v11 v12 v13 v14 v15 v16 v17 v18 v19 v20 v21 v22 v23 v24 v25 v26 v27 v28 v29 v30 v31 v32 v33 v34 v35 v36 v37 v38 v39 v40 v41 v42 v43 v44 v45 v46 v47 v48 v49 v50 v51 v52 v53 v54 v55 v56 v57 v58 v59 v60 v61 v62 /MISSING=LIST WISE /CRITERIA= CLUSTER(3) /METHOD=CLASSIFY /PRINT ID(v1) INITIAL ANOVA CLUSTER DISTANT.
Resources	**Elapsed Time**	0:00:00,06
	Workspace Required	7208 bytes

Table 26 - Initial cluster membership

Case Number	Matriz de coeficientes técnicos.	Cluster	Distance
1	1. Productos de la agricultura y ganadería	1	,000
2	2. Electricidad, gas, agua y combustibles	3	,634
3	3. Minerales no energéticos	2	,655
4	4. Productos de la metalurgia básica y fund	3	,602
5	5. Productos de forja y talleres	3	,651
6	6. Estructuras metálicas	3	,638
7	7. Maquinaria industrial	3	,590
8	8. Material eléctrico	3	,690
9	9. Material electrónico	3	,744
10	10. Máquinas oficina y precisión	2	,633

11	11. Vehículos y sus piezas	2	,000
12	12. Otro material de transporte	3	,631
13	13. Productos cárnicos	1	,522
14	14. Productos lácteos	3	,586
15	15. Otros productos alimenticios	3	,607
16	16. Bebidas y tabaco	3	,658
17	17. Productos textiles	3	,788
18	18. Productos de la confección	3	,604
19	19. Productos de cuero y calzado	3	,691
20	20. Papel y productos de papel	3	,654
21	21. Productos impresos	3	,610
22	22. Productos de la edición	3	,582
23	23. Productos farmacéuticos	3	,657
24	24. Otros productos químicos	3	,583
25	25. Productos de la química industrial	3	,000
26	26. Productos de la química básica	3	,393
27	27. Productos del viario	3	,639
28	28. Cemento y derivados	3	,610
29	29. Productos de otras industrias no metáli	3	,654
30	30. Madera, corcho y sus productos	2	,736
31	31. Productos de caucho y materias plástica	3	,628
32	32. Muebles	3	,587
33	33. Otras manufacturas	3	,599
34	34. Trabajos de construcción	2	,620
35	35. Servicios de comercio al por mayor e in	3	,563
36	36. Servicios de comercio de vehículos y co	3	,576
37	37. Servicios de comercio al por menor y re	3	,582
38	38. Servicios de hostelería	3	,582
39	39. Servicios de transporte terrestre	3	,538
40	40. Servicios de transporte no terrestre	3	,575
41	41. Servicios anexos al transporte	3	,581
42	42. Comunicaciones	3	,590
43	43. Servicios inmobiliarios y de alquiler	3	,601
44	44. Servicios de informática	3	,586
45	45. Servicios de asesoramiento	3	,573
46	46. Servicios tecnico	3	,583
47	47. Servicios de publicidad	3	,572

48	48. Otros servicios profesionales	3	,576
49	50.1. Servicios de educación de mercado	3	,578
50	50.2. Servicios de educación de no mercado	3	,585
51	51.1. Servicios sanitarios de mercado	3	,585
52	51.2. Servicios sanitarios de no mercado	3	,584
53	52.1. Servicios recreativos de mercado	3	,604
54	52.2. Servicios recreativos de no mercado	3	,585
55	53. Servicios personales	3	,585
56	54. Servicios de intermediación financiera	3	,567
57	55. Servicios de seguros y planes de pensio	3	,570
58	56. Servicios de saneamiento público	3	,592
59	57. Servicios de asociaciones	3	,585
60	58. Servicio doméstico	3	,585
61	59. Servicios de administración pública	3	,585

Table 27 - Final Cluster Centres

	Cluster		
	1	**2**	**3**
01. Agricultura y ganadería	,0165	,0070	,0078
02. Energía y minería	,0009	,0013	,0058
03. Metálicas básicas	,0000	,0224	,0119
04. Estructuras metálicas	,0000	,0848	,0046
05. Forja y talleres	,0000	,0113	,0110
06. Artículos metálicos	,0000	,0245	,0108
07. Maquinaria industrial	,0001	,0130	,0108
08. Material eléctrico	,0000	,0153	,0118
09. Material electrónico	,0002	,0168	,0116
10. Máquinas oficina y precisión	,0003	,0534	,0075
11. Vehículos y sus piezas	,0000	,1314	,0024
12. Otro material de transporte	,0000	,0360	,0086
13. Industrias cárnicas	,3165	,0006	,0027
14. Industrias lácteas	,1516	,0007	,0076
15. Otras alimenticias	,1454	,0009	,0084
16. Bebidas y tabaco	,0021	,0000	,0106
17. Industria textil	,0000	,0054	,0123
18. Confección	,0075	,0003	,0130

19. Cuero y calzado	,0085	,0001	,0132
20. Industria del papel	,0006	,0036	,0123
21. Imprentas	,0001	,0030	,0116
22. Edición	,0000	,0003	,0121
23. Productos farmacéuticos	,0015	,0062	,0125
24. Otra química final	,0001	,0002	,0138
25. Química industrial	,0002	,0010	,0139
26. Química de base	,0001	,0012	,0139
27. Vidrio	,0000	,0033	,0113
28. Cemento y derivados	,0000	,0038	,0122
29. Otras industrias no metálica	,0000	,0117	,0111
30. Madera	,0000	,0875	,0057
31. Caucho y plástico	,0000	,0057	,0113
32. Industria del mueble	,0000	,0548	,0074
33. Otras manufacturas	,0000	,0135	,0131
34. Construcción	,0002	,0262	,0086
35. Comercio mayorista	,0019	,0091	,0080
36. Comercio vehículos y combust	,0000	,0432	,0062
37. Otro comercio menor y repara	,0033	,0034	,0049
38. Hostelería	,0445	,0022	,0091
39. Transporte terrestre	,0001	,0058	,0129
40. Transporte no terrestre	,0000	,0000	,0125
41. Servicios anexos al trans por	,0000	,0048	,0045
42. Comunicaciones	,0002	,0068	,0094
43. Inmobiliarias y alquileres	,0000	,0362	,0040
44. Actividades informáticas	,0000	,0324	,0079
45. Asesoramiento	,0000	,0059	,0092
46. Servicios tecnico	,0008	,0135	,0111
47. Publicidad	,0014	,0010	,0126
48. Otros servicios professionale	,0003	,0058	,0081
50.1. Educación de mercado	,0058	,0088	,0078
50.2. Educación de no mercado	,0003	,0016	,0022
51.1. Sanidad de mercado	,0062	,0150	,0078
51.2. Sanidad de no mercado	,0013	,0124	,0054
52.1. Servicios recreativos de m	,0087	,0016	,0106
52.2. Servicios recreativos de n	,0005	,0125	,0064
53. Servicios personales	,0114	,0153	,0073

54. Intermediación finanziera	,0000	,0050	,0043
55. Seguros y planes de pensione	,0000	,0022	,0064
56. Servicios de saneamiento	,0000	,0088	,0077
57. Actividades asociativas	,0008	,0051	,0072
58. Servicio doméstico	,0000	,0000	,0000
59. Administraciones públicas	,0013	,0042	,0040

Table 28 - Distances between Final Cluster Centres

Cluster	1	2	3
1		,439	,379
2	,439		,202
3	,379	,202	

Table 29 - ANOVA

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
01. Agricultura y ganadería	,000	2	,001	58	,110	,896
02. Energía y minería	,000	2	,001	58	,114	,893
03. Metálicas básicas	,000	2	,001	58	,383	,683
04. Estructuras metálicas	,015	2	,001	58	14,667	,000
05. Forja y talleres	,000	2	,002	58	,072	,930
06. Artículos metálicos	,001	2	,001	58	,509	,604
07. Maquinaria industrial	,000	2	,001	58	,146	,865
08. Material eléctrico	,000	2	,002	58	,085	,919
09. Material electrónico	,000	2	,003	58	,070	,933
10. Máquinas oficina y precisión	,005	2	,001	58	4,291	,018
11. Vehículos y sus piezas	,038	2	,004	58	9,586	,000
12. Otro material de transporte	,002	2	,002	58	1,159	,321
13. Industrias cárnicas	,095	2	,001	58	95,095	,000
14. Industrias lácteas	,020	2	,001	58	19,497	,000
15. Otras alimenticias	,018	2	,001	58	20,562	,000
16. Bebidas y tabaco	,000	2	,002	58	,185	,831
17. Industria textil	,000	2	,003	58	,080	,923
18. Confección	,000	2	,002	58	,172	,843
19. Cuero y calzado	,000	2	,003	58	,149	,862

20. Industria del papel	,000	2	,002	58	,144	,866
21. Imprentas	,000	2	,001	58	,337	,715
22. Edición	,000	2	,001	58	,323	,725
23. Productos farmacéuticos	,000	2	,002	58	,116	,890
24. Otra química final	,001	2	,001	58	,409	,666
25. Química industrial	,001	2	,002	58	,215	,807
26. Química de base	,001	2	,003	58	,178	,837
27. Vidrio	,000	2	,002	58	,163	,850
28. Cemento y derivados	,000	2	,002	58	,188	,829
29. Otras industrias no metálica	,000	2	,001	58	,109	,897
30. Madera	,015	2	,003	58	5,768	,005
31. Caucho y plástico	,000	2	,002	58	,091	,914
32. Industria del mueble	,005	2	,001	58	8,152	,001
33. Otras manufacturas	,000	2	,001	58	,171	,844
34. Construcción	,001	2	,001	58	1,570	,217
35. Comercio mayorista	,000	2	,000	58	,212	,810
36. Comercio vehículos y combust	,003	2	,001	58	4,884	,011
37. Otro comercio menor y repara	,000	2	,000	58	,048	,953
38. Hostelería	,001	2	,000	58	4,233	,019
39. Transporte terrestre	,000	2	,001	58	,399	,673
40. Transporte no terrestre	,000	2	,001	58	,382	,684
41. Servicios anexos al transpor	,000	2	,000	58	,154	,857
42. Comunicaciones	,000	2	,001	58	,158	,854
43. Inmobiliarias y alquileres	,002	2	,000	58	7,648	,001
44. Actividades informáticas	,001	2	,001	58	2,138	,127
45. Asesoramiento	,000	2	,000	58	,211	,810
46. Servicios técnicos	,000	2	,000	58	,254	,776
47. Publicidad	,000	2	,001	58	,337	,715
48. Otros servicios profesionale	,000	2	,000	58	,355	,703
50.1. Educación de mercado	,000	2	,000	58	,043	,958
50.2. Educación de no mercado	,000	2	,000	58	,129	,879
51.1. Sanidad de mercado	,000	2	,001	58	,187	,830
51.2. Sanidad de no mercado	,000	2	,000	58	,682	,510
52.1. Servicios recreativos de m	,000	2	,001	58	,314	,732
52.2. Servicios recreativos de n	,000	2	,000	58	1,059	,353
53. Servicios personales	,000	2	,000	58	,470	,627
54. Intermediación financiera	,000	2	,000	58	,203	,817

55. Seguros y planes de pensione	,000	2	,000	58	,345	,710
56. Servicios de saneamiento	,000	2	,000	58	,184	,832
57. Actividades asociativas	,000	2	,000	58	,184	,833
58. Servicio doméstico	,000	2	,000	58	.	.
59. Administraciones públicas	,000	2	,000	58	,179	,837

Note: The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Table 30 - Number of Cases in each Cluster

Cluster	**1**	2,000
	2	5,000
	3	54,000
Valid		61,000
Missing		,000

In the second interation the number of centres is eight.

