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Greece/Portugal

Policies for competitiveness in less-favoured regions of Europe: a comparison of Greece and Portugal

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Greece and Portugal are the weakest European economies. Their accession to the European Community provided a stimulus for policies to improve the competitiveness of their industries, in order to withstand competition within the Single Market. Support through Community regional development instruments was channelled to Greek and Portuguese science and technology, and industrial policies. The paper examines and compares the implementation of two sets of such policies: science and technology policy, and quality policy, highlighting issues and underlying factors involved in their success or failure.

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GREECE AND PORTUGAL are the weakest European economies, and the largest net recipients of European funds. Appropriate use of those funds to improve the competitiveness of their industries is paramount. Otherwise, competition within the Common Market may have devastating effects for the two economies. While this is well understood, competitiveness remains a rather elusive policy pursuit.[1] There is little agreement as to what constitutes competitiveness and what are legitimate and effective means to pursue it.[2] In broad terms, it is understood that the competing units are firms, the performance of which is affected, but not determined, by their access to resources and innovative stimuli.[3] A policy for competitiveness is one that provides for the existence of resources and stimuli, and facilitates access to them, aiming at establishing vibrant national and regional systems of innovation.[4]

This paper examines some central elements of such policies in Greece and Portugal, in particular science and technology policies and policies for quality promotion. As the first section argues, these two sets of policies overlap, interact and complement each other in crucial functions of national systems of innovation. On this basis the paper asks: how successful have the Greek and Portuguese governments been in developing and implementing such policies and what are the crucial factors that have determined their success?

The second section embarks on a comparative presentation of the ways in which technology and quality management became policy issues in the two countries, the policy structures that were set up and

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the policies implemented. The third section pursues a comparative policy appraisal, which leads to conclusions summarized in the final section.

Technology and quality policies

Government concerns with technology have historically emerged because of the potential contributions of technology to war. The Manhattan project is considered by many as the starting point of modern science and technology policies.[5] As wars within the developed world became virtually extinct, developed nations started looking into R&D for solutions to their economic and social problems, and raised their R&D expenditure to more than 2% of their GDP.

In the 1970s, Japan began sending strong signals that R&D performance on its own is not enough to guarantee competitiveness. In the period 1970–1980, when Japanese companies were gaining market shares faster than the companies of any other nation, Japan was by far outperformed in R&D by both the US and Western Europe. Extensive research into the exploitability of R&D pointed out that R&D is most exploitable when performed by firms, and that its exploitability increases when it is accompanied by appropriate firm structures and management processes.[6]

Some explanations of the Japanese miracle focused on the role of the Japanese Union of Scientists and Engineers in the 1960s in adopting the American managerial concept of Total Quality Control.[7] This idea developed into a new management concept involving employee empowerment, flexible managerial structures, and improved communication between workers, engineers and managers.[8] The result became known as Total Quality Management (TQM).

TQM has had a major influence in the way people think about management in general and quality management in particular. In the 1990s, the concept of TQM passed to Western managers the messages that innovation researchers in Europe and the US had clearly articulated[9] but apparently failed to promote.[10] Thus, quality management became a vehicle for governments trying to affect the ways their firms managed production and innovation processes, which were also supported by science and technology policies.[11]

Greece and Portugal

Greece and Portugal have not been directly affected by the Japanese miracle. In their troubled political history, policies for science and technology and quality promotion had not been priority areas. Their accession to the EC, which highlighted their economic problems and brought about unavoidable losses of macroeconomic control, acted as a stimulus for developments. The Community also provided a major source of funds to support such developments. This support imposed a need for external accountability on the two governments, which put their ability to plan and implement relevant policies to the test and highlighted the peculiarities of their national systems of innovation.

