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## ABSTRACT

The debate on the catching-up process of Southern European economies in the European economy has revolved around two different issues. The first one is about income per capital convergence. This debate has focused on the role of trade in products and to lesser extent in 'ideas' in the growth process of the European periphery. The other set of issues is a broad one. The emphasis is on the pre-conditions for sustainable, innovation driven growth in Southern European economies.

Until recently, these two issues have been examined in isolation. Implications have been considered only *ex-post* after the introduction of specific sets of policies. This project is an attempt to bring the two issues together with a coherent analytical framework. The level of analysis is the southern European countries and the impact of the European integration process on sectoral industrial restructuring processes. We examined three country case studies of Southern European economies: Greece, Portugal and Spain. After the entrance to the EU, these countries opened their domestic markets to intra-EU trade and introduced the deregulation of their capital markets. The improvement of macroeconomic conditions and the emerging new markets for capital have changed the patterns of behaviour of the business sector as far as their decision making process on new investment is concerned. Interest rates for investment loans have declined considerably and new markets for capital became available. At the same time, competition for mature manufacturing sectors has increased and demand for locally produced tradable good is growing slowly. We have examined the process of sustainable development at the enterprise level through new technological investment and industrial restructuring and the contribution of endogenous knowledge assets and competencies. The hypothesis we put forward in this project is that technological development goes beyond the provision of innovation capabilities and incentives for technological investment projects. It depends on the quality of investment decisions and in the long run on the profitability of these projects.

Several programmes have been designed to reduce the financial constraints faced by firms – namely SMEs –, and to provide them with additional funds to launch more innovative projects. In many instances, such programmes together with the decline in interest rates, spurred investments and contributed to the upgrading of firms productive structures, at least on what fixed capital is concerned. But the financial restriction still holds. The relationship between SMEs and the banking system is not an easy one: in general, banks are being more interested in reducing their risks to a minimum than with the development of firms initiatives; on the other hand, banks refer that SME do not present investment proposals attractive enough, while their accounts are not transparent to enable an accurate assessment of risks. Nevertheless, having in mind the financial structure of SMEs and their difficulties in competitive markets, there is a clear need for policies that will overcome information problems in technological investment project cycles.

## 1. EXECUTIVE SUMMARY

The debate on the catching-up process of Southern European economies in the European economy has revolved around two different issues. The first one is about income per capital convergence. This debate has focused on the role of trade in products and to lesser extent in 'ideas' in the growth process of the European periphery. The other set of issues is a broad one. The emphasis is on the pre-conditions for sustainable, innovation driven growth in Southern European economies.

The policy influence that these research agendas have exercised to the formulation of EU policies is evident. The demolition of trade barriers and the counter-inflationary policies that have been successfully carried out in these countries have been justified with arguments on the welfare implications of intra-EU trade and the negative impact of inflation on growth as the background. The same applies for the impact of the second set of issues on a different plane of policy considerations. In that case, the emphasis of the development of local technological capabilities resulted in the proliferation of large-scale policy initiatives for technological development programmes with grants and subsidies and with generous allocation of resources for infrastructure development.

Until recently, these two issues have been examined in isolation. Implications have been considered only *ex-post* after the introduction of specific sets of policies. The most notable example is the case of a significant decline of government spending for R&D and other innovation related activities as a result of the policy for the reduction of public deficits that was forced with the introduction of the EMU criteria. Only in the case of the recent wave of deregulation a clear argument was put forward for the links between regulated markets for non-tradable goods services and the efficiency of product markets. In fact, it has been argued that the implementation of market deregulation policies will facilitate an improvement in productivity through the removal of barriers for the adoption of new innovation in production and more efficient organisational structures.

This project is an attempt to bring the two issues together under a coherent analytical framework. The level of analysis is the southern European countries and the impact of the European integration process on sectoral industrial restructuring processes. We examined three country case studies of Southern European economies: Greece, Portugal and Spain. After the entrance to the EU, these countries opened their domestic markets to intra-EU trade and introduced the deregulation of their capital markets. Technology policy received strong support as one of the structural policies needed to improve the prospects of economic development in Southern Europe. Governments supported the development of local technological capabilities with programmes geared to technical assistance to local firms, incentives to FDI, training, and the modernisation of infrastructure. Additional funds have been allocated through the EC Structural Funds for the Objective I Regions and from competitive RTD Framework Programmes. R&D efforts in Southern Europe have significantly progressed over the past decade thanks to support provided by EC programmes that have financed more than half of the cost of the R&D infrastructure.