Table 31 - Notes of the iteration

Output Created		01-JUL-2007 13:56:59
Comments		
Input	**Filter**	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	61
Missing Value Handling	**Definition of Missing**	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any clustering variable used.
Syntax		QUICK CLUSTER v2 v3 v4 v5 v6 v7 v8 v9 v10 v11 v12 v13 v14 v15 v16 v17 v18 v19 v20 v21 v22 v23 v24 v25 v26 v27 v28 v29 v30 v31 v32 v33 v34 v35 v36 v37 v38 v39 v40 v41 v42 v43 v44 v45 v46 v47 v48 v49 v50 v51 v52 v53 v54 v55 v56 v57 v58 v59 v60 v61 v62 /MISSING=LISTWISE /CRITERIA= CLUSTER(8) MXITER(10) CONVERGE(0) /METHOD=KMEANS(NOUPDATE) /PRINT ID(v1) INITIAL ANOVA CLUSTER DISTAN.

Resources	**Elapsed Time**	0:00:00,05
	Workspace Required	18808 bytes

Table 32 – Initial Cluster Centres

	Cluster							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
01. Agricultura y ganadería	,0328	,0249	,0021	,0003	,0007	,0001	,0001	,0001
02. Energía y minería	,0016	,0045	,0007	,0022	,0035	,0016	,0001	,0007
03. Metálicas básicas	,0000	,0285	,0339	,0001	,0049	,0006	,0000	,0024
04. Estructuras metálicas	,0000	,0010	,0012	,0000	,0007	,0234	,0002	,0112
05. Forja y talleres	,0000	,0943	,0027	,0000	,0043	,0014	,0001	,0594
06. Artículos metálicos	,0000	,0085	,0033	,0001	,0094	,0005	,0029	,0290
07. Maquinaria industrial	,0002	,0010	,0022	,0000	,0037	,0038	,0457	,1695
08. Material eléctrico	,0000	,0005	,0011	,0000	,0041	,0226	,0026	,3346
09. Material electrónico	,0002	,0002	,0009	,0000	,0044	,0003	,4062	,0141
10. Máquinas oficina y precisión	,0002	,0022	,0015	,0000	,0009	,0012	,1073	,0129
11. Vehículos y sus piezas	,0000	,0003	,0250	,0002	,0005	,5597	,0004	,0018
12. Otro material de transporte	,0000	,0018	,0003	,0000	,0003	,0277	,0003	,0005
13. Industrias cárnicas	,4840	,0114	,0001	,0002	,0025	,0001	,0001	,0001
14. Industrias lácteas	,3017	,0218	,0034	,0000	,0246	,0000	,0000	,0000
15. Otras alimenticias	,2758	,1123	,0038	,0000	,0186	,0000	,0000	,0001
16. Bebidas y tabaco	,0040	,0011	,0001	,0000	,0039	,0000	,0000	,0000
17. Industria textil	,0000	,0019	,0005	,4208	,0114	,0000	,0001	,0001
18. Confección	,0149	,0012	,0000	,3298	,0040	,0000	,0000	,0001
19. Cuero y calzado	,0169	,0001	,0003	,0274	,0045	,0000	,0001	,0000
20. Industria del papel	,0012	,0599	,0080	,0002	,3369	,0000	,0002	,0001
21. Imprentas	,0001	,1381	,0032	,0004	,1540	,0006	,0011	,0006
22. Edición	,0001	,0507	,0004	,0000	,2733	,0000	,0001	,0007
23. Productos farmacéuticos	,0029	,0444	,0001	,0001	,0087	,0000	,0000	,0005
24. Otra química final	,0002	,1311	,0006	,0024	,0441	,0000	,0001	,0000
25. Química industrial	,0003	,3605	,0045	,0052	,0097	,0001	,0002	,0020
26. Química de base	,0003	,3254	,0042	,0007	,0005	,0011	,0010	,0005
27. Vidrio	,0000	,0026	,0140	,0006	,0132	,0017	,0001	,0002
28. Cemento y derivados	,0000	,0049	,0011	,0000	,0048	,0000	,0000	,0009
29. Otras industrias no metálica	,0000	,0293	,0356	,0000	,0050	,0000	,0000	,0001

30. Madera	,0000	,0059	,4251	,0000	,0012	,0016	,0004	,0002
31. Caucho y plástico	,0001	,0350	,0029	,0014	,0100	,0111	,0085	,0007
32. Industria del mueble	,0000	,0044	,1782	,0018	,0071	,0020	,0442	,0147
33. Otras manufacturas	,0001	,0040	,0139	,0056	,0872	,0000	,0552	,0143
34. Construcción	,0003	,0012	,0020	,0000	,0002	,0092	,0065	,0417
35. Comercio mayorista	,0028	,0044	,0010	,0004	,0028	,0191	,0052	,0048
36. Comercio vehículos y combust	,0000	,0002	,0001	,0000	,0001	,1852	,0001	,0043
37. Otro comercio menor y repara	,0029	,0002	,0001	,0001	,0002	,0012	,0016	,0005
38. Hostelería	,0436	,0056	,0034	,0039	,0012	,0000	,0009	,0008
39. Transporte terrestre	,0001	,0018	,0005	,0001	,0009	,0184	,0013	,0033
40. Transporte no terrestre	,0000	,1880	,0000	,0000	,0000	,0000	,0000	,0002
41. Servicios anexos al transpor	,0000	,0006	,0097	,0000	,0014	,0001	,0001	,0002
42. Comunicaciones	,0003	,0004	,0002	,0004	,0077	,0001	,0274	,0204
43. Inmobiliarias y alquileres	,0000	,0029	,0021	,0001	,0153	,0155	,0098	,0027
44. Actividades informáticas	,0000	,0002	,0004	,0000	,0006	,0002	,1292	,0037
45. Asesoramiento	,0000	,0011	,0000	,0000	,0069	,0022	,0007	,0000
46. Servicios técnicos	,0013	,0091	,0014	,0020	,0175	,0111	,1211	,0313
47. Publicidad	,0000	,0091	,0048	,0000	,0056	,0000	,0001	,0000
48. Otros servicios profesionale	,0004	,0038	,0011	,0007	,0158	,0018	,0011	,0036
50.1. Educación de mercado	,0044	,0018	,0005	,0008	,0068	,0011	,0209	,0008
50.2. Educación de no mercado	,0002	,0000	,0000	,0002	,0013	,0000	,0008	,0003
51.1. Sanidad de mercado	,0002	,0095	,0002	,0012	,0012	,0001	,0039	,0008
51.2. Sanidad de no mercado	,0004	,0175	,0000	,0006	,0003	,0000	,0000	,0000
52.1. Servicios recreativos de m	,0076	,0009	,0001	,0000	,0030	,0000	,0107	,0000
52.2. Servicios recreativos de n	,0007	,0008	,0014	,0029	,0074	,0000	,0017	,0047
53. Servicios personales	,0227	,0010	,0735	,0013	,0000	,0010	,0001	,0000
54. Intermediación financiera	,0000	,0000	,0000	,0000	,0085	,0002	,0007	,0034
55. Seguros y planes de pensione	,0000	,0001	,0001	,0000	,0021	,0006	,0130	,0006
56. Servicios de saneamiento	,0000	,0176	,0001	,0004	,0006	,0206	,0000	,0001
57. Actividades asociativas	,0011	,0011	,0001	,0003	,0046	,0000	,0002	,0004
58. Servicio doméstico	,0000	,0000	,0000	,0000	,0000	,0000	,0000	,0000
59. Administraciones públicas	,0018	,0001	,0001	,0016	,0051	,0028	,0006	,0004

Table 33 - Iteration History(a)

Iteration	Change in Cluster Centres							
	1	2	3	4	5	6	7	8
1	,000	,196	,196	,000	,000	,000	,220	,368
2	,000	,000	,196	,000	,000	,000	,000	,003
3	,000	,000	,000	,000	,000	,000	,000	,000

a Convergence achieved due to no or small change in cluster centres. The maximum absolute coordinate change for any center is ,000. The current iteration is 3. The minimum distance between initial centres is ,567.