Science and technology policy in Greece

The late 1970s saw the first attempts to set up a Greek science and technology policy. In 1981 with the socialist government, a comprehensive science and technology policy structure got into shape, on the basis of economic concerns raised by the accession to the EC.[12] The Ministry of Research and Technology (MRT), which quickly turned into the General Secretariat of Research and Technology (GSRT) within the Ministry of Industry, Energy and Technology, was at the centre of the policy structure

> "The design and implementation of a national policy in science and technology through the formulation of the relevant programmes, the stimulation and the creation of research and technological potential, technological development and imports and exports of technology fall into the jurisdiction of the MRT." (Law 1514/85)

Relevant research programmes were to be formulated in accordance with priorities set by the five-year national development plans. The whole system of consultations and programme development implied a policy structure with systemic goals which define the framework for sub-system goals, which in turn define the framework for goals of research programmes. The hierarchical nature of the system combined with low levels of institutional autonomy and led to a rather rigid policy-making structure which, as it was soon realized, was unable to formulate clear goals for technology development. The incorporation of Information Technology (IT), biotechnology and new materials as priority sectors in the National Plan for the Development of Science and Technology 1988–1992 was largely a result of imitation.[13] GSRT was faced with lack of expertise when it came to priority-setting, and with authority problems when it came to implementing its priorities.[14] Research programmes were launched without sectoral priorities. The most important of these was the programme for the promotion of industrial research (PAVE), launched in 1985, which subsidized the efforts of firms in research, development, prototyping, testing, demonstration projects and market surveys. Participation in the programme mirrored existing conditions in industry.

To implement its mandate of de-bureaucratization of the Greek R&D system,[15] GSRT followed the route of creating new institutions. Research institutes were set up next to universities, working with university staff outside the remit of the university bureaucracy

In 1989, the European Commission decided to channel its regional development support through the joint preparation of regional community support frameworks with the national governments

These became quickly involved in European R&D programmes Sectoral technology transfer companies were set up as joint ventures between the Greek government and industrial firms. These companies grew rapidly during the first years of their operations, but in 1990 some of the most dynamic of such companies were facing problems. In particular their most talented staff were offered better paid jobs in industry, which they could not match because of their incorporation into the civil service.[16]

In 1989, the European Commission decided to channel its regional development support through the joint preparation of regional Community Support Frameworks (CSF) with the national governments. Having had problems in financing the National Plan for the Development of Science and Technology 1988–1992 from the government budget, GSRT submitted a large part of it for funding by the Greek CSF. The agreed Operational Programme for Research and Technology (EPET) at 102 million ecu (mecu) was significantly smaller than GSRT wanted. One of the reasons was the limited success of the Integrated Mediterranean Programmes (IMP), which was attributed to policy design and implementation problems with Greek institutions.[17] The Greek CSF RTD 1990–1993, comprising the IMP for Information Technology (which had been running since 1986), EPET and STRIDE HELLAS had a total budget of 339 mecu.

EPET and STRIDE HELLAS support (among other things) R&D performance in firms, as does PAVE which in 1991 absorbed STRIDE funding.[18] Kuhlman carried out a survey of 103 technologically dynamic firms, 60 of which performed in-house R&D in 1989.[19] A study of that period[20] stated that there were only about 200 firms in Greece active in R&D, so it is safe to assume that Kuhlman's sample was largely a subset of the most technologically dynamic Greek firms. He found out that for this sample of firms the average R&D expenditure grew in real terms by 33% between 1989 and 1991. For the same sample cooperation with organizations outside Greece increased

While such findings are encouraging, there is a question as to the representativeness of the samples. To what extent do these findings represent developments across the Greek economy? This is particularly important in view of dualistic tendencies in the Greek economy observed in the mid-1980s, between a small dynamic element of transnational Greek firms and subsidiaries of multinational enterprises on the one hand, and a large population of laggards on the other.[21] In the early 1990s, a new element was added to the group of dynamic firms, when a few small indigenous IT firms began participating in national and EC R&D programmes, and one major Greek transnational corporation emerged in the area. Still there is some evidence that the dualism persists. A 1991 survey, concerned with the prospects of Greek firms in the Single Market, revealed that only 1.6% from a sample of 2,000 thought about opportunities in technological improvements.[22]

The quality management issue in Greece

In the mid-1980s, the newly created sectoral technology transfer companies faced a great demand for quality control tests, concerned largely with determining characteristics of various intermediary goods that firms used in their production processes.[23] This type of demand was until then covered by Greek Standards Organization (ELOT). ELOT was set up in 1976, as part of Greece's initial steps into policy-making for industrial modernization, but it was only in the mid-1980s that it acquired an important position within the Greek technological infrastructure, by setting up four laboratories to perform certification tests for four sectors: low voltage electric and electronic appliances, electric cable, toys, and plastic pipes.

