The impact of socio-economic inputs on rtd, innovativeness, and competitiveness of european and east asian smes: comparative analysis and policy suggestions for regional convergence

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The impact of socio-economic inputs on RTD, innovativeness and competitiveness of European and East Asian SMEs – Comparative analysis and policy suggestions.

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1. Introduction

This paper presents state-of-the-art conceptual and empirical output of recent research work[1] on the identification of the factors that determine the innovativeness and competitiveness of SMEs in Europe and East Asian countries. In the context of globalisation, new technology and learning-based production, and in the direction of the European regional convergence and social cohesion, our research obtained insights of the links between economic performance and socio-technological inputs. More specifically, on the basis of cross-national and cross-industry comparisons, the ways that regional/national innovation systems influence firm performance and growth are analysed.

A survey was carried out in seven European and East Asian countries: England, Scotland, Italy, Greece, Israel, Korea, and Taiwan; and two industrial sectors: the traditional labour-intensive garments manufacturing, and the technology-intensive microelectronics and software industry. The quantitative analysis was complemented by qualitative information – obtained via interviews and questionnaires with firms. The results of the analysis lead to conclusions for the successful alteration of the relation between inputs and achievements; as well as suggestions for strategies supporting competitive knowledge-based economies of upgraded employment and improved social cohesion.

In this context, the present paper specifically focuses upon: (i) the links between RTD and competitiveness in different economic sectors and regions/countries; (ii) the factors that differentiate RTD investment and achievement amongst various innovation systems; (iii) the interaction of business strategies and RTD policy. Our main arguments are based on the exploration of the causality between firm competitiveness and (i) endogenous factors,

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such as the in-house technological effort, as well as (ii) exogenous factors, such as the linkages with local and international actors and institutions (Park 1996, Brouwer 1993, Geroski 1993, Hughes 1986, Brouwer & Kleinkencht 1993).

2. Conceptual and Methodological Framework – Variables and Model Construction :

Much of the recent research publications on the implications of globalisation are based on evidence for trade and foreign direct investment (FDI) flows. But often, important aspects of current developments, such as the structure of FDI (i.e. sectoral and national shares) and trade flows, and the vehicles of change (i.e. institutions and technology) are ignored. Moreover, the major globalisation phenomena are increasingly connected with the shift of production to science-based industries in the advanced countries.

This process was partly initiated by the massive public investments in R&D during the World War II and the following cold war period. The institutional and technological changes that emerged, primarily in the US economy, marked the beginning of the 'knowledge-based economy'. Today, new technology is considered as a major factor shaping contemporary production, employment and economic growth, leading to qualitative changes in the specialisation and international role of countries in the world economy.

The rapid introduction of new technologies, spurred by globalisation processes, has often been the main cause for widespread job losses in certain industries, increased wage and income disparities, and work insecurity. At the same time, businessmen, technology experts, economists and politicians - at both national and international level - have great expectations for a long-term growth and employment creation based on the implementation of new technology.

On these grounds, the present paper analyses international research findings in order to address the question of regional specialisation and competitiveness in contemporary globalised industries. This question is related to regional cohesion and growth, based on the competitiveness and innovation capacity of regional/national production systems, and sustained by networking and institutional support. In this context, we seek to identify the local and international ties that labour-intensive or knowledge-intensive industries develop, and evaluate their impact on specialisation and growth. Particular attention is paid to the territory-specific configuration of local agglomerations: their business 'milieu' consisting of traded and untraded transactions and interdependencies among economic actors.

Socio-economic, and often intangible, transactions and links are strong means of information and knowledge dissemination. These are reflected on firm embeddedness within the local or international business environment. Grannoveter (1973, 1984, 1992) suggested the concept of 'embeddedness' to denote the social relations that determine one amongst many different possible outcomes. He argued that frequent interfirm interaction generates trust, and he substantiated the networking effects on economic performance.

Furthermore, the social nature of labour skills and knowledge is taken into account in our research approach. These are more than mere technological input, as they are related to the 'generic' and 'learning' capabilities of human resources. The dimension of the locality is also essential, as the business milieu is shaped by territorially-specific interdependencies and interactions among economic actors (Storper 1997). Different territory-specific networks and linkages define diverse innovative capacities and competitiveness of regional production systems (Cook 1998, Audrech 1998, Maskell & Malmberg 1999, Larsson & Malmberg 1999, Varaldo and Ferruci 1996, Oerlemans et al 1998).

The first methodological issue in our research is to examine how technological advancement determines the performance of a firm. It has often been argued that firm technological activity affects directly its technology output, which in turn affects the firm economic output. In other words, the technological transactions of a firm have an indirect impact on its economic performance. On the other hand, socio-economic transactions of non-technological nature are considered as directly influencing the firm economic performance.