Table 34 - Cluster Membership

Case Number	Matriz de coeficientes técnicos.	Cluster	Distance
1	1. Productos de la agricultura y ganadería	1	,000
2	2. Electricidad, gas, agua y combustibles	8	,317
3	3. Minerales no energéticos	8	,331
4	4. Productos de la metalurgia básica y fund	8	,153
5	5. Productos de forja y talleres	8	,361
6	6. Estructuras metálicas	8	,269
7	7. Maquinaria industrial	8	,137
8	8. Material eléctrico	8	,368
9	9. Material electrónico	7	,220
10	10. Máquinas oficina y precisión	7	,220
11	11. Vehículos y sus piezas	6	,000
12	12. Otro material de transporte	8	,273
13	13. Productos cárnicos	8	,161
14	14. Productos lácteos	8	,112
15	15. Otros productos alimenticios	8	,218
16	16. Bebidas y tabaco	8	,301
17	17. Productos textiles	4	,000
18	18. Productos de la confección	8	,176
19	19. Productos de cuero y calzado	8	,361
20	20. Papel y productos de papel	5	,000
21	21. Productos impresos	8	,243
22	22. Productos de la edición	8	,075

23	23. Productos farmacéuticos	8	,351
24	24. Otros productos químicos	8	,106
25	25. Productos de la química industrial	2	,196
26	26. Productos de la química básica	2	,196
27	27. Productos del viario	8	,279
28	28. Cemento y derivados	8	,186
29	29. Productos de otras industrias no metáli	8	,336
30	30. Madera, corcho y sus productos	3	,000
31	31. Productos de caucho y materias plástica	8	,349
32	32. Muebles	8	,109
33	33. Otras manufacturas	8	,150
34	34. Trabajos de construcción	8	,223
35	35. Servicios de comercio al por mayor e in	8	,110
36	36. Servicios de comercio de vehículos y co	8	,081
37	37. Servicios de comercio al por menor y re	8	,057
38	38. Servicios de hostelería	8	,091
39	39. Servicios de transporte terrestre	8	,257
40	40. Servicios de transporte no terrestre	8	,052
41	41. Servicios anexos al transporte	8	,056
42	42. Comunicaciones	8	,227
43	43. Servicios inmobiliarios y de alquiler	8	,300
44	44. Servicios de informática	8	,076
45	45. Servicios de asesoramiento	8	,096
46	46. Servicios tecnico	8	,096
47	47. Servicios de publicidad	8	,211
48	48. Otros servicios profesionales	8	,153
49	50.1. Servicios de educación de mercado	8	,054
50	50.2. Servicios de educación de no mercado	8	,066
51	51.1. Servicios sanitarios de mercado	8	,068
52	51.2. Servicios sanitarios de no mercado	8	,067
53	52.1. Servicios recreativos de mercado	8	,153
54	52.2. Servicios recreativos de no mercado	8	,067
55	53. Servicios personales	8	,066
56	54. Servicios de intermediación financiera	8	,088
57	55. Servicios de seguros y planes de pensio	8	,104
58	56. Servicios de saneamiento público	8	,122
59	57. Servicios de asociaciones	8	,067

60	58. Servicio doméstico	8	,067
61	59. Servicios de administración pública	8	,067

Table 35 - Final Cluster Centres

	Cluster							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
01. Agricultura y ganadería	,0328	,0294	,0021	,0003	,0007	,0001	,0001	,0076
02. Energía y minería	,0016	,0046	,0007	,0022	,0035	,0016	,0008	,0058
03. Metálicas básicas	,0000	,0229	,0339	,0001	,0049	,0006	,0001	,0129
04. Estructuras metálicas	,0000	,0007	,0012	,0000	,0007	,0234	,0004	,0124
05. Forja y talleres	,0000	,0475	,0027	,0000	,0043	,0014	,0001	,0105
06. Artículos metálicos	,0000	,0051	,0033	,0001	,0094	,0005	,0038	,0130
07. Maquinaria industrial	,0002	,0008	,0022	,0000	,0037	,0038	,0253	,0113
08. Material eléctrico	,0000	,0004	,0011	,0000	,0041	,0226	,0151	,0126
09. Material electrónico	,0002	,0001	,0009	,0000	,0044	,0003	,2158	,0053
10. Máquinas oficina y precisión	,0002	,0016	,0015	,0000	,0009	,0012	,1809	,0059
11. Vehículos y sus piezas	,0000	,0106	,0250	,0002	,0005	,5597	,0249	,0025
12. Otro material de transporte	,0000	,0009	,0003	,0000	,0003	,0277	,0007	,0118
13. Industrias cárnicas	,4840	,0058	,0001	,0002	,0025	,0001	,0001	,0054
14. Industrias lácteas	,3017	,0151	,0034	,0000	,0246	,0000	,0000	,0069
15. Otras alimenticias	,2758	,0568	,0038	,0000	,0186	,0000	,0001	,0065
16. Bebidas y tabaco	,0040	,0006	,0001	,0000	,0039	,0000	,0000	,0109
17. Industria textil	,0000	,0015	,0005	,4208	,0114	,0000	,0001	,0050
18. Confección	,0149	,0037	,0000	,3298	,0040	,0000	,0003	,0070
19. Cuero y calzado	,0169	,0208	,0003	,0274	,0045	,0000	,0000	,0123
20. Industria del papel	,0012	,0306	,0080	,0002	,3369	,0000	,0002	,0053
21. Imprentas	,0001	,0700	,0032	,0004	,1540	,0006	,0009	,0065
22. Edición	,0001	,0253	,0004	,0000	,2733	,0000	,0003	,0063
23. Productos farmacéuticos	,0029	,0649	,0001	,0001	,0087	,0000	,0153	,0103
24. Otra química final	,0002	,1840	,0006	,0024	,0441	,0000	,0001	,0064
25. Química industrial	,0003	,2464	,0045	,0052	,0097	,0001	,0002	,0047
26. Química de base	,0003	,2963	,0042	,0007	,0005	,0011	,0007	,0030
27. Vidrio	,0000	,0014	,0140	,0006	,0132	,0017	,0002	,0114
28. Cemento y derivados	,0000	,0028	,0011	,0000	,0048	,0000	,0005	,0128
29. Otras industrias no metálica	,0000	,0148	,0356	,0000	,0050	,0000	,0001	,0113
30. Madera	,0000	,0030	,4251	,0000	,0012	,0016	,0003	,0059

31. Caucho y plástico	,0001	,0228	,0029	,0014	,0100	,0111	,0048	,0107
32. Industria del mueble	,0000	,0027	,1782	,0018	,0071	,0020	,0240	,0083
33. Otras manufacturas	,0001	,0047	,0139	,0056	,0872	,0000	,0335	,0113
34. Construcción	,0003	,0007	,0020	,0000	,0002	,0092	,0063	,0110
35. Comercio mayorista	,0028	,0042	,0010	,0004	,0028	,0191	,0068	,0083
36. Comercio vehículos y combust	,0000	,0001	,0001	,0000	,0001	,1852	,0000	,0070
37. Otro comercio menor y repara	,0029	,0001	,0001	,0001	,0002	,0012	,0013	,0054
38. Hostelería	,0436	,0028	,0034	,0039	,0012	,0000	,0038	,0101
39. Transporte terrestre	,0001	,0009	,0005	,0001	,0009	,0184	,0048	,0134
40. Transporte no terrestre	,0000	,0940	,0000	,0000	,0000	,0000	,0000	,0093
41. Servicios anexos al transpor	,0000	,0004	,0097	,0000	,0014	,0001	,0003	,0049
42. Comunicaciones	,0003	,0003	,0002	,0004	,0077	,0001	,0241	,0093
43. Inmobiliarias y alquileres	,0000	,0015	,0021	,0001	,0153	,0155	,0126	,0065
44. Actividades informáticas	,0000	,0001	,0004	,0000	,0006	,0002	,1444	,0058
45. Asesoramiento	,0000	,0005	,0000	,0000	,0069	,0022	,0063	,0097
46. Servicios técnicos	,0013	,0061	,0014	,0020	,0175	,0111	,0789	,0089
47. Publicidad	,0000	,0045	,0048	,0000	,0056	,0000	,0001	,0128
48. Otros servicios profesionale	,0004	,0028	,0011	,0007	,0158	,0018	,0039	,0083
50.1. Educación de mercado	,0044	,0009	,0005	,0008	,0068	,0011	,0313	,0076
50.2. Educación de no mercado	,0002	,0000	,0000	,0002	,0013	,0000	,0011	,0023
51.1. Sanidad de mercado	,0002	,0048	,0002	,0012	,0012	,0001	,0390	,0080
51.2. Sanidad de no mercado	,0004	,0088	,0000	,0006	,0003	,0000	,0291	,0053
52.1. Servicios recreativos de m	,0076	,0006	,0001	,0000	,0030	,0000	,0059	,0110
52.2. Servicios recreativos de n	,0007	,0005	,0014	,0029	,0074	,0000	,0072	,0073
53. Servicios personales	,0227	,0007	,0735	,0013	,0000	,0010	,0004	,0076
54. Intermediación financiera	,0000	,0000	,0000	,0000	,0085	,0002	,0117	,0043
55. Seguros y planes de pensione	,0000	,0001	,0001	,0000	,0021	,0006	,0081	,0065
56. Servicios de saneamiento	,0000	,0123	,0001	,0004	,0006	,0206	,0005	,0080
57. Actividades asociativas	,0011	,0006	,0001	,0003	,0046	,0000	,0104	,0075
58. Servicio doméstico	,0000	,0000	,0000	,0000	,0000	,0000	,0000	,0000
59. Administraciones públicas	,0018	,0001	,0001	,0016	,0051	,0028	,0014	,0043

Table 36 - Distances between Final Cluster Centres

Cluster	1	2	3	4	5	6	7	8
1		,753	,787	,825	,775	,870	,720	,628
2	,753		,647	,699	,592	,740	,564	,445

3	,787	,647		,712	,657	,736	,569	,462
4	,825	,699	,712		,705	,798	,632	,530
5	,775	,592	,657	,705		,757	,569	,461
6	,870	,740	,736	,798	,757		,658	,588
7	,720	,564	,569	,632	,569	,658		,325
8	,628	,445	,462	,530	,461	,588	,325	

Table 37 - ANOVA

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
01. Agricultura y ganadería	,000	7	,001	53	,373	,914
02. Energía y minería	,000	7	,001	53	,025	1,000
03. Metálicas básicas	,000	7	,001	53	,186	,987
04. Estructuras metálicas	,000	7	,002	53	,098	,998
05. Forja y talleres	,000	7	,002	53	,277	,960
06. Artículos metálicos	,000	7	,001	53	,090	,999
07. Maquinaria industrial	,000	7	,001	53	,160	,992
08. Material eléctrico	,000	7	,002	53	,058	1,000
09. Material electrónico	,012	7	,001	53	8,305	,000
10. Máquinas oficina y precisión	,009	7	,000	53	27,017	,000
11. Vehículos y sus piezas	,044	7	,000	53	968,294	,000
12. Otro material de transporte	,000	7	,002	53	,095	,998
13. Industrias cárnicas	,032	7	,000	53	74,265	,000
14. Industrias lácteas	,012	7	,000	53	43,515	,000
15. Otras alimenticias	,011	7	,000	53	43,902	,000
16. Bebidas y tabaco	,000	7	,002	53	,060	1,000
17. Industria textil	,024	7	,000	53	243,989	,000
18. Confección	,015	7	,001	53	26,600	,000
19. Cuero y calzado	,000	7	,003	53	,050	1,000
20. Industria del papel	,016	7	,000	53	98,999	,000
21. Imprentas	,004	7	,000	53	11,086	,000
22. Edición	,010	7	,000	53	67,880	,000
23. Productos farmacéuticos	,001	7	,002	53	,507	,825
24. Otra química final	,009	7	,000	53	23,325	,000
25. Química industrial	,016	7	,001	53	26,651	,000