It was in the same period that, in view of the Single Market, the policy role of standardization changed radically. Through mutual recognition and harmonization of standards amongst the EC Member States, national agencies acquired the role of certifying local producers to standards accepted by users in other countries. ELOT, unable to certify firms outside the technical capabilities of its four laboratories, turned to the services of laboratories of some national research centres. However, the authority of non-accredited laboratories to perform certification tests, became widely disputed. In 1992 the 'accreditation debate' was still strong. An Accreditation Council involving representatives of ELOT, SEV (the Confederation of Greek Industries), TEE (Technical Chambers of Greece), the Technical University of Athens, and the National Chemical Laboratory of the State was established in 1989 at arm's length from ELOT. However, this did not do much for the debate, as the lack of a metrology system and a system for monitoring organizational performance, together with bureaucratic problems, prevented it from proceeding to any accreditation until at least 1992.

In the meantime, European standardization systems began to be orientated towards quality assurance standards. The International Standards Organization (ISO), recognizing the difficulties associated with the development of product-oriented standards within a framework of rapid technological change, moved to specify the ISO 9000 standard series of quality management processes. As the use of these standards

in European government procurement increased, private organizations accredited by systems of other European countries set up certification operations in Greece. In 1992 there were five ISO 9000 certified firms in Greece, three of them by ELOT and two by BVQI, a company accredited in The Netherlands.

While within government there were long debates going on as to the status of the Accreditation Council and the function and patronage of the national metrology system, financed largely by the EC PRISMA programme, the dualism in the economy was once more becoming evident. A study of 131 out of the largest 400 Greek firms by Vitantzakis *et al* revealed that 65 % of them do not have a quality manager, while 11 of them, all subsidiaries of multinational enterprises, were in the process of establishing TQM programmes.[24] Other studies also revealed a lack of awareness of the competitive importance of management processes, similar to the lack of awareness of the importance of technology.[25]

Recent years witnessed a growing grassroots movement in which SEV and the Greek Management Association (EEDE) have played a major role. This movement expresses itself through demonstration projects, such as the '1991 year of quality' campaign, and educational activities. Furthermore, a community of experts is emerging benefiting from the experience of the TQM programmes of subsidiaries of multinational enterprises. Perhaps most importantly, some university schools of management are entering the area providing some prospects for broader developments. This movement comes from the management community, which is quite distinct from the community of engineers which surrounds the national standardization system and the national technology infrastructure.

Technology policy in Portugal

The 1974 revolution provided science with an important place in Portugal's constitution, which reaffirmed national development plans as major instruments in guiding the efforts of government. The organization mediating between science and the national development plans is the National Council for Science and Technology (JNICT), which was set up in the late 1960s to plan, coordinate, finance and promote scientific research. The national development plan 1974–1980 had a chapter on science and technology, an in-depth technical document prepared by JNICT but never implemented. The plan for 1981–1984 had the same fate. By 1985 JNICT had changed six ministerial patrons without however finding the ability to successfully implement its policies.

In 1986 the Law on Scientific Research and Technological Development restated in some detail intentions to use science and technology as a major instrument in pursuing economic and social development. A Secretariat of the State for Science and Technology was created within the Ministry for Planning and Territorial Administration (MPAT) and was given JNICT's political patronage. At the same time the Portuguese government was negotiating the eligibility of Portuguese institutions to participate in EC R&D activities.[26]

The 1986 Law strengthened the role of JNICT, which in turn promoted the creation of private-non-profit (PNP) organizations at the side of universities with increased flexibility to conduct contracted research. At the same time JNICT embarked on a programme on the Mobilization of Science and Technology, where sectoral programmes were established in areas such as robotics and data-processing, materials research, space sciences, applied mathematics for innovation, integrated fusion, and maritime sciences. By this and other similar programmes JNICT generated some initial demand for research contracts, to support and at the same time familiarize newly established PNP organizations as well as researchers in universities and government research laboratories with the workings of a market for research. The scheme worked and PNP institutions blossomed throughout the country, while government research laboratories became increasingly involved. The creation of sectoral R&D companies, to promote co-operation between public, PNP and private institutions and to diffuse technologies in their sectors, was also sought by government but with limited success. Only two such companies were set up; one in biotechnology and one in electronics, and only the latter is considered to be successful.