With the Third and Fourth Activities of the fourth Framework Programme and Structural Funds for the period 1994 -1999 the European Community has given increasing emphasis to investment in training and research and technology development capabilities in the Less Favoured Regions with particular emphasis on the problems of local manufacturing firms. The improvement of macroeconomic conditions and the emerging new markets for capital have changed the patterns of behaviour of the business sector as far as their decision making process on new investment is concerned. Interest rates for investment loans have declined considerably and new markets for capital became available. At the same time, competition for mature manufacturing sectors has increased and demand for locally produced tradable good is growing slowly.

Our project offers an additional hypothesis regarding the conditions for successful technological development. A central proposition of this study is that the process of European integration itself - expansion in the 1980s, free trade in 1992 and monetary unification in 1999 - all have major consequences for the macroeconomic context, institutional structure and capital market behaviour of Europe. These macro-financial changes have a determinate effect on the desire and ability of SMEs in Southern Europe to acquire technology, and thus can either support or undermine policies of technological development at the Community or the national level. This investment problem has severe consequences at a number of levels. First, these firms are responsible for the greater part of manufacturing employment and productive skills. If they cannot survive and develop, then the workforce becomes rapidly de-skilled and migrates. Second, a thriving regional economy requires a strong network of innovative manufacturing firms which will stimulate further investment in suppliers, services, transport etc. Third, national industrial strategies in Southern Europe are necessarily based on the reconversion of inefficient large-scale corporations (often in public ownership) in traditional industrial sectors and the promotion of dynamic and innovative firms in new sectors. To a great extent, such modernisation necessarily involves the transfer of technologies from advanced industrial centres, but its adsorption requires considerable managerial and financial resources, while subsequent corporate growth will require endogenous innovation.

We suggest that by introducing the concept of technological investment in this project we could eventually analyse the impact of investment patterns on technological upgrading processes. Furthermore, this way we could introduce a clear link from investment to technological modernisation, productivity and competitiveness. This approach is more relevant to Southern Europe, in view of the medium level of technological development in these countries and the small size of local firms in the three selected countries. It was suggested that a detailed analysis of technological investment at the sectoral level could throw some light to the funding requirements of investment projects at the firm level. It could also improve our understanding of the link of specific categories of technology investment to financial constraints and difficult access to credit.

We have examined the process of sustainable development at the enterprise level through new technological investment and industrial restructuring and the contribution of endogenous knowledge assets and competencies. That was a challenging task because,

among other problems, of the lack of a theoretical framework that could provide a set of hypotheses for empirical research on these issues. We took the perspective that we could link the macroeconomic environment with structural adjustment processes by focusing on the role exercised by macroeconomic policies in investment decision making. A second level of analysis was the utilisation of incentives and knowledge assets at the enterprise level. The hypothesis we put forward is that technological development goes beyond the provision of innovation capabilities and incentives for technological investment projects. It depends on the quality of investment decisions and in the long run on the profitability of these projects.

In order to examine the relationship between technological development and finance with emphasis on SMEs, one has to situate the basic trends in the performance of firms within the wider context of globalisation, the process of European monetary integration and the stabilisation policies of the past decade. In order to evaluate the individual and combined effects of each of these processes (globalisation, EMU and stabilisation policies) one has also to take into account the institutional format of the economy under consideration. Institutions (banks, for instance) matter in an obvious way when financing of new firms, new investment projects and high risk investment projects is at stake. What is less easily perceived though is the fact that the institutional set up of an economy matters enormously not only because it influences the supply of funds but also because it conditions the demand for finance involving high risk, and shapes the overall economic behaviour (including investment behaviour and the attitudes vis-à-vis technology and innovation).