The direct and indirect effects of the technological activity and the socio-economic linkages of firms on innovativeness and competitiveness are substantiated and estimated in the following simultaneous equation system :

$$(1.1)\ SALGR_i = a_1 + b_1\, EMBI_i^{**} + c_1\, \widehat{INPROD}_i + d_1\, NINDE_i^{**} + f_1\, SEMPL_i^{*} + e_{1i} \quad , \widehat{R^2}=0,27$$

$$(1.2) INPROD_i = a_2 + b_2\, RDEXEMP_i^{*} + c_2\, LICEN_i^{*} + d_2\, SC\&EN_i^{**} + f_2\, TPROC_i^{**} + e_{2i} \quad , \widehat{R^2}=0,77$$

i = firm, e_{1i} and e_{2i} the unexplained part of the regression

**significant at 1%, * significant at 5%

Growth of sales is considered as a dynamic measure of the economic performance of SMEs in the local, national, and international market. It indicates the ability of a firm to compete in the domestic and international market. Therefore, we suggest that firm

economic performance/competitiveness is captured by the variable of sales growth (SALGR). Furthermore, according to the OECD research for the assessment of innovation (1996), patents and product innovations are considered as the main indicators of technological output. Thus, we suggest that firm innovation capacity, defined as firm technological output, is captured by the variable of product innovations (INPROD) - indicating the probability of a firm to introduce a product innovation.

For the definition and measurement of firm technological activity, we distinguish between: (i) endogenous factors - i.e. in-house technological effort, and (ii) exogenous factors – i.e. technology transfer linkages. The in-house technological effort is better specified as the firm R&D expenditures per employee (RDEXEMP), as well as the ratio of scientists and engineers to total firm employment (SC&EN). While, the technology transfer transactions are measured as licensing and technology partnerships with national/international leaders for the adoption of new process technologies (LICEN).

Technological in-house effort is based on a continuous activity of knowledge accumulation (Brouwer & Kleinkencht 1996) – a process that larger firms can mainly sustain. Particularly in SMEs, the R&D intrafirm activity involves development (D) rather, than research (R). In other words, R&D is related to the firm size (SEMPL). Nevertheless, the strongest direct determinants of firm innovativeness are the technical skills of employees at all levels of the production process (Bourgault & Lefebvre 1994). Skilled labour facilitates the adoption of innovation/new process technologies (TPROC) and stimulate the generation of know-how and/or new products (Daly 1985, Steadman & Wagner 1989).

The external technological input linkages of the firm (e.g. the number of licenses bought from national and international firms) are also the vehicles of technology transfer (Caves 1982). Both, technological transactions with external actors and internal technological effort have a direct impact on firm innovativeness (Symeonidis 1996). However, according to the related literature, there has not been strong research evidence (Brouwer & Kleinknecht 1996) suggesting that firm engagement in R&D collaboration, or participation in technology transfer networks, enhances innovation output. Nonetheless, the more R&D activity a firm undertakes, the greater is the opportunity for technological advancement and product innovations (Acs & Gifford 1996).

Innovativeness itself (INPROD) is defined as a direct determinant of competitiveness. While, competitiveness is indirectly affected by the external and internal technological transactions of a firm, and directly affected by transactions non-purely technological. The

latter are socio-economic linkages, captured in the variable of embeddedness (EMBI). Local networking and international embeddedness of firms is measured by: (i) the frequency of firm interactions with local and/or international actors, e.g. competitors, suppliers, customers, financial institutions (defining 'strong' or 'weak' ties), and (ii) by the extent of interfirm networks (defining 'long-' or 'short-reaching' ties).

According to Grannoveter (1984, 1992) long reaching networks are more effective than bigger volume networks – this effect he calls 'the strength of weak ties'. Research has also suggested that the development of international linkages is more important for economic performance, than the development of local linkages. Even the weak international ties offer to the firm the advantage of higher 'exposure', and allow for playing a brokerage role, i.e. connecting local to international actors.

3. Cross-industry and cross-national findings:

The research findings across the 5 European and 2 East Asian countries under consideration resulted in the following set of conclusions, valid for all the examined cases. Firstly, it was verified that firm competitiveness relies on technological effort and innovativeness rather, than low cost strategies – which has been for long believed for the performance of Asian firms. Secondly, the innovation capacity of firms is strongly related to the technology intensity of their activity. In other words, firms in low-tech industries (e.g. garments manufacturing) are less innovative than firms in high-tech industries (e.g. microelectronics and software production).