Portuguese industry overall remains quite insensitive to technological issues. A survey by GEPIE/CISEP of 1,026 manufacturing firms revealed that the greatest concern regarding innovation was with equipment acquisition and the least concern was with R&D.[27] National surveys revealed that between 1988 and 1990 business expenditure on R&D almost doubled in current prices, while the number of R&D active firms increased by 10%.[28] A survey of the electronics sector found that it is characterized not only by relatively high R&D intensity, but also by a relatively large number of small R&D intensive firms, the activities of which may not be accounted for by official statistics.[29] These observations posed issues of dualism in the Portuguese economy between the small technology-active segment of industry, and the large population of laggards.

Responding to this issue, the government embarked on the largest effort in Portugal's history to promote the technological development of the country. This effort involved two major components: the CIENCIA 1990–1993 programme and the 1989–1993/1994–1999 PEDIP (Specific Programme for the Development of the Portuguese Industry). CIENCIA aimed at the upgrading of public sector science and involved a large training component. This was because it was felt that the skill-base of the Portuguese science and technology system was its main weakness, and it also influenced the cultural characteristics of the system. CIENCIA aimed at creating a large pool of scientists and engineers,

which would outweigh the needs of public sector research and spill over to industry.

At the same time, PEDIP 1989-1993 was spending 500 mecu in industrial modernization programmes. PEDIP comprised six programmes which operated across industrial sectors, and two sectoral programmes financed by a special EC Budgetary Line. Programme 1 supported basic technological infrastructures and Programme 2 involved incentives for training activities in new technologies and techniques. Programme 3 included the provision of financial incentives to enterprises to form R&D units, as well as to perform innovative projects. PITIE and PRODIBE were two special programmes within Programme 3, supporting respectively selected projects in information technology and electronics, and capital goods. Programme 4 provided for the creation of two risk-capital societies to support start-ups of new technology-based firms, while Programme 5 supported demonstration projects, applications of new technologies, intellectual property rights, participation of firms in EC programmes, and technical assistance. Programme 6 was concerned with quality improvement and will be dealt with in more detail in the next section of the paper.

PEDIP was managed by its own administration, which although hierarchically dependent on the Ministry of Industry, had autonomy in all aspects of the execution of the programme. Under this administration, the total of its funds were committed before its end, and 100% of the allocated funds were absorbed for every year of its operation. The total investment in projects supported by the programme reached an impressive 2.5 billion ecu.

The quality management issue in Portugal

The importance of PNP organizations within the Portuguese system of innovation is emphasized by the establishment in 1969 of the Portuguese Quality Association (APQ) which involved individuals, company memberships and public bodies interested in quality matters. The experience of these parties working together to promote quality management in Portugal played a major role in the shape of the Portuguese National Quality Management System (SNGQ). This was established in 1983, as a result of the increasing realization of the importance of quality standards for international markets, initially by suppliers of automotive companies, but soon after by all sorts of manufacturers of intermediary goods.

The SNGQ aimed at involving a wide spectrum of stakeholders in developing a national quality policy. Its top body, the National Council for Quality (CNQ), involved representatives of a wide-ranging community, from metrological laboratories to consumer and industrial associations, and of course the APQ. Its executive was the Directorate General for Quality of the Ministry of Industry and Energy, which in 1986 was replaced by the Portuguese Institute for Quality (IPQ). IPQ became the organization responsible for metrological control, accreditation and certification.

Between 1987 and 1991 the APQ undertook the 'APQ in the Regions/Quality in Companies' project. This involved a survey of 4,000 firms of all sectors and sizes to gather information while spreading the message of the importance of quality management. This revealed that in 1989 only 5% of companies had set up a quality management system. In 1989, the CNQ issued a proposal for a quality policy which argued for the importance of quality management in general and TQM in particular, in view of the form of competition Portuguese industry would face in the Single European Market.