26. Química de base	,024	7	,000	53	294,499	,000
27. Vidrio	,000	7	,002	53	,061	1,000
28. Cemento y derivados	,000	7	,002	53	,088	,999
29. Otras industrias no metálica	,000	7	,001	53	,152	,993
30. Madera	,025	7	,000	53	102,116	,000
31. Caucho y plástico	,000	7	,002	53	,040	1,000
32. Industria del mueble	,004	7	,000	53	11,726	,000
33. Otras manufacturas	,001	7	,001	53	1,071	,395
34. Construcción	,000	7	,001	53	,150	,993
35. Comercio mayorista	,000	7	,000	53	,226	,977
36. Comercio vehículos y combust	,005	7	,000	53	18,920	,000
37. Otro comercio menor y repara	,000	7	,000	53	,155	,993
38. Hostelería	,000	7	,000	53	,598	,755
39. Transporte terrestre	,000	7	,001	53	,208	,982
40. Transporte no terrestre	,002	7	,001	53	1,890	,090
41. Servicios anexos al transpor	,000	7	,000	53	,180	,988
42. Comunicaciones	,000	7	,001	53	,208	,982
43. Inmobiliarias y alquileres	,000	7	,000	53	,128	,996
44. Actividades informáticas	,005	7	,000	53	58,258	,000
45. Asesoramiento	,000	7	,001	53	,127	,996
46. Servicios técnicos	,001	7	,000	53	4,151	,001
47. Publicidad	,000	7	,001	53	,100	,998
48. Otros servicios profesionale	,000	7	,000	53	,239	,974
50.1. Educación de mercado	,000	7	,000	53	1,429	,213
50.2. Educación de no mercado	,000	7	,000	53	,126	,996
51.1. Sanidad de mercado	,000	7	,001	53	,467	,854
51.2. Sanidad de no mercado	,000	7	,000	53	,929	,492
52.1. Servicios recreativos de m	,000	7	,001	53	,135	,995
52.2. Servicios recreativos de n	,000	7	,000	53	,240	,973
53. Servicios personales	,001	7	,000	53	2,515	,026
54. Intermediación financiera	,000	7	,000	53	,335	,934
55. Seguros y planes de pensione	,000	7	,000	53	,146	,994
56. Servicios de saneamiento	,000	7	,000	53	,213	,981
57. Actividades asociativas	,000	7	,000	53	,154	,993
58. Servicio doméstico	,000	7	,000	53	.	.
59. Administraciones públicas	,000	7	,000	53	,250	,970

Note: The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Table 38 - Number of Cases in each Cluster

Cluster	**1**	1,000
	2	2,000
	3	1,000
	4	1,000
	5	1,000
	6	1,000
	7	2,000
	8	52,000
Valid		61,000
Missing		,000

And, finally, in the last interation the number of centres is three again (but with different centres).

Table 39 - Notes of the iteration

Output Created		01-JUL-2007 13:57:32
Comments		
Input	**Filter**	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	61
Missing Value Handling	**Definition of Missing**	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any clustering variable used.
Syntax		QUICK CLUSTER v2 v3 v4 v5 v6 v7 v8 v9 v10 v11 v12 v13 v14 v15 v16 v17 v18 v19 v20 v21 v22 v23 v24 v25 v26 v27 v28 v29 v30 v31 v32 v33 v34 v35 v36 v37 v38 v39 v40 v41 v42 v43 v44 v45 v46 v47 v48 v49 v50 v51 v52 v53 v54 v55 v56 v57 v58 v59 v60 v61 v62 /MISSING=LISTWISE /CRITERIA= CLUSTER(3) /METHOD=CLASSIFY /PRINT ID(v1) INITIAL ANOVA CLUSTER DISTAN.
Resources	**Elapsed Time**	0:00:00,05
	Workspace Required	7208 bytes

Table 40 - Initial Cluster Centres

	Cluster		
	1	**2**	**3**
01. Agricultura y ganadería	,0328	,0001	,0249
02. Energía y minería	,0016	,0016	,0045
03. Metálicas básicas	,0000	,0006	,0285
04. Estructuras metálicas	,0000	,0234	,0010
05. Forja y talleres	,0000	,0014	,0943
06. Artículos metálicos	,0000	,0005	,0085
07. Maquinaria industrial	,0002	,0038	,0010
08. Material eléctrico	,0000	,0226	,0005
09. Material electrónico	,0002	,0003	,0002
10. Máquinas oficina y precisión	,0002	,0012	,0022
11. Vehículos y sus piezas	,0000	,5597	,0003
12. Otro material de transporte	,0000	,0277	,0018

13. Industrias cárnicas	,4840	,0001	,0114
14. Industrias lácteas	,3017	,0000	,0218
15. Otras alimenticias	,2758	,0000	,1123
16. Bebidas y tabaco	,0040	,0000	,0011
17. Industria textil	,0000	,0000	,0019
18. Confección	,0149	,0000	,0012
19. Cuero y calzado	,0169	,0000	,0001
20. Industria del papel	,0012	,0000	,0599
21. Imprentas	,0001	,0006	,1381
22. Edición	,0001	,0000	,0507
23. Productos farmacéuticos	,0029	,0000	,0444
24. Otra química final	,0002	,0000	,1311
25. Química industrial	,0003	,0001	,3605
26. Química de base	,0003	,0011	,3254
27. Vidrio	,0000	,0017	,0026
28. Cemento y derivados	,0000	,0000	,0049
29. Otras industrias no metálica	,0000	,0000	,0293
30. Madera	,0000	,0016	,0059
31. Caucho y plástico	,0001	,0111	,0350
32. Industria del mueble	,0000	,0020	,0044
33. Otras manufacturas	,0001	,0000	,0040
34. Construcción	,0003	,0092	,0012
35. Comercio mayorista	,0028	,0191	,0044
36. Comercio vehículos y combust	,0000	,1852	,0002
37. Otro comercio menor y repara	,0029	,0012	,0002
38. Hostelería	,0436	,0000	,0056
39. Transporte terrestre	,0001	,0184	,0018
40. Transporte no terrestre	,0000	,0000	,1880
41. Servicios anexos al transpor	,0000	,0001	,0006
42. Comunicaciones	,0003	,0001	,0004
43. Inmobiliarias y alquileres	,0000	,0155	,0029
44. Actividades informáticas	,0000	,0002	,0002
45. Asesoramiento	,0000	,0022	,0011
46. Servicios tecnico	,0013	,0111	,0091
47. Publicidad	,0000	,0000	,0091
48. Otros servicios profesionale	,0004	,0018	,0038
50.1. Educación de mercado	,0044	,0011	,0018

50.2. Educación de no mercado	,0002	,0000	,0000
51.1. Sanidad de mercado	,0002	,0001	,0095
51.2. Sanidad de no mercado	,0004	,0000	,0175
52.1. Servicios recreativos de m	,0076	,0000	,0009
52.2. Servicios recreativos de n	,0007	,0000	,0008
53. Servicios personales	,0227	,0010	,0010
54. Intermediación financiera	,0000	,0002	,0000
55. Seguros y planes de pensione	,0000	,0006	,0001
56. Servicios de saneamiento	,0000	,0206	,0176
57. Actividades asociativas	,0011	,0000	,0011
58. Servicio doméstico	,0000	,0000	,0000
59. Administraciones públicas	,0018	,0028	,0001

Table 41 - Cluster Membership

Case Number	Matriz de coeficientes técnicos.	Cluster	Distance
1	1. Productos de la agricultura y ganadería	1	,000
2	2. Electricidad, gas, agua y combustibles	3	,634
3	3. Minerales no energéticos	2	,655
4	4. Productos de la metalurgia básica y fund	3	,602
5	5. Productos de forja y talleres	3	,651
6	6. Estructuras metálicas	3	,638
7	7. Maquinaria industrial	3	,590
8	8. Material eléctrico	3	,690
9	9. Material electrónico	3	,744
10	10. Máquinas oficina y precisión	2	,633
11	11. Vehículos y sus piezas	2	,000
12	12. Otro material de transporte	3	,631
13	13. Productos cárnicos	1	,522
14	14. Productos lácteos	3	,586
15	15. Otros productos alimenticios	3	,607
16	16. Bebidas y tabaco	3	,658
17	17. Productos textiles	3	,788
18	18. Productos de la confección	3	,604
19	19. Productos de cuero y calzado	3	,691
20	20. Papel y productos de papel	3	,654
21	21. Productos impresos	3	,610

22	22. Productos de la edición	3	,582
23	23. Productos farmacéuticos	3	,657
24	24. Otros productos químicos	3	,583
25	25. Productos de la química industrial	3	,000
26	26. Productos de la química básica	3	,393
27	27. Productos del viario	3	,639
28	28. Cemento y derivados	3	,610
29	29. Productos de otras industrias no metáli	3	,654
30	30. Madera, corcho y sus productos	2	,736
31	31. Productos de caucho y materias plástica	3	,628
32	32. Muebles	3	,587
33	33. Otras manufacturas	3	,599
34	34. Trabajos de construcción	2	,620
35	35. Servicios de comercio al por mayor e in	3	,563
36	36. Servicios de comercio de vehículos y co	3	,576
37	37. Servicios de comercio al por menor y re	3	,582
38	38. Servicios de hostelería	3	,582
39	39. Servicios de transporte terrestre	3	,538
40	40. Servicios de transporte no terrestre	3	,575
41	41. Servicios anexos al transporte	3	,581
42	42. Comunicaciones	3	,590
43	43. Servicios inmobiliarios y de alquiler	3	,601
44	44. Servicios de informática	3	,586
45	45. Servicios de asesoramiento	3	,573
46	46. Servicios tecnico	3	,583
47	47. Servicios de publicidad	3	,572
48	48. Otros servicios profesionales	3	,576
49	50.1. Servicios de educación de mercado	3	,578
50	50.2. Servicios de educación de no mercado	3	,585
51	51.1. Servicios sanitarios de mercado	3	,585
52	51.2. Servicios sanitarios de no mercado	3	,584
53	52.1. Servicios recreativos de mercado	3	,604
54	52.2. Servicios recreativos de no mercado	3	,585
55	53. Servicios personales	3	,585
56	54. Servicios de intermediación financiera	3	,567
57	55. Servicios de seguros y planes de pensio	3	,570
58	56. Servicios de saneamiento público	3	,592

59	57. Servicios de asociaciones	3	,585
60	58. Servicio doméstico	3	,585
61	59. Servicios de administración pública	3	,585