Furthermore, innovativeness is based on continuous learning and labour skills upgrading. In this sense, investment in human capital (employment of highly skilled personnel, training and specialisation of employees) has a positive effect on the economic performance of a firm. Additionally, it is evidenced that the innovative performance of firms is determined by codified rather, than tacit knowledge. In other words, the role of intangible transactions on firm competitiveness is limited. Finally, the innovation capacity of firms is mainly based on international linkages with technology leaders, while local technological transactions mainly serve as the foundation of further international partnerships.

These general observations, common in all case-studies, allow for the formation of a common benchmarking basis of innovativeness and competitiveness across all examined regions and industries.

(a) Benchmarking the technological performance and competitiveness of SMEs

According to our econometric analysis, the firm R&D expenditures, licensing, the skills of employees, and the adoption of process innovations, are the factors indirectly affecting the economic performance of firms. On the other hand, product innovation, international embeddedness (particularly, interaction with international customers and suppliers), and the effort to upgrade human capacity, are factors of a direct impact on firm competitiveness. Given the predictive ability of the model, the indirect factors are the benchmarks of innovativeness, and the direct factors the benchmarks of competitiveness.

The following Table 1 illustrates the distribution of the international sample firms between the top and bottom ends of rank. The surveyed SMEs are ranked in descending order, according to the fitted values of the growth-of-sales variable for each industry in question (i.e. garments and information technology). As previously discussed, the fitted values of the estimated model capture the effects of competitiveness benchmarks such as international embeddedness, human capacity, and innovation capacity.

Table 1: Ranking SMEs Competitiveness

	INFORMATION TECHNOLOGY (electronics & software industry)			GARMENTS MANUFACTURING		
Percentage of firms in	Top 25% of international sample	Mid 50% of international sample	Low 25% of international sample	Top 25% of international sample	Mid 50% of international sample	Low 25% of international sample
TAIWAN	20%	40%	40%	54%	46%	16%
KOREA	12%	77%	11%	100%	0%	0%
ENGLAND	13%	78%	9%	8%	23%	69%
SCOTLAND	32%	26%	42%	16%	69%	15%
ITALY	40%	50%	10%	28%	49%	23%
GREECE	10%	65%	35%	19%	71%	10%
ISRAEL	100%	0%	0%	-	-	-

The observation of Table 1 indicates that, in *the garments industry* specifically, the Asian firms are the best performers in terms of competitiveness, while the Italian firms score better amongst the European. The Greek firms follow, whilst the English and Scottish are at the bottom rows. According to our analysis, the success of the Italian garment manufacturing firms stems mainly from their R&D intensive activity (e.g. design). While, labour skills play the dominant role in success of the East Asian SMEs. Their high score in process innovation and licensing implies an extensive process of technological upgrading and innovation adoption.

In *the IT industry* (electronics and software), the Israeli firms are the best performers, and the Italian and Scottish SMEs follow. The UK firms stand in the middle, whilst the Greek lag well behind. In the East Asian countries, the analysis shows that the Taiwanese firms score better than the Korean. The success of the Israeli IT firms is attributed to their high international embeddedness, compared to the rest of the international sample. Their production of indigenous technology is internationally promoted, at the same time that SMEs in the other countries of the sample are technology users. The high R&D expenditures and ratio of scientists and engineers in the Israeli IT industry are rather more important for its performance, than the adoption of process technologies or licensing.

(b) Assessing Networking and Local Clustering in SMEs innovation capacity

In the traditional *industry of garments*, SMEs tend to cluster geographically, across all countries under consideration. Such firms are embedded within the local socio-economic environment. However, the more successful SMEs tend to develop national and international networks on both the supply and demand side (through outsourcing raw materials, producing for niche markets, and selling to international customers). The following Table 2 illustrates, in a range of 0-5, the local and international embeddedness scores of each industry and country under consideration.

Table 2 : Local and International Embeddedness in the IT and Garments industry

	INFORMATION TECHNOLOGY		GARMENTS MANUFACTURING	
Embeddedness	Local	International	Local	International
TAIWAN	3,8	2,2	4,4	2,9
KOREA	3,3	1,6	2,4	1,4
ENGLAND	2,5	1,7	2,4	1,2
SCOTLAND	3,4	2,1	2,7	2,5
ITALY	4,4	3,6	3,9	1,6
GREECE	3,8	2,3	4,2	2,0
ISRAEL	3,8	4,5	-	-

As observed, the Asian IT firms have strong local interfirm linkages, particularly in Taiwan. This doesn't mean however, that the results they obtain would be applicable, or even desirable, in European markets. For example, many Taiwanese SMEs operate as component subcontractors to large firms, and have limited in-house R&D activity or innovation. In Korea, SMEs have traditionally formed a part of the local subcontracting networks centred on family firms. Despite their dense local ties, they lag behind in R&D and international marketing, and consequently they are vulnerable to global competition.