This proposal came at the time of the launch of PEDIP and led to an explosion of interest in quality matters.[30] With 46 mecu from PEDIP, a 'quality campaign' was launched to increase the awareness of firms of quality management matters and processes, while investment in testing laboratories, quality assurance systems, and training and consultancy, was also promoted. By 1992, IPQ had already accredited 48 testing laboratories, eight metrology laboratories, and seven inspection bodies. In 1990 a training centre for quality matters (CEQUAL) was established by APQ and the Institute of Employment and Training, which became involved in major quality management projects within large firms such as ALCATEL, MABOR (tyres) and MAP (plastics). More than 5000 people were trained between 1990 and 1992.

At the same time, the quality campaign contributed to the development of a flourishing market for consultancy services. Parts of the demand for such services were covered by PNP institutions while rising numbers of consultancy firms appeared in the market. By 1993, 182 Portuguese firms had been certified to standards of the ISO 9000 series.

Comparing Greece and Portugal

Policies for competitiveness in general, and for science, technology and quality promotion in particular, in Greece and Portugal share much in their evolution. The EC has been a major factor, stimulating developments and providing policy with funds. In both countries planning and considerations of infrastructure linked to the creation of autonomous institutions were important elements of science and technology policy, while the private sector played an important role in quality promotion. However, there have also

In both Greece and Portugal, planning and considerations of infrastructure linked to the creation of autonomous institutions were important elements of science and technology policy

been important differences in the apparent levels of policy success, which can be accounted for by differences in the structures of the two economies and their governments' implementation of relevant policies.

In Greece, the proportion of BERD funded by industry and government fell drastically during the late 1980s, in parallel with a drastic increase of contributions from abroad. By contrast, in Portugal the local contributions to BERD remained roughly steady throughout the 1980s and continued to be steady when PEDIP was already running. While the R&D performance of a relatively small dynamic group of Greek firms has increased radically during the years of government support, this was also the case in Portugal without government support.

Part of that picture is explained by the inherent characteristics of the two countries' industrial structures. Throughout the 1980s, the proportion of R&D funded by industry varied between 20% and 25% in Greece, and between 27% and 31% in Portugal.[31] Furthermore, the industrial structure in Portugal appears to be stronger than that in Greece, where in 1989 the metallurgy sector was the only non-consumer, non-primary, R&D-intensive industry, accounting for a significant proportion (11.25%) of Greek exports, 1% up from its 1980 share.[32] At the same time, in Portugal transport goods accounted for 7.25% of industrial exports — some 80% of it being cars — and machinery accounted for 11.97%, of which some 50% was electrical machinery.[33]

However, to fully understand developments in the two economies, differences in policy need also to be addressed. Both countries went down the road of promoting autonomous research institutions. JNICT was very effective in its demand-side support, through specific programmes, for scientific entrepreneurship, while GSRT was very effective at the supply-side, creating the technology transfer companies. These differences can be partly accounted for by the institutional positions of JNICT and GSRT. Being part of the Ministry of Industry, GSRT was able to streamline developments in industry. To indicate its commitment it had to participate in the new companies as a shareholder, thus placing them under the operational restrictions of the Greek civil service. At the same time GSRT was pressed to establish industrially relevant research priorities where there was little research-relevant industry to address. JNICT's links with science provided a different perspective which made priority-setting a more feasible exercise.

Industrially relevant priorities in Portugal were formulated by the Ministry of Industry and expressed in PEDIP. In this respect, the Portuguese industrial structure, with its strengths in intermediary goods, provided a better guide to priority-setting than that of Greece. However, realizing the importance of PEDIP, Portugal implemented it in an exemplary fashion through an independent administration. Fully absorbed, PEDIP 1989-1993 was some 35% larger than the Greek CSF which faced absorption problems. Furthermore, it touched many more firms than the programmes of the Greek CSF, and in many more aspects of their building-up of innovative capabilities. Quality management was one of those aspects.

The differences between the two countries as regards quality policy illustrate once more the different traditions in terms of coordination between public and private sector initiatives. APQ, a private non-profit organization, was for many years the only Portuguese organization concerned with quality matters. Its universality in terms of representation was certainly an important factor in the smooth and quick development and implementation of a quality policy. The Portuguese quality system does not seem to have suffered the bureaucratic rows over political patronage that the Greek system did.