Table 42 - Final Cluster Centres

	Cluster		
	1	**2**	**3**
01. Agricultura y ganadería	,0165	,0070	,0078
02. Energía y minería	,0009	,0013	,0058
03. Metálicas básicas	,0000	,0224	,0119
04. Estructuras metálicas	,0000	,0848	,0046
05. Forja y talleres	,0000	,0113	,0110
06. Artículos metálicos	,0000	,0245	,0108
07. Maquinaria industrial	,0001	,0130	,0108
08. Material eléctrico	,0000	,0153	,0118
09. Material electrónico	,0002	,0168	,0116
10. Máquinas oficina y precisión	,0003	,0534	,0075
11. Vehículos y sus piezas	,0000	,1314	,0024
12. Otro material de transporte	,0000	,0360	,0086
13. Industrias cárnicas	,3165	,0006	,0027
14. Industrias lácteas	,1516	,0007	,0076
15. Otras alimenticias	,1454	,0009	,0084
16. Bebidas y tabaco	,0021	,0000	,0106
17. Industria textil	,0000	,0054	,0123
18. Confección	,0075	,0003	,0130
19. Cuero y calzado	,0085	,0001	,0132
20. Industria del papel	,0006	,0036	,0123
21. Imprentas	,0001	,0030	,0116
22. Edición	,0000	,0003	,0121
23. Productos farmacéuticos	,0015	,0062	,0125
24. Otra química final	,0001	,0002	,0138
25. Química industrial	,0002	,0010	,0139
26. Química de base	,0001	,0012	,0139
27. Vidrio	,0000	,0033	,0113
28. Cemento y derivados	,0000	,0038	,0122
29. Otras industrias no metálica	,0000	,0117	,0111

30. Madera	,0000	,0875	,0057
31. Caucho y plástico	,0000	,0057	,0113
32. Industria del mueble	,0000	,0548	,0074
33. Otras manufacturas	,0000	,0135	,0131
34. Construcción	,0002	,0262	,0086
35. Comercio mayorista	,0019	,0091	,0080
36. Comercio vehículos y combust	,0000	,0432	,0062
37. Otro comercio menor y repara	,0033	,0034	,0049
38. Hostelería	,0445	,0022	,0091
39. Transporte terrestre	,0001	,0058	,0129
40. Transporte no terrestre	,0000	,0000	,0125
41. Servicios anexos al transpor	,0000	,0048	,0045
42. Comunicaciones	,0002	,0068	,0094
43. Inmobiliarias y alquileres	,0000	,0362	,0040
44. Actividades informáticas	,0000	,0324	,0079
45. Asesoramiento	,0000	,0059	,0092
46. Servicios tecnico	,0008	,0135	,0111
47. Publicidad	,0014	,0010	,0126
48. Otros servicios profesionale	,0003	,0058	,0081
50.1. Educación de mercado	,0058	,0088	,0078
50.2. Educación de no mercado	,0003	,0016	,0022
51.1. Sanidad de mercado	,0062	,0150	,0078
51.2. Sanidad de no mercado	,0013	,0124	,0054
52.1. Servicios recreativos de m	,0087	,0016	,0106
52.2. Servicios recreativos de n	,0005	,0125	,0064
53. Servicios personales	,0114	,0153	,0073
54. Intermediación financiera	,0000	,0050	,0043
55. Seguros y planes de pensione	,0000	,0022	,0064
56. Servicios de saneamiento	,0000	,0088	,0077
57. Actividades asociativas	,0008	,0051	,0072
58. Servicio doméstico	,0000	,0000	,0000
59. Administraciones públicas	,0013	,0042	,0040

Table 43 - Distances between Final Cluster Centres

Cluster	1	2	3
1		,439	,379

2	,439		,202
3	,379	,202	

Table 44 - ANOVA

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
01. Agricultura y ganadería	,000	2	,001	58	,110	,896
02. Energía y minería	,000	2	,001	58	,114	,893
03. Metálicas básicas	,000	2	,001	58	,383	,683
04. Estructuras metálicas	,015	2	,001	58	14,667	,000
05. Forja y talleres	,000	2	,002	58	,072	,930
06. Artículos metálicos	,001	2	,001	58	,509	,604
07. Maquinaria industrial	,000	2	,001	58	,146	,865
08. Material eléctrico	,000	2	,002	58	,085	,919
09. Material electrónico	,000	2	,003	58	,070	,933
10. Máquinas oficina y precisión	,005	2	,001	58	4,291	,018
11. Vehículos y sus piezas	,038	2	,004	58	9,586	,000
12. Otro material de transporte	,002	2	,002	58	1,159	,321
13. Industrias cárnicas	,095	2	,001	58	95,095	,000
14. Industrias lácteas	,020	2	,001	58	19,497	,000
15. Otras alimenticias	,018	2	,001	58	20,562	,000
16. Bebidas y tabaco	,000	2	,002	58	,185	,831
17. Industria textil	,000	2	,003	58	,080	,923
18. Confección	,000	2	,002	58	,172	,843
19. Cuero y calzado	,000	2	,003	58	,149	,862
20. Industria del papel	,000	2	,002	58	,144	,866
21. Imprentas	,000	2	,001	58	,337	,715
22. Edición	,000	2	,001	58	,323	,725
23. Productos farmacéuticos	,000	2	,002	58	,116	,890
24. Otra química final	,001	2	,001	58	,409	,666
25. Química industrial	,001	2	,002	58	,215	,807
26. Química de base	,001	2	,003	58	,178	,837
27. Vidrio	,000	2	,002	58	,163	,850
28. Cemento y derivados	,000	2	,002	58	,188	,829
29. Otras industrias no metálica	,000	2	,001	58	,109	,897

30. Madera	,015	2	,003	58	5,768	,005
31. Caucho y plástico	,000	2	,002	58	,091	,914
32. Industria del mueble	,005	2	,001	58	8,152	,001
33. Otras manufacturas	,000	2	,001	58	,171	,844
34. Construcción	,001	2	,001	58	1,570	,217
35. Comercio mayorista	,000	2	,000	58	,212	,810
36. Comercio vehículos y combust	,003	2	,001	58	4,884	,011
37. Otro comercio menor y repara	,000	2	,000	58	,048	,953
38. Hostelería	,001	2	,000	58	4,233	,019
39. Transporte terrestre	,000	2	,001	58	,399	,673
40. Transporte no terrestre	,000	2	,001	58	,382	,684
41. Servicios anexos al transpor	,000	2	,000	58	,154	,857
42. Comunicaciones	,000	2	,001	58	,158	,854
43. Inmobiliarias y alquileres	,002	2	,000	58	7,648	,001
44. Actividades informáticas	,001	2	,001	58	2,138	,127
45. Asesoramiento	,000	2	,000	58	,211	,810
46. Servicios técnicos	,000	2	,000	58	,254	,776
47. Publicidad	,000	2	,001	58	,337	,715
48. Otros servicios profesionale	,000	2	,000	58	,355	,703
50.1. Educación de mercado	,000	2	,000	58	,043	,958
50.2. Educación de no mercado	,000	2	,000	58	,129	,879
51.1. Sanidad de mercado	,000	2	,001	58	,187	,830
51.2. Sanidad de no mercado	,000	2	,000	58	,682	,510
52.1. Servicios recreativos de m	,000	2	,001	58	,314	,732
52.2. Servicios recreativos de n	,000	2	,000	58	1,059	,353
53. Servicios personales	,000	2	,000	58	,470	,627
54. Intermediación financiera	,000	2	,000	58	,203	,817
55. Seguros y planes de pensione	,000	2	,000	58	,345	,710
56. Servicios de saneamiento	,000	2	,000	58	,184	,832
57. Actividades asociativas	,000	2	,000	58	,184	,833
58. Servicio doméstico	,000	2	,000	58	.	.
59. Administraciones públicas	,000	2	,000	58	,179	,837

Note: The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Table 45 - Number of Cases in each Cluster

Cluster	1	2,000
	2	5,000
	3	54,000
Valid		61,000
Missing		,000

Backward and forward linkages in the Madrid productive framework

The paragraph above has showed that there is not any clear specialisation within the Madrid-based productive framework, thus it is possible to state that many different sectors act as drivers for of the regional economy. However, the analysis has been conducted without taking into account the functional linkages among sectors, yet their position and distance on the LIM. A more robust way to understand which sectors represent the pillars of the local economy is to detect and evaluate the intensity of backward and forward linkages among the 61 branches of the I-O tables. Recalling what we stated in the first chapter of this essay, we detect both backward linkages and forward linkages within the Madrid productive framework.[94]

The output multipliers, defined as the column sum of the Leontief inverse indicate backward linkages. Using the row sums of the Leontief inverse, the output multipliers are given by $(I-A)^{-1}\ i$. Table 46, below, shows the *i*th(s) sectoral multipliers and report the backward linkages of each given sector as in index in which z_{ij} is an element of $(I-A)^{-1}$.

Table 46 – Sectoral output multipliers in the Madrid metro-region (2002)

Sector	output multiplier	index $n\sum_i z_{ij} / \sum_j \sum_i z_{ij}$ (BW linkages)
Servicio doméstico	1,0000	0,393589724
Educación de no mercado	1,3090	0,515228072
Administraciones públicas	1,5792	0,621570029
Intermediación finanziera	1,5817	0,622552568
Otro comercio menor y reparación	1,6401	0,645536018

94 See pag. 26.

Energía y minería	1,6419	0,646229961
Servicios anexos al transporte	1,6706	0,657544692
Seguros y planes de pensiones	1,7925	0,705494021
Sanidad de no mercado	1,9489	0,767062403
Actividades asociativas	1,9796	0,779135537
Servicios recreativos de no mercado	1,9822	0,780153911
Inmobiliarias y alquileres	1,9962	0,785681129
Servicios de saneamiento	2,1250	0,836367296
Otros servicios profesionales	2,1374	0,841260785
Educación de mercado	2,1791	0,857675023
Comercio mayorista	2,1806	0,858257168
Asesoramiento	2,2408	0,881949956
Servicios personales	2,2723	0,894343866
Comunicaciones	2,3073	0,908145636
Agricultura y ganadería	2,3317	0,917730445
Sanidad de mercado	2,3820	0,937549932
Bebidas y tabaco	2,4729	0,973322004
Hostelería	2,4735	0,973562204
Servicios recreativos de mercado	2,4982	0,983271898
Vidrio	2,5033	0,985261172
Actividades informáticas	2,5281	0,995048717
Comercio vehículos y combustibles	2,5283	0,995124964
Cemento y derivados	2,5374	0,998698916
Construcción	2,5517	1,004337101
Otras industrias no metálicas	2,6716	1,051508962
Transporte no terrestre	2,6911	1,059198688

Caucho y plástico	2,7080	1,065848445
Transporte terrestre	2,7237	1,072031256
Otro material de transporte	2,7299	1,074479011
Edición	2,7411	1,078850376
Publicidad	2,7646	1,088135968
Imprentas	2,7793	1,093889925
Servicios tecnico	2,7962	1,100567751
Industrias lácteas	2,8152	1,108028498
Maquinaria industrial	2,8263	1,112409731
Industria textil	2,8332	1,115115596
Máquinas oficina y precisión	2,8497	1,121620548
Forja y talleres	2,8541	1,123327932
Estructuras metálicas	2,8642	1,127319803
Industria del papel	2,8767	1,132227608
Industrias cárnicas	2,9200	1,14929122
Industria del mueble	2,9462	1,159601117
Otras alimenticias	2,9673	1,167897434
Metálicas básicas	2,9714	1,169494306
Artículos metálicos	3,0005	1,180974132
Confección	3,0059	1,183095952
Material eléctrico	3,0072	1,18359186
Material electrónico	3,0180	1,187862445
Productos farmacéuticos	3,0578	1,203530056
Otras manufacturas	3,1444	1,237586273
Cuero y calzado	3,1892	1,255234406
Madera	3,2261	1,269745252

Otra química final	3,2551	1,281180642
Química industrial	3,3204	1,306886568
Química de base	3,3671	1,325244527
Vehículos y sus piezas	3,6905	1,452538566

Similarly, according to the model presented above in the essay to determine forward linkages we will assume that intermediate inputs are proportional to total inputs (Jones, 1976)

$$x_{ij} = b_{ij} X_j.$$

This means that the intermediate flows are supply led rather than demand led. Such hypothesis can be considered as true over the short run, even in a regional economy, such as of Madrid, that has shown a remarkable capacity to expand its output. Then the row sums of $(I\text{-}B)^{-1}$ are measures of forward linkages. The table below (Table 47) shows the "input multiplier" and an index measuring the intensity of forward linkages per each sector where q_{ij} is an element of $(I\text{-}B)^{-1}$.