The literature appears to indicate that technological acquisition, R&D and innovations in both products and processes by firms all involve investment decisions, and thus require a financial decision as well as a technological one. In consequence, as the structure and behaviour of the capital market strongly affects investment decisions, it will also affect technological development. Because of the imperfect mastery of technology and the uncertainty about the intensity of future product demand investors prefer to hold liquid assets which has negative implications on productivity. Furthermore, the critical issue in industrialising countries is not the production of machinery but the degree to which embodied technology is being adopted. In any case there is a drop in productivity during the period of learning. New technologies cannot be used as productively as old ones, unless the economy has accumulated a certain amount of production experience. The risk of technological sophistication results in inefficient technological choices and limited specialisation: finally firms prefer less specialised and less productive technologies.

Specifically, the macroeconomic changes and new market structures arising from European integration have a determinate effect on the investment decisions of the SMEs in the manufacturing sectors of the Southern European economies that are the subject of this study. It is thus necessary for us to consider three poles of decision-making - firms, banks and suppliers - and combine current research on both technological innovation and corporate finance, in the dynamic context of European institutional change. Technology acquisition requires finance because it is really about investment; but this is not merely a financial question because it involves the restructuring of ownership and control as the

firm expands. In this context, therefore, we understand 'capital markets' to include bank lending, securities issues, unquoted equity participation and government funding schemes as well as domestic and international stock exchanges as such.

The competitiveness of firms is increasingly based on their innovative capabilities, through the development, absorption and upgrading of new solutions – not only on the technological domain, but also in the marketing and organisational fields. In Southern European countries, public authorities do not seem to have fully acknowledged the challenges of innovation, focussing more on relatively uncoordinated science and technology, and industrial policies than betting on an integrated innovation policy approach. In spite of this, several actions have been launched with an aim to support the strengthening of firms capabilities, especially on what technological issues are concerned. Either in the context of Community Support Frameworks or on a purely domestic basis, several policy instruments – such as financial incentives, tax holidays, training support and infrastructure provision – have been launched to achieve those objectives. However, their effectiveness has been limited by a lack of understanding of how firms are managed and actually make their investment decisions.

*The Greek case study provided strong evidence that* the cost of capital is no longer seen as a critical factor affecting growth. This is reflected in the declining trend of financial expenditure throughout the 1990s. The main performance indicators of the average firm have improved over the 1990s. More specifically, progress has been clearly recorded in the terrain of profitability and new investment. These positive trends notwithstanding, the prevailing development strategy of manufacturing firms remains in many respects traditional (path-dependent) and low-risk oriented. This applies for products and markets, technology and the treatment of labour costs as primary targets for improving efficiency. Maintaining markets and products remains a more attractive option than creating new or improving products, or than expanding in more demanding new markets. As a corollary to this non-dynamic development strategy (which is consistent with the view expressed in the relevant literature stressing the lack of long-term commitment on the part of Greek entrepreneurs) comes the unwillingness of the entrepreneurs to be exposed with personal risk when contemplating new investment.

As far as its main sources of finance are concerned, personal funds remain very important, although easier access to bank credit (of both short - and long-term nature) has gone hand in hand with the decline in the cost of capital. This development should be partly seen as a result of the restructuring and liberalisation of the financial system itself, and partly as a by-product of the improvement of the macroeconomic performance of the Greek economy over the past few years. Albeit the modernisation drive of the financial system, the new tools of financing technology related investment (venture capital companies and business angels) remain marginal (at best) or irrelevant for the firms of our sample.

The technological capabilities of Greek SMEs, as reflected in our findings, are not particularly impressive. It looks as if innovation takes the shape of abrupt leaps into altogether new manufacturing processes with the wholesale introduction of new

production lines. This is suggestive of a process lacking the checks and balances of incremental change and gradual improvement (the latter presupposing deeper knowledge and understanding of products and processes). Innovative investment is seen more as an internal process, rather than an interactive/creative one. Indicative in this respect is the prevalence of the view that a major obstacle to further investment is the lack of demand. Besides the problems of restricted technological capabilities, it appears that there also exist severe information problems concerning the investment incentives legislation (as reported in the interviews with banks).