ELOT, a very autonomous organization and of impressive performance by Greek standards,[34] took some ten years to become effective. The lack of other important elements of a quality policy, such as metrology and accreditation, seemed to handicap its effectiveness in promoting the development of Greek industry. The relevant bureaucratic debates indicate a distrust between private and public sectors, which turns business away from ELOT, and possibly other Greek organizations, to European organizations free to offer their services anywhere in the Common Market. Furthermore, this distrust may well prevent the incorporation of developments in the area of TQM which come from private initiatives, into a coherent national quality infrastructure.

Conclusions

To summarize, a short historical overview points out one key commonality between Greece and Portugal: the role of the European Community in the recognition of the importance of successful policies for competitiveness, and the funding of such policies. Such policies were designed and implemented within their different industrial and policy structures. To a certain extent, areas of policy success reflect the industry structures and policy-making systems of the two countries. However, two key differences cannot be explained solely by structural considerations. The first difference lies in the ability of the two countries to raise substantial amounts of funds from the European Community. In that respect, the poor implementation of the Greek IMPs has haunted the efforts of GSRT to develop effective policies for competitiveness. The second difference lies with the levels of trust between government and the private sector in the two countries, which manifests itself in the extent of, and means for, concordance between public and private initiatives. Low levels of trust bring low levels of policy success which in turn fuel further decline in the levels of trust. As levels of policy success affect the fund-raising ability of policy-makers, Greek institutions need to operate against a circle of decline in relation to both their audience in Greece and the European Community.[35]

Appendix: List of acronyms

General acronyms:

BERD: Business Expenditure on R&D
CSF: Community Support Frameworks
GDP: Gross Domestic Product
IMP: Integrated Mediterranean Programmes
ISO: International Standards Organization
PNP: Private-non-profit
STRIDE: Science and Technology for Regional Development
TQM: Total Quality Management

Greek organizations and programmes:

EEDE: Greek Management Association
ELOT: Greek Standards Organization
EPET: Operational Programme for Research and Technology
GSRT: General Secretariat of Research and Technology
MRT: Ministry of Research and Technology
PAVE: Programme for the Promotion of Industrial Research
SEV: Confederation of Greek Industries
TEE: Technical Chambers of Greece

Portuguese organizations and programmes:

APQ: Portuguese Quality Association
CNQ: National Council for Quality
IPQ: Portuguese Institute for Quality
JNICT: National Council for Science and Technology
MPAT: Ministry for Planning and Territorial Administration
PEDIP: Specific Programme for the Development of the Portuguese Industry
SNGQ: National Quality Management System

Notes and references

1 P Krugman (1994), "Competitiveness: a dangerous obsession", *Foreign Affairs*, pages 28-44

2 See reference 1; Buckley *et al* (1988) "Measures of International Competitiveness: A Critical Survey", *Journal of Marketing Management*, 4 (2), pages 175-200

3 L G Georghiou and J S Metcalfe (1993) "Evaluation of the impact of European Community research programmes upon industrial competitiveness", *R&D Management*, 23, pages 161-169; M E Porter, (1985), *Competitive Advantage*, Free Press, London and New York; D J Teece (1986), "Profiting from technological innovation: implications for integration, collaboration, licensing and public policy", *Research Policy*, 15, pages 285-305.

4 B A Lundvall (1988), "Innovation as an interactive process: from user-producer interaction to the national system of innovation", in G Dosi *et al* (editors), *Technical Change and Economic Theory*, Pinter, London; B A Lundvall (editor) (1992), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter, London and New York; C Charbit *et al* (1991), " Local Systems of Innovation in Europe", CEC, FAST Occasional Paper XII-422-91; R R Nelson (editor) (1993), *National Innovation Systems: A Comparative Study*, Oxford University Press, New York.

5 e.g. J J Salomon (1977), " Science Policy Studies and the Development of Science Policy", in I Spiegel-Roesing and D de Solla Price (editors), *Science, Technology and Society: A Cross-disciplinary Perspective*, Sage London; M Kogan and M Henkel (1983), *Government and Research*, Heinemann, London.

6 C Freeman (1982), *The Economics of Industrial Innovation*, 2nd Edition, Pinter, London; L Georghiou *et al* (1986), *Post-innovation Performance*, Macmillan, London.

7 S Watanabe (1990), "Work organization, technical progress and culture with special reference to group activities in Japanese industries", paper presented in the Technology and Competitiveness conference, 24-27 June 1990, organized by the French Ministry for Industry and Regional Planning, the French Ministry for Research and Technology and OECD.