Table 47 – Sectoral input multipliers in the Madrid metro-region (2002)

Sector	Input multiplier	Index $n\sum_i q_{ij} / \sum_j \sum_i q_{ij}$ (FW linkages)
Servicio doméstico	1,0000	0,39359
Servicios de administración pública	1,0000	0,39359
Servicios recreativos de no mercado	1,0067	0,396237
Servicios sanitarios de no mercado	1,0310	0,40578
Servicios de educación de no mercado	1,0439	0,410859
Servicios personales	1,0627	0,418266
Servicios de asociaciones	1,0994	0,432713
Servicios sanitarios de mercado	1,1664	0,459083
Servicios de comercio al por menor y reparación	1,2020	0,473095

Productos lácteos	1,2358	0,486398
Servicios de saneamiento público	1,2458	0,49034
Productos de la edición	1,2576	0,494991
Otros productos químicos	1,2716	0,500473
Servicios de educación de mercado	1,2989	0,511237
Servicios recreativos de mercado	1,3809	0,543499
Productos de la confección	1,3921	0,547924
Productos cárnicos	1,3961	0,549475
Muebles	1,4082	0,554248
Servicios anexos al transporte	1,4873	0,585379
Servicios de transporte no terrestre	1,5177	0,597358
Productos de cuero y calzado	1,6534	0,650768
Bebidas y tabaco	1,7109	0,673409
Productos del vidrio	1,7531	0,69001
Cemento y derivados	1,8457	0,726457
Servicios de informática	1,9050	0,749808
Productos de la metalurgia básica y fundición	1,9115	0,752354
Servicios de seguros y planes de pensiones	1,9629	0,772596
Otros productos alimenticios	1,9896	0,783106
Servicios de hostelería	1,9945	0,785014
Servicios de comercio de vehículos y combustibles	2,0032	0,78843
Productos farmacéuticos	2,1770	0,856862
Otro material de transporte	2,1886	0,861424
Otras manufacturas	2,2938	0,902811
Maquinaria industrial	2,3381	0,920263
Servicios tecnico	2,4315	0,957003

Productos impresos	2,6257	1,033446
Productos textiles	2,7913	1,098645
Productos de la agricultura y ganadería	2,9272	1,1521
Servicios de asesoramiento	3,0147	1,186545
Servicios de intermediación finanziera	3,0938	1,217671
Servicios de comercio al por mayor e intermediarios	3,1150	1,226046
Productos de forja y talleres	3,1411	1,236305
Trabajos de construcción	3,2093	1,263153
Productos de otras industrias no metálicas	3,3005	1,299031
Estructuras metálicas	3,4059	1,340521
Material eléctrico	3,4514	1,358422
Madera, corcho y sus produco	3,4518	1,35861
Máquinas oficina y precisión	3,5152	1,383537
Productos de caucho y materias plásticas	3,5870	1,411824
Minerales no energéticos	3,6257	1,427019
Otros servicios profesionales	3,6571	1,439409
Comunicaciones	3,7144	1,461947
Servicios de publicidad	3,8233	1,504823
Productos de la química básica	4,0709	1,602252
20. Papel y productos de papel	4,2021	1,653887
Material electrónico	4,3167	1,699006
Vehículos y sus piezas	4,5266	1,781607
Servicios inmobiliarios y de aquile	5,0641	1,99317
Electricidad, gas, agua y combustibles	5,3715	2,114181
Servicios de transporte terrestre	5,7599	2,267043
Productos de la química industrial	7,5585	2,974949

The indexes of tables 46-47 can be used to measure the relative strength of the forward and backward linkages within the Madrid FUR. Bearing in mind that in the case of the Madrid FUR the dependence on import is very high, since the region is strictly connected with other regions within Spain, it is possible to draw some conclusions looking at the numerical results. According to Hirschman (1958) key sectors of the local economy are those sectors with both backward and forward indices greater than unity. However, the most interesting aspect which might emerge, for developing economies, is the appearance of sectors that "nearly" qualify as key sectors. This conclusion was first introduced by Matallah and Proops (1994), and further developed by the same authors (Matallah, Proops, 1996), and can be summarized by defining "strong", "intermediate", and "weak" as in table 48 below (Matallah, Proops, 1996).

Table 48 – Three different intensities of backward (forward) linkages

Strong linkage index	*index* > 1
Intermediate linkage index	0.9 > *index* = 1
Weak linkage index	*index* < 0.9

Source: Matallah, Proops, 1996

Following the methodology showed in the table above it is possible to understand what the key sectors in the Madrid economy are: i.e. those sectors acting as pillars of the local economy by generating a large number of bw and fw linkages. The table 49, below, is the rank of the indexes used as a measure of bw and fw linkages. It is very interesting to note that the traditional manufacturing (and particularly the automotive industry) plays an important role in the regional economy, that, as was assessed in chapter two, it is mainly a post-industrial economy in which the service sector generates the larger part of the regional GDP.

Through this new piece of analysis it possible to assess that the service sector is not autonomous in the region and depends on manufacturing activities. What it is important to note is that these manufacturing activities are probably changing following the evolution of the local technology and the local capacity to innovate. However, to verify this hypothesis it would be necessary to have a long time series and to apply the same methodology at each period to assess how the ranking evolves.

Table 49 – Rank of Backward and Forward linkages in the Madrid metro-region

Sector	BW	FW
Servicio doméstico	0,39359	0,39359
Educación de no mercado	0,51523	0,410859
Administraciones públicas	0,62157	0,39359

Intermediación finanziera	0,62255	1,217671
Otro comercio menor y reparación	0,64554	0,473095
Energía y minería	0,64623	2,114181
Servicios anexos al transporte	0,65754	0,585379
Seguros y planes de pensiones	0,70549	0,772596
Sanidad de no mercado	0,76706	0,40578
Actividades asociativas	0,77914	0,432713
Servicios recreativos de no mercado	0,78015	0,396237
Inmobiliarias y alquileres	0,78568	1,99317
Servicios de saneamiento	0,83637	0,49034
Otros servicios profesionales	0,84126	1,439409
Educación de mercado	0,85768	0,511237
Comercio mayorista	0,85826	1,226046
Asesoramiento	0,88195	1,186545
Servicios personales	0,89434	0,418266
Comunicaciones	0,90815	1,461947
Agricultura y ganadería	0,91773	1,1521
Sanidad de mercado	0,93755	0,459083
Bebidas y tabaco	0,97332	0,673409
Hostelería	0,97356	0,785014
Servicios recreativos de mercado	0,98327	0,543499
Vidrio	0,98526	0,69001
Actividades informáticas	0,99505	0,749808
Comercio vehículos y combustibles	0,99512	0,78843
Cemento y derivados	0,99870	0,726457
Construcción	1,00434	1,263153

Otras industrias no metálicas	1,05151	1,299031
Transporte no terrestre	1,05920	0,597358
Caucho y plástico	1,06585	1,411824
Transporte terrestre	1,07203	2,267043
Otro material de transporte	1,07448	0,861424
Edición	1,07885	0,494991
Publicidad	1,08814	1,504823
Imprentas	1,09389	1,033446
Servicios tecnico	1,10057	0,957003
Industrias lácteas	1,10803	0,486398
Maquinaria industrial	1,11241	0,920263
Industria textil	1,11512	1,098645
Máquinas oficina y precisión	1,12162	1,383537
Forja y talleres	1,12333	1,236305
Estructuras metálicas	1,12732	1,340521
Industria del papel	1,13223	1,653887
Industrias cárnicas	1,14929	0,549475
Industria del mueble	1,15960	0,554248
Otras alimenticias	1,16790	0,783106
Metálicas básicas	1,16949	0,752354
Artículos metálicos	1,18097	1,427019
Confección	1,18310	0,547924
Material eléctrico	1,18359	1,358422
Material electrónico	1,18786	1,699006
Productos farmacéuticos	1,20353	0,856862
Otras manufacturas	1,23759	0,902811

Cuero y calzado	1,25523	0,650768
Madera	1,26975	1,35861
Otra química final	1,28118	0,500473
Química industrial	1,30689	2,974949
Química de base	1,32524	1,602252
Vehículos y sus piezas	1,45254	1,781607

Limits of – and objections to – this methodology

The results obtained are not neutral to the level of aggregation. In fact, a high level of aggregation may have the following results. First, aggregation reduces the technological factor of the intersectoral relationship described by the input-output table, i.e. reducing the impact of a sector on the economy. Second, it reduces the homogeneity of sectors. In an input-output table, classification and division of the economic sectors might affect the sectoral hierarchy. Another limitation of this approach is that the inter-sectoral relationship derived from an input-output table should reflect the technological structure of the regional economy. However, the elements of an input-output table are the result of a complex interaction of several factors, i.e. economic, technical, institutional, etc. Thus it is challenging for a model to consider all this variables and to take them into account while assessing the regional productive framework.

There are also external limits. The methods used and the results obtained are based mainly on the current interindustry flow matrices. They do not take into account the transaction of fixed capital within the economy. The integration of fixed capital would modify the results already obtained. Their integration would necessitate the construction of the capital matrices and the utilisation of a dynamic Leontief model (Miernyk, 1977). Moreover, the effects induced by the spending of revenues paid to households are not included. Their integration once more would modify the classification of the economic sectors. Theoretically speaking, their integration is seen as possible by making them endogenous within the economic system (Morrisson and Smith, 1979).