Finally, the hesitant and traditional attitude to development strategies, is not solely confined to the entrepreneurs but extends also to the banks (the suppliers of credit). It could be argued that the weak innovation related entrepreneurship of the owners/managers of the firms is matched by a similar (traditional and risk -averting) attitude on the part of the existing financial institutions. Banks apply stricter criteria for technology-based investments; they have greater difficulty in financing process innovation, technology development and intangible technology. They prefer a situation in which SMEs come forward with concrete and completely costed projects rather than with a variety of options.

The Greek financial system has been going through radical structural change over the 1990s. This change has not essentially affected the predominance of the Banks as the main financial institutions, but has triggered a process of internal differentiation of activities inside the Banks themselves. The virtual non-existence of alternative sources of finance, leads to the seventh concluding point, which is that the bulk of SME non -private financing comes in the form of bank loans. Banks do consider SME lending to constitute an important part of their asset portfolio, but they do not feel that they have to make any special effort to attract SME customers because the latter have nowhere else to go. Banks evaluate loan applications according to the standard commercial (but not developmental) criteria (liquidity, financial ratios, collateral and the like). Interestingly, the length of the relations with a customer does not enter in the evaluation process (contrary to what seems to be happening in the rest of the world). Nor does exporting activity appear to be capable of relaxing the strict financial criteria. What is probably even more striking is the stated reluctance of bankers to finance R&D projects even when backed by partnerships with an established research institute. Implicit in the answers provided both by the Banks and the firms is the acknowledgement of the fact that the Banks lack the necessary capacity to evaluate an investment project in its own right.

*Taking into account our company survey and the interviews with bank executives in Portugal, there appears to be a “differentiated attachment” between firms and banks. The two partners don’t ascribe the relationship the same value: “firms value the relationship more than banks”. In fact, firms show a strong fidelity to their banks, and have a perception (probably, not fully justified) of reciprocity. Usually companies would not break a long established relationship with their bank, provided that interest rate differentials fall in an acceptable range. Banks, however, do not decide primarily on the basis of the relationship and firms’ characteristics and may often better conditions to new*

clients in order to attract them. It is possible, however, that in a context of increasing access to external sources of finance, Portuguese banks would increase their attachment to (some) relationships in order to prevent competition.

The existence of “market failures” in financial markets – and particularly with regard to SMEs and to innovative investments – provides a rationale for public policies in this regard. It is widely acknowledged that such policies should no longer be aimed at direct intervention, such as credit and interest rate controls, having in mind the globalisation of capital markets and the creation of EMU. But there is still much room, especially in Portugal, to introduce more transparency in the market, namely through the improvement of environmental conditions.

The strengthening and the dynamics of the Portuguese “national system of innovation financing” requires, therefore, actions – one might even say, concerted actions – from the three main organisational players: banks, companies (in our case, SMEs) and public bodies. In this vein, bank executives were asked to provide their opinion concerning the most appropriate actions to be taken by the different players. Respondents were given, for each player, a closed list of improvement measures. Somewhat surprisingly, what we found was a focus of bank executives in a small number of options in each case. It would appear as if problems might be solved by focussing on a limited set of issues, as we will see below.

In this regard, the most critical theme seems to be accounting transparency. In fact, all our interlocutors ranked “improving accounting standards” in the two top levels of the scale used (very or quite important). Two other factors scored as important by all banks, but with less emphasis, were the involvement of more experienced entrepreneurs in the projects and the existence of a longer relationship with the bank beforehand. Having in mind the ranking of lending criteria presented above, these aspects are less relevant, since banks’ main focus is on financial analysis. Nevertheless, the rationale for looking for improvements in these areas is easily understandable. Banks complain about the lack of strategic and managerial capabilities of Portuguese entrepreneurs. So the involvement of experienced managers would increase the probability of project success. With regard to the advantage of long-established relationships, this is obvious: banks would know the company and its management better, and this would therefore improve risk assessment procedures.