In Europe, IT firms tend to agglomerate geographically, e.g. in the 'Silicon Glen' of Scotland (except from the software firms), the Oxford area of England, or the metropolitan area of Athens in Greece. However, industrial clustering is not always associated to strong interfirm linkages. For example, the Italian IT firms - even when in the same locality – do not have interfirm transactions, due to their fragmented specialisation and diverse niche markets orientation. Their high local embeddedness score lies in their strong interdependencies with local institutional agents such as banks, etc.

Furthermore, local clustering is not necessary for technology and innovation spillovers, and does not always indicate the existence of tight interfirm linkages. Proximity advantages are important to SMEs in the electronics and software industry as long as they form the basis upon which international ties are built. It is evidenced that the most innovative and competitive firms tend to penetrate international niche markets, and benefit from developing further international linkages. In order to do this, they create national and international networks of customers and suppliers, and they build up links to universities – local or international. In this process, they employ information and communication technologies (ICTs) for minimising the distance dimension.

4. Regional Diversity and Policy Lessons :

The results discussed in the previous section, verify that technology and knowledge intensity is strongly related to the innovation capacity of firms. In this sense, the low-tech firms can learn from the high-tech firms. Furthermore, the statistical analysis shows that the East Asian firms score relatively higher than the European, in both labour-intensive and technology-intensive sectors. Especially in garments manufacturing, European SMEs are less innovative than the Asian. Such differences are not very pronounced in the IT industry, where the Israeli firms are dominant.

The benchmarks resulting from the previous analysis provide pointers for highlighting national advantages, and also for rectifying disadvantages as well. Successful policy lessons for *the garments sector* can best be drawn from the Asian and Italian cases. The main elements that determine SMEs performance are the R&D expenditures (i.e. in design), and the adequate labour skills (i.e. share of scientists and engineers in total firm employment). In particular, the success of the Italian firms is associated mainly to R&D (product design), whilst for the Asian firms labour skills upgrading plays the crucial role.

The main *draw backs* of the UK firms in the garments industry are identified in the lack of sufficient skilled labour. Even in the case of the design-intensive Italian firms, their stock of skills needs to be upgraded beyond the level of craftsmanship, in order to sustain competitiveness. In the case of the Greek SMEs, despite the efficiency in skills, the technological upgrading of production processes is applied merely as a low cost strategy; consequently, human resources are underutilized.

On these grounds, *policy suggestions* should take into account the need to upgrade skills and professional competence in the garments industry. Furthermore, it is essential that policy agencies support the ties of local clusters with non-local designers, customers, wholesale and retail outlets. As local embeddedness sometimes becomes a barrier to SMEs growth (preventing them from following the fast market changes, etc.), external linkages based on new technologies are crucial. In this direction, policy measures are required in order to upgrade the sector's technological infrastructure (ICTs), improve the diffusion of business services, sustain the adoption of quality control, and encourage business collaboration with technology institutions.

The *information technology industry (electronics & software)* is very diverse in terms of technological levels and dynamism. Electronics-related activities range from very sophisticated and specialised products to relatively simple items assembled by components. In software-related activities, SMEs generally grow more rapidly, as capital barriers to entry are low and market and profit potential is high. The analysis illustrated that the IT SMEs in Italy and Greece are the most underdeveloped amongst the European.

Successful policy lessons can be drawn from the dynamic Israeli, as well as Taiwanese and Korean SMEs. The East Asian firms build advanced technological capabilities, through extensive linkages with technology institutions and other firms, orchestrated by the government. In general terms, active government support is mostly evidenced in Korea and Taiwan, while the extensive impact of government policies in Israel is largely indirect. England and Scotland traditionally have good SME policy support systems, but not as active and dynamic as those in East Asia.

The main *draw backs* for the European IT firms are primarily identified in the cutting back of science and research activity and investments. As a result, the UK firms cannot develop the knowledge base necessary for their thrift. Moreover, the lagging IT firms in Greece and Italy have no international markets, low technological capabilities, and receive little governmental assistance.

On these grounds, *policy recommendations* for the IT sector should consider the need to support in-house R&D and new-product-development. Government measures supporting innovation and competition need to boost the venture capital market with public funding. Improvements to the overall system financing SMEs start-up are necessary. Additionally, the assistance of international technology transfer linkages is required, along with the support of interfirm networking, marketing and export activities.

In conclusion, the cross-country and cross-industry comparisons of the research findings bring out the specific characteristics of the regional innovation systems under consideration. The evidenced diversity suggests different policy measures for the various national contexts. However, the major issues concerning SMEs financial and institutional support, and networking, have transnational applicability. In any case, the interpretation of the research findings is strongly related to the interaction of firm strategies with policy.

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