8 See reference 7.

9 T Burns and G M Stalker (1961), *The Management of Innovation*, Tavistock, London; J Woodward (1965), *Industrial Organization: Theory and Practice*, Oxford University Press, London.

10 See for example A S Knitowski (1993), "Total Quality Decision-Making: A Link of Cognitive Science and Behavioural Decision Theory to the Deming Management Method", in D J Sumanth *et al* (editors), *Productivity & Quality Management Frontiers - IV* (2 volumes), Industrial Engineering and Management Press, Norcross, Georgia, USA

11 B Barker and N Kastrinos (1994), "Quality Improvement Policies in Europe", in B Barker (editor), "*Quality Promotion in Europe*", Gower, London

12 D Deniozos *et al* (1989), 'Utilization of the results of public research and development in Greece", CEC, EUR 11533 EN.

13 See C Edquist (1994), "Technology Policy: The Interaction between Governments and Markets", in G Aichholzer and G Schienstock (editors), *Technology Policy: Towards an Integration of Social and Ecological Concerns*, Walter de Gruyter, Berlin and New York for an analysis of similar phenomena globally.

14 D Sotiriou (1984), *Design and Implementation of Science and Technology Policy in Greece*, EKKE, Athens (in Greek) observed that within the policy structure, the GSRT had to impose its programmes on ministries which were higher in the governmental hierarchy. In the same vein, in an interview with Kastrinos in 1990, the director of a large national research centre insisted that the Greek administration is characterized by an endemic dissociation of authority from responsibility.

15 See D Sotiriou (1987), "Science Policy in Greece", *Science and Public Policy*, 14, pages 23-30.

16 N Kastrinos (1990), "Research and Technological Development Policies in Greece and European Community Regional Development Assistance", M.Sc. thesis, University of Manchester.

17 CEC (1988), "Integrated Mediterranean Programmes: progress report 1986/87 and opinion of IMPs advisory Committee", SEC (88) 335 final; CEC (1989), "Integrated Mediterranean Programmes: 1988 progress report", SEC (89) final

18 S Kuhlmän (1992), "Thematic Evaluation of Community Support Frameworks for Research and Technology Development in Greece", Report to the European Commission DG XVI.

19 See reference 18

20 See reference 12.

21 K Vaitsos and T Giannitsis (1987), *Technological Transformation and Economic Development: The Greek Experience and International Perspectives*, Gutenberg, Athens (in Greek)

22 ICAP (1991), *Industrial Review*, July-August (in Greek).

23 See reference 16.

24 N Vitantzakis *et al* (1992), "Definition, measurement and improvement of quality in Greek enterprises" Technical College of Athens, graduate thesis.

25 N Mouzopoulos (1992), "Quality awards and Small-Medium Enterprises", paper presented at the 3rd European Conference for Education, Training and Research, Rome, 9-10 April.

26 Caraca *et al* (1993), *Study of the Impact of Community RTD Programmes on the Portuguese S&T Potential*, JNICT, Lisbon argue that the attachment of JNICT to MPAT played a major role in the subsequent linking of EC R&D and regional policies.

27 GEPIE/CISEP (1992), Inovacao Industria Portuguesa — Observatorio MIE, GEPMIE, Lisboa.

28 JNICT (1990), "Inquerito ao Potencial Cientifico e Tecnologico Nacional: Actualizacao a 1988", Lisboa; JNICT (1993) "Inquerito ao Potencial Cientifico e Tecnologico Nacional: 1990", Lisboa

29 F Romero (1991), "RTD and firm size, The Portuguese Electrical/Electronics sector: a survey", MERIT Research Memoranda, University of Limburg.

30 Z L Pereira (1993), Portugal, in B Barker (editor), *Quality Promotion in Europe*, Gower, London.

31 OECD (1994), *Main Science and Technology Indicators.*

32 T Giannitsis, and D Mauri (1993), *Technological Structures and Technology Transfer in Greek Industry* Gutenberg, Athens (in Greek).

33 OECD (1992), *Economic Survey: Portugal.*

34 See reference 18.

35 Since this paper was first written, the GSRT has been more successful in raising funds from the second CSF and mobilizing industry in the directions of its initiatives.