It appears that bank managers know the issues, and that banks have been exploring the possibilities to be more efficient in delivering their services and closer to firms. Past experiences are incorporated in today’s behaviours. The waves of bad debts which occurred since the early 1980’s led banks to become more cautious when granting loans. There is, however, some room for improvement, the more so as the process is of a permanent moving nature. Solutions depend simultaneously of past trajectories, competitive pressures and visions of future. We may suggest that, in the present wave of mergers and acquisitions, being closer to firms is an asset which differentiates Portuguese

from foreign banks. But larger firms business is still more appealing than SMEs one, and supporting innovation for its own sake is not banks business.

*The examination of the obstacles to technological investment in the Spanish case study* indicated that the lack of internal financial resources, although significant, are no more important than the concern with commercial, technical or human restrictions. On the other hand, the lack of external financial resources was not considered a relevant obstacle for technological investment. Neither was the uncertainty about the financial effectiveness of new technology, the assistance of private consultants or the co-operation of public research institutions. We can conclude that SMEs' technological and innovation decisions are more determined by corporate and business strategies than by access to external financial resources or to institutional co-operative information. This does not imply the refusal of the hypothesis about the lack of financial resources for innovation, because the medium technology intensive SMEs (Electrical) indicate that the restructuring and renovation process is more significant. Moreover, the challenge of global competitiveness indicates that the low technology intensive SMEs are not only exposed to the uncertainty of innovation but also to the uncertainty of markets, human resources and technical disruptions.

The complex relationship between technology investment by SMEs has characteristics that are typical of the process of restructuring and technological upgrading under uncertainty and change for competitiveness. A significant proportion of the SMEs have led the catch up process to EU levels in sectors that are not characterised by radical innovations. The finance of restructuring, mainly based in tangible capital goods, was conditioned by collateral requirements. In this sense, public financial policy should continue facilitating the guarantees that led to specific successful investment projects. Finally, we have identified a process of investment where financial decisions or EU applications for funding are not the condition but a consequence of investment decisions. Financial investment decisions can be completed through venture capital, but it is not clear that these SMEs will be an interesting option for investors in terms of uncertainty, innovation and evolution.

Investment and competitiveness are not simple processes. There is a complex connection between the investment process that guides the firm's modernisation through the renovation of equipment, systems and distribution channels, and innovation projects in a strict sense, that develop and/or introduce new products, processes or services. On the one hand, the modernisation investment process establishes the basic circumstances to compete and provides the conditions that make the innovation process possible. These circumstances can be summed up as financial resources and the productive and marketing environment for learning, developing and introducing innovation policies. On the other hand, innovation projects endow firms with a specific differentiation in products, processes or services that lead to competitive advantage.

Until recently, Spanish SMEs could survive just by modernising and, in some markets, the obstacles that existed allowed backward firms to stay in the market. This is not sustainable in the long term, and firms require investment funding to modernise as well as innovation

capability to compete. Nevertheless, the financial circumstances necessary for both processes are not always present. In big corporations, modernisation funds are provided by the financial system, while innovation is often self-funded. Moreover, their growth, when there is a qualitative jump, is funded by the stock market. However, in the case of small and medium enterprises, the working of the market poses problems for the funding of modernisation and this makes the innovation process dependent on these difficulties and a downward spiralling effect is caused. Financial tools that provide resources for both processes are distinct but they reinforce each other in a positive or negative way. Without the modernisation process, innovation would not be possible, or the conditions that made innovation profitable would not be present. Without innovation, competitiveness is quickly eroded and the modernisation process itself is complicated.