Finally, some objections could be raised against this approach. The first objection concerns the hypothesis of stable technical coefficients, which is based on the assumptions of the static Leontief model. The economy is mainly in a continuous dynamic state, which means that the sectoral hierarchy might not be stable. Given that this essay takes into account very close periods, this objection may not be valid in this context. The second objection is advanced from the relation between linkages and the efficiency of the economy. The indices calculated do not take into account the differential efficiency of the several branches of the national economy. For instance, backward linkages might favour those sectors with limited efficiency with regard to

intermediate consumption. The third and last objection concerns the problem of employment. The methods used do not take the variable of employment into account, bearing in mind that economic sectors have different potential with regard to this aspect. In a region like Madrid the labour market is buoyant, it would have been extremely difficult to take into account the dynamics of local employment.

CONCLUSIONS

From the 1970s onwards, a scenario of significant political, technological and socioeconomic restructuring has led to a resurge in the debate on the role of regional economies in the international economy, and on how their actual performance can be benchmarked in light of regional economic theory. Since the 1970s we have witnessed a series of remarkable transformations. The crisis of the Breton Woods system, the subsequent move to a system of flexible exchange rates that was consolidated in 1973, and the tendency towards a more de-regulated international monetary system created an international environment of higher volatility and turbulence in international financial markets. This scenario was intensified by a series of rapid and intense technological advances that allowed for the introduction of real time operations in international financial and capital markets, and the creation of new instruments and products (derivatives, the Eurodollar market, etc.). In light of this increasingly complex and volatile international scenario, nation government were encountering difficulties to fine tune their traditional macroeconomic policy recipes in terms of a trade-off between unemployment and inflation. Instead, the consistent rise of oil prices and unemployment levels fuelled a rather new situation of stagflation (stagnation combined with inflation) for which the standard fiscal and monetary policy instruments of macroeconomic policy proved surprisingly unprepared. Finally, an intense process of productive restructuring created a situation characterized by a transition from large scale mass production of homogeneous goods (Fordism) towards more flexible, demand driven production systems.

The compounded effect of the above mentioned transformations triggered a renewed multidisciplinary debate on the roles of nations and regions (and in particular metropolitan regions) within the global economy. The renewed interest in regional economics, for example, lead to a more in depth discussion on the spatial and territorial dimensions of economies, in addition to the more traditional research that was undertaken on macro and microeconomic issues. In Italy, for instance, “industrial districts” were discovered and a fruitful debate was open about their efficiency and their capacity to compete on the international market.[95] Moreover, there was an increasing awareness on the need for a multidisciplinary approach. As a consequence, since the 1980s, an embryonic multidisciplinary field in regional studies has developed, providing a diversity of methodological approaches and empirical case studies, all focusing on the central role of regional economic processes. A first example of this tendency was the

95 . The debate in Italy firstly focussed on the capacity of small firms to survive. One of the possible strategies taken into account by policy makers was to promote merging among SMEs to increase firms’ average dimension and then their efficiency (Brusco, Righi, 1989).

literature on innovation and learning systems, whereby the issue of spatial proximity played a central role in triggering innovation in regions.[96] A second example of this tendency occurred within the urban planning and urban sociology literature, where it was increasingly acknowledged that the built environment was intensively influenced by urban and metropolitan economic processes.[97]

The present essay tries to retrace regional economics and locational theory and reaches the conclusion that such a field has not yet produced a single approach that can explain and reproduce the complex (exogenous and endogenous) dynamics underpinning regional competitiveness. In other words, there is no single model that is able to describe the device generating agglomeration dynamics in a given region. Neo-classic approaches, for instance, can only describe one of the infinite number of patterns in which the system may evolve. Because of the interaction of different forces, even small changes in some variables are able to change the system from one pattern to another (an emergent structure). Such dynamic shows three main features (Arthur 2005). First of all, the system has a constant incentive to evolve (while according to static economics, agents should not have any incentive to move from the equilibrium once it is achieved). Second, the evolutionary path of the system is not given and even small variations can change the intensity or the direction of the vector field. Finally, while in static economics agents try to form their expectations about an outcome that is a function of their very expectations (a self-referential situation), in the dynamic approach such condition is considered a very special event.

Nonetheless, as discussed in the essay, in spite of the rise of complexity, it is still possible to assess regional dynamics along *four important dimensions*. These dimensions should not be looked upon as a standard list, (or a manual), but rather as elements of a lens though which one can look at regional economies within the specific *historical, political, and institutional context*. Moreover, these elements are interconnected and, if articulated by a set of policies, may trigger a virtual regional economic development trajectory.[98] These four dimensions are: *the role of labour pooling, interdependencies among firms, technological externalities, and, finally, the governance system.*

As already analyzed by classical authors such as Marshall (1890) and Jacobs (1969), one of the potential advantages of regions and metropolitan areas is the presence of a well functioning labour market, which enables the intermediation between demand and an ample and diversified supply of all types of labour skills. Agglomerations tend to favour processes of *labour pooling*, whereby the quality and quantity of available labour both reduce the transaction costs associated with hiring and firing, and increase the

96 . See, for example, Nelson and Winter (1977) and Dosi (1984), and, more recently, Storper and Venables (2003).

97 . The most famous fore-runner within the field of urban and regional planning of course being the book written by Jacobs (1969).

98 . On the idea of virtual development trajectories that allow regions to escape from vicious cycles based on low cost cut throat competition, see Pike and Sengenberger (1999).

potential of positive learning and spill over effects within local and regional labour markets. Possible indicators of the presence of positive labour pooling effects can be found through labour market statistics on unemployment levels, the time period during which people remain unemployed, hiring and firing statistics, skills levels, skills mismatches and unemployment levels associated with age and training, among others. Through the approach presented in the essay it is possible to assess the capacity of some given regional sectors (or supply chains) to absorb the local supply of labour thanks to their success on the (international) market (a demand side effect).

The dynamic and synergic patterns of interdependencies among firms that are part of a specific production chain located within a given region (or metropolitan region) represent the second dimension of regional economic competitiveness. The basic concept of clustering, or the existence of industrial districts, has likewise been pioneered in its preliminary forms by Marshall (1890). That is, based on the existence of a dense network of related producers, economies of scale and scope can be obtained by the collectivity of enterprises which, in the absence of spatial proximity, would not have been realized (the so-called positive externalities). The more recent literature on regional economics has looked for complements to this classical concept of *Marshallian districts*. More particularly, according to Schmitz (1998), this *static* (or *passive*) *dimension of clustering*, characterized by the presence of a dense network of producers, is a necessary but not a sufficient condition for creating dynamic regional competitiveness. According to him, we should also look at patterns of *active cooperation and interaction* among producers that are constantly trying to overcome challenges of the global economy. An active strategy of cooperation among enterprises and other stakeholders within regional economies might then lead to what is labelled by him as *collective efficiency*. It should also be noted that the concept of positive externalities, as triggered by inter-firm interdependencies and interactions, should be interpreted within the broader perspective of the workings of the region as a whole. In that respect, it is important to analyze how the more dynamic, export oriented segments are linked to the more inward, domestic (regional market) oriented niches of the regional economy, specifically in order to maximize the developmental impact of growth (Aoki, 2002).[99]

The third dimension of regional competitiveness relates to the economy´s capacity to trigger positive technological externalities through the generation and dissemination of science, technology and innovation. The essay considers this issue to be a particular form of the above mentioned spatial positive externalities among regional agents, but

99 . In case of weak linkages between the two compartments, the income and employment multipliers associated with the growth of dynamic outward oriented sectors will at best be limited. Taking the scenario of weak linkages between the dynamic and inward oriented segments of the regional economy one step further, there is a need to develop more in depth knowledge on the interactions between formal and informal sectors, or, alternatively, between the larger, internationalized segments of the regional economy (which are more evident in the case of metropolitan regions) and the compartment that is composed of smaller and medium sized enterprises

specifically focused on the characteristics that allow for the creation of regional and local innovation systems.

The basic logic behind this dimension is the fact that spatial proximity favours rapid learning and diffusion effects, which get incorporated by firms, and subsequently locked into the regional space economy. The intense generation and dissemination of innovation allows regions to move away from vicious cycles based on mere cost competition (Pike and Sengenberger, 1999). There are several indicators that could be used to measure the presence of technological spill-over effects and regional innovation systems. First, and similar to clustering as such, it should be observed that regional innovation systems are composed of passive and active dimensions (Schmitz, 1998). The passive dimension is related to the physical infrastructure and the available learning and innovation institutions, such as technical schools and training centres, university hospitals, universities and academic centres, specialized research centres and the (private or public) existing capacity to implement Research and Development, as reflected in the presence of specialized industrial or governmental laboratory infrastructure. However, as in the discussion on industry clustering, the mere presence of a physical network aimed at Research and Development and the delivery of innovation is a necessary but not a sufficient condition to move towards dynamic and competitive innovation systems. The active dimensions of innovation systems are strategic, and related to the concrete process of interaction and mobilization of stakeholders within regions aimed at the technological learning and modernization, for example through the articulation between university and business.[100] Moreover, local governments might also be actively involved in the stimulation of innovation systems through incubator systems, technological parks and financial incentives. Nevertheless, it is important to evaluate how effectively these instruments have been leveraging more concrete partnerships aimed at science, technology and innovation in regional economies. In addition, it should be observed that Research and Development is only one possible (i.e. the more tangible) source of innovation in economies. However, the more dynamic and active learning systems are characterized by a series of diversified (both tangible and intangible) sources of innovation that originate within regional economic systems themselves, for example through interactions within the production chains (relations between technical suppliers and customers), through university-business linkages or through other networks of local stakeholders. In terms of analyzing and benchmarking this specific profile of innovation systems, over and above the role of Research and Development expenditures, more emphasis will also have to be put on so-called tacit or non codified sources of knowledge and learning. Finally, it should be observed that while the passive dimensions of innovation systems can be relatively easily measured in official statistics on the available research capacity (universities etc.), its active components will have to be captured

100 . The results of intense linkages between firms and universities can be measured, among others, by the number of applications for patents, and the actual efficiency with which requests for patent get approved and operated. An additional dimension refers to the institutional and legal framework that facilitates interaction among private enterprises and universities (innovation laws etc.).

through qualitative diagnosis (case studies and on field research) on the presence, intensity and effectiveness of interactions among local stakeholders.[101]

The fourth dimension in appraising the regional competitiveness of regions is the governance performance. The essay does not have the aim of providing a lengthy analysis of the concept of governance itself, yet to assess the importance of a correct mechanism to manage the policy setting and implementation process; i.e. how well government and other stakeholders are able to combine the previously discussed dimensions of regional competitiveness (labour pooling, firm networking and clustering, regional innovation systems, provision of liveable communities through the built environment) into a reasonably working region that is productive and fair for the majority of its citizens.[102] In other words, within regional economies it is necessary to define collective rules ensuring that positive dynamics (increasing returns) can develop through the interaction of the agents operating in it.

This requires a movement away from strictly neo-classical analyses of regional economic development and socio-spatial transformation, which tend to see problems of territorial development, including those between and within regions, "as no more than the spatial manifestation of an adjustment-failure on the part of the factors of production" (Danson, et al. 2000). Advocates of *new regionalism*, including many researchers and policy-makers at the OECD, World Bank, and EU, increasingly reject this laissez-faire reading and instead update (albeit substantially) the older Keynesian view that governments have a key role to play in disrupting territorial disequilibria. However, unlike previous experiences with regional policy, the role of the state is now considered far more circumscribed by international financial institutions and multi-national corporations, i.e. by macro-structural conditions attending advanced globalization.

Accordingly, governance efforts must shift away from top-down, command-oriented, and sectoral ("siloed") approaches to place-based models of governance. These models typically imply a stronger, yet more flexible, networked and supportive, role for *regional-scale government*, although the specific form this takes will vary. Public intervention in such a scenario cannot simply be thought of as a mechanism for allocating resources within the economy but must assume the role of guide and director of processes. It must take the shape, on the one hand, of a set of actions aimed at defining and guaranteeing individual access rights and, on the other, of interventions aimed at developing the exchange capacities of markets and business systems (Bianchi, 1995). An explanation may be sought in the fact that local communities increasingly interact with the rest of the world in a continuous process of integration and globalization without necessarily responding to stimuli from the central state. Given such conditions, the central public authority is no longer able to guarantee the development of the local

101 . For an introduction on the mechanism of dynamic learning economies see Storper and Walker (1989), Storper (1997) and Scott and Storper (1986).

102 . For a more detailed discussion on the issue of city regional and metropolitan governance in the international scenario see for example Rojas et al. (2005).

community (Bianchi, 1995), and it is also increasingly obvious to many researchers and policy-makers that the current phase of global economic restructuring requires now new answers to the "regional question" (Amin and Thrift, 1995; Thrift and Olds, 1996; Storper, 1998; Allen and Cochrane, 2007).[103]

Given the strong interactions among local (and global) actors characterising regional context, linear-type response mechanisms (the logic behind traditional macroeconomic policies) are no more verified. Policy-makers must equip themselves with a set of objective instruments and programming actions able to cope with non-linearity and the consequences of complexity. In this vein the essay presents a *response function* to model the propagation mechanism of economic policy in a situation of complexity. The response function, in turn, depends on the distribution and the type of interaction between agents within the market. So the result is that a thick network of coordinating agents who exchange the information they posses on the local needs will set, implement, and evaluate more efficiently place-based policies than a single policy-maker that does not interact with the territory and with local agents so lacking the needed information to address correctly local challenges.[104]

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The theoretical framework discussed above has been used to assess the international competitiveness, and the working, of the urban region of Madrid, the capital-city of Spain. Urban regions, and in particular those above 1.5 million inhabitants, represent the engines of growth of the world economy: they produce the bulk of national wealth, act as command places of globalisation, and are home to the larger part of world population (OECD 2006). Broadly arguing, these trends have enhanced the importance of territories in respect of nations, and studying large urban regions is an alternative way to assess the effects of globalisation. In fact, some phenomena like migration, innovation, pollution, and even crime have all acquired a clear territorial feature. Thus, beside macroeconomic policies (often implemented by super-national institutions, as in the case of the EU), these issues need to be tackled through place-based strategies. This being said, Madrid represents an excellent case to be assessed. It represents almost 20% of Spain's economy, and its population (13% of the national one) has been constantly increasing because of the large influx of migrants coming in large part from South America. Moreover, the

103 . It is worth noting that the present essay while recognising the importance of the regional governance device, does not assume that regions have detached themselves from the national space-economy and national regulatory regime. On the contrary, the governance performance will depend on the capacity of different tiers of government to get coordinated and to share all the information they have to set the policy with the highest possibility of achieving the expected outcome.

104 . The information base for this new generation of regional economic development policies will be more complex, dynamic and diversified. As a consequence, there is an international tendency to complement national and regional sector based economic statistics with decentralized economic observatories, characterized by the incorporation of additional dimensions (innovation systems, labor pooling, clustering etc.), over and above an intense participation of non-governmental stakeholders in the elaboration, maintenance and evaluation of these information systems.

regional government of the Community of Madrid has been producing input output tables in 1999, 2000, and 2002, thus there is a large availability of data. And, last but not least, the functional urban region of Madrid is consistent with its political (administrative) geography.[105]

Given these conditions, the essay has tried to evaluate the international competitiveness of Madrid. In particular, it has tried to understand whether there is accordance between positive socio-economic trends and local development. In this context, the hypothesis is that to enhance its competitiveness in a sustainable way a given region has to improve its capacity to agglomerate factors of production, i.e. to generate positive externalities. If a region does not respect such conditions, its international competitiveness will not improve, and the possible increase of negative externalities may actually affect local performance on the medium term. Therefore, the essay has studied the working of the regional labour market, the strength of linkages among Madrid-based firms, and the capacity of the region of producing and using innovation. A minor part of the analysis has also been focused on the regional governance performance.

The Madrid metropolitan region is among OECD best performers in terms of job creation. Unemployment rate was 6.5% in 2006. Most remarkable condition is that such performance has been achieved with a steady and large influx of immigrants (almost 400 000 between 2000 and 2006). Migrants' labour supply has been absorbed mainly by construction and low-tech services. Therefore, sectors in *overtime* have filled their vacancies with workers that were not part of the regional labour market (Cfr. Aoki, 2002).[106] Other Madrid-based industries (especially medium-high tech services) have filled their vacancies with a large quantity of fixed-term workers (which in Madrid are 28% of the total). Because of these conditions, wage level in Madrid is still relatively low compared with other European urban regions, so growth is not generating inflation.

However, this positive dynamic is challenged by three related issues. First of all, the regional workforce is utilised in an extensive way rather than intensive. Immigrants, for example, are hired without taking into account their skills and their level of education. This condition is quite common in all the OECD regions. Immigrants, because of the change of language and culture, are exposed to a loss of their human capital (Borjas, 1986). Nonetheless, in the case of Madrid the bulk of immigrants come from Hispanic countries, so it is possible to argue that this loss of human capital is dramatically reduced or does not take place at all. Concentrating them in low-tech sectors may actually represent a waste of human capital that, instead, could be used to improve regional competitiveness in tradable knowledge-intensive sectors. Following a similar logic, a large part of young educated Spaniards are hired with fixed-term contracts, and without taking into account their specific skills (i.e. education). Often, fixed term contracts are

105 . The assessment of the metropolitan region of Madrid is the result of 18 months of focused, and partly on field, research. The author is also the coordinator of the OECD Territorial Review of Madrid, published by the OECD in 2007.

106 . See pag. 20 of this essay

not transformed in open-end contracts, and workers keep on changing jobs without following a coherent path. The result is the reduction of their on-the-job skills. As in the case of immigrants, the human capital Spaniards embody is not used to enhance local specialisation in science-based sectors. Therefore, the job-education mismatch (both in the case of migrants and Spaniards) causes a reduction of regional labour productivity.

Second, non-tradable low-tech sectors such as construction and domestic services have absorbed the bulk of the local labour supply. Such sectors have increased their weight (i.e. their share of regional GDP) within the regional economy that, in turn, has been reducing its specialisation in export-oriented science-based industries. Accordingly, a large part of Madrid's development depends on local demand, which has been constantly increasing because of the large demographic growth registered over the last decade. Nowadays, shortage of valuable land pushes housing prices up. In this condition the city cannot keep on growing at the same pace. The concentration of new comers in deprived (cheap) areas may generate strong negative externalities. In such situation, local demand is likely to become steady in the near future. At the same time, Madrid is losing important high tech niches on the global market (as in the case of electronics, for instance), and it could be very difficult to re-enter in such niches.

Therefore, although Madrid is a *hub and spokes* economy (Markusen et al., 1999) and is home to some important clusters in knowledge intensive sectors, linkages among export oriented segments and the more inward, domestic oriented niches of the regional economy are relatively weak. Surprisingly enough, mature manufacturing scores the highest rate when assessing backward and forward linkages. In this condition the income and employment multipliers associated with the growth of dynamic outward oriented sectors (i.e. the developmental impact of growth) will at best be limited. The financial sector in the city of Madrid is a good example of limited transmission effects. While the financial sector in Madrid has proven to be rather successful in terms of linking into an international network, its local impact in terms of employment and income generation is limited, as demonstrated by the weak backward and forward linkages of such sector within the regional economy.

Obviously the weak interaction with science based sectors reduces regional innovation capacity, which represents the third challenge for Madrid. The regional capacity to trigger positive technological externalities through the generation and dissemination of science, technology and innovation is limited by the lack of active coordination and collaboration between scientific institutions and firms. In other words, while the passive dimension, i.e. the availability of physical infrastructure and science based institutions (especially public), can be considered as good as in leading OECD metro-regions, Madrid suffers for the weakness of its active dimension. That is, despite of a substantial number of good universities, research centres and university hospitals, and a significant number of policy initiatives aimed at the creation of research parks and technological incubators, the city region has shown a decreasing trend of patent applications (a proxy for innovation) when compared with the national trend. Therefore, the reduced importance of knowledge intensive sectors within the metropolitan economy,

and the weak linkages between these industries and the rest of the economy reduces regional innovation capacity.

Although Madrid governance performance has not been extensively discussed in the present essay, the metropolitan region is home to one of the most advanced governance devices in the OECD. Local authorities, the Community of Madrid and the Municipality of Madrid, have a large range of powers and exclusive responsibilities, and the functional region of Madrid is consistent with its political geography (administrative boundaries). This means that the *right* authority, with an almost complete knowledge of the region, can set a given policy at the *right* territorial scale. The authority will also be there to receive the feedbacks from the policy (i.e. to evaluate the impact) and to change it, if needed. In this condition local policies are likely to be effective and to respect local complexity.

In some fields Madrid regional authorities have respected this "algorithm" and have effectively produced public goods such as transportation facilities, and housing. In this way, for instance, the region has been able to absorb the large influx of migrants, with a limited increase of negative externalities, such as congestion and crime. In some other fields, however, local authorities are still trying to find an effective policy answer. It is the case of the large job-skill mismatch, and the weak active dimension of regional innovation capacity, which affect regional productivity. To address such problem local authorities need to implement a collective strategic vision endorsed across stakeholders, including the national government, to enhance synergies and avoid duplications, and to involve civil society to increase social consensus.

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