The first problem when dealing with SME debt in the Spanish context is that many companies find it difficult to get credit access because it is nearly impossible for them to meet the bank's demanded guarantees. The difficulty is closely linked to firm size, age and credit terms. These factors are very much inter-related. The level of guarantees demanded by the banks affect objective and subjective factors that determine the risk level of a project. Firm size is related to both factors. The introduction of specialised mutual guarantees is a response to that in two ways. They facilitate interaction, through the promotion of specialisation on SMEs problems within the local environment. This allows them to increase their knowledge about the enterprise and its environment, and through the direct assessment to SMEs with the financial project design. On the other hand, they operate directly in the size factor through the diversification of risk on reciprocal guarantees system. The second problem encountered is the terms of guarantees. Again, we have to distinguish between objective and subjective factors. Financial companies have been obliged to accept higher rates of risk because they are forced to compete in an increasingly competitive SME market due to Government subsidised financial credit lines. However, once they have entered the market, experience and learning have changed the risk perception over the last few years. The third problem in SME funding is the volume of resources available. One of the general problems in SME funding is the difficulty of channelling funds towards enterprises because of the risks related to the size of the firm. This reason alone limits the supply of funds. Securitization aims to reduce credit risk and unlock financial companies' own resources in order to increase the supply of funds for the SMEs. From the point of view of individual enterprises, the situation remains the same because access to credit is the same and has the same conditions. Taking this into account, the important thing is not the absolute quantity of resources mobilised but the effect created by the practices applied. At the margin of the increase of quantities assigned to each one of the tools mentioned, it is important to highlight the significance of three qualitative aspects: agent specialisation, the improvement of the process of learning, and, finally, the consolidation of the distinct agents and tools. In the first place, it is worth stressing that, as has been argued in other parts of the report, information and knowledge, as well as their correct management, have a central role in changing the subjective risk perception. In this field, specialisation is essential, as much as for the banking institutions as for venture capitalists and administrative agents. The need for a process of

specialisation from distinct agents is essential in order to respond to the challenges of rapid technological change and globalisation.

In the long run, the process of learning by private and public agents in Spain, in relation to the market and among themselves, is an essential factor for the development of an adequate institutional framework. This means that the institutional framework cannot be imposed voluntarily, but is the fruit of a mature consensus between different agents. This does not imply that the process does not require stimulus that is the responsibility of the administration, orientating intervention or presenting possibilities through a regulatory framework freely accepted by private agents. Finally, one of the factors of success for the modification of conditions of the working of financial markets is the articulation of the distinct public and private agents who intervene in the market to the point of constituting an articulated and coherent institutional framework. This synergetic effect could operate through multiple relationships. All these examples show the way in which the institutional framework changes the broad conditions of market operations and increases the impact of financial incentives and other interventions supporting technological development and industrial restructuring.

It has been seen in this project how technology innovation and financing interact, and how this interaction changes with the age and size of the firm. The choices between policies to support R&D or external acquisition, to support more or less successful SMEs and to support venture capital as part of a big push for some firms, or improvements in banking provision as part of a general policy to increase the efficiency of financing, have been discussed. The effect of policy has been considered in terms not only of the type of firm to benefit, but also the type of investment being implicitly targeted and how this might be affected by policy.

Policies have been considered which impact both on the availability of (public and private) equity, and that of bank finance. Investment efficiency must be the guiding light which determines the ultimate policy recommendations of this project. The key distortion in the process of technological investment by SMEs' may be the role of their owner/managers. For this reason, analysis at the firm level of choices between equity and bank finance is crucial to understanding the potential of policy options. What is required is an attempt to model the decisions of the SME - the underlying preferences as well as the outcomes which seem primarily the result of financing availability - and thus gain the understanding necessary to mediate on the question of policy in equity or bank finance structures. The effects of encouraging different types of technology investment at the expense of others must also be taken into account, and the robustness of the results on SME technology and investments which have been utilised in this project must be further established.

Several programmes have been designed to reduce the financial constraints faced by firms – namely SMEs –, and to provide them with additional funds to launch more innovative projects. In many instances, such programmes together with the decline in interest rates, spurred investments and contributed to the upgrading of firms productive structures, at least on what fixed capital is concerned. But the financial restriction still holds. The

relationship between SMEs and the banking system is not an easy one: in general, banks are being more interested in reducing their risks to a minimum than with the development of firms initiatives; on the other hand, banks refer that SME do not present investment proposals attractive enough, while their accounts are not transparent to enable an accurate assessment of risks. Nevertheless, having in mind the financial structure of SMEs and the ir difficulties in competitive markets, there is a clear need for policies that will overcome information problems in technological investment project cycles.

## 2. BACKGROUND AND OBJECTIVES OF THE PROJECT

The recent debate on technological accumulation and convergence in southern Europe depends heavily on the assumption that one of the main benefits of regional integration processes is the diffusion of knowledge.<sup>1</sup> The diffusion process is being supported by competition policies. According to this approach, successful local agents (firms) respond to exogenous shifts of the technological frontier in the world economy with "best practise" corporate strategies. Virtuous cycles come next with the modernisation of the manufacturing base, significant improvement of corporate performance and competitiveness in export markets. The idea underlying this approach is that firms are competent enough to develop an efficient response to these challenges.<sup>2</sup>

Another aspect of the increasing importance of the diffusion oriented policy initiatives in the European Union is the emphasis on horizontal technology policy instruments. Technology policy received strong support as one of the structural policies needed to improve the prospects of economic development in Southern Europe. Governments supported the development of local technological capabilities with programmes geared to technical assistance to local firms, incentives to FDIs, training, and the modernisation of infrastructure. Additional funds have been allocated through the EC Structural Funds for the Objective I Regions and from competitive RTD Framework Programmes. R&D efforts in Southern Europe have significantly progressed over the past decade thanks to support provided by EC programmes that have financed more than half of the cost of the R&D infrastructure. With the Third and Fourth Activities of the fourth Framework Programme and Structural Funds for the period 1994 -1999 the European Community has given increasing emphasis to investment in training and research and technology development capabilities in the Less Favoured Regions with particular emphasis on the problems of local manufacturing firms.<sup>3</sup>

This process produced mixed results in different regions due to (a) differences in "demand pull" factors, (b) the lack of co-ordination of policies (human resources vs. education policies and/or research vs. on the job training), and (c) differences in the level of institutional efficiency in less developed regions. The countries in question have a growth trajectory which has been determined by the import of technology in various forms. It seems that the conditions under which the inflows of technology can be exploited have been changed and there is increasing need to introduce matching efforts on the side of the recipient countries. We also found that macroeconomic policies and the timing of the adjustment processes at the national level exercised significant influence on corporate

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<sup>1</sup> For a general presentation of the role of technology diffusion in regional integration processes, see Padoan (1997). A set of comparative studies is available in Bartzokas (2001).

<sup>2</sup> For a detailed presentation of this debate and extensive literature, see Bartzokas:( 1998).

<sup>3</sup> For an evaluation of these policy trends that underlines the need for complementary policies, see Higgins, et. al (1999); see also Clarysse (1999).

performance and innovation dynamics in these countries.<sup>4</sup>

Our project offers an additional hypothesis regarding the conditions for successful technological development. A central proposition of this study is that the process of European integration itself - expansion in the 1980s, free trade in 1992 and monetary unification in 1999 - all have major consequences for the macroeconomic context, institutional structure and capital market behaviour of Europe. These macro -financial changes have a determinate effect on the desire and ability of SMEs in Southern Europe to acquire technology, and thus can either support or undermine policies of technological development at the Community or the national level. This investment problem has severe consequences at a number of levels. First, these firms are responsible for the greater part of manufacturing employment and productive skills. If they cannot survive and develop, then the workforce becomes rapidly de -skilled and migrates. Second, a thriving regional economy requires a strong network of innovative manufacturing firms which will stimulate further investment in suppliers, services, transport etc. Third, national industrial strategies in Southern Europe are necessarily based on the reconversion of inefficient large -scale corporations (often in public ownership) in traditional industrial sectors and the promotion of dynamic and innovative firms in new sectors. To a great extent, such modernisation necessarily involves the transfer of technologies from advanced industrial centres, but its adsorption requires considerable managerial and financial resou rces, while subsequent corporate growth will require endogenous innovation.

Indeed, there is increasing evidence (at the empirical level from the practise of regional development and theoretically in the fields of asymmetric information and endogenous growth) that firms in southern Europe have special difficulties in achieving socially desirable levels of investment. The effectiveness of policy instruments such as tax incentives, skills training and infrastructure provision is limited by the lack of understanding of how firms actually make investment decisions. Investment decisions involve a combination of financial, technological and human resources; of which finance and technology is scarce in poorer regions and must be accessed through Europe -wide markets.<sup>5</sup>

A number of critical issues have been raised in the relevant literature. First comes the issue of *internal versus external finance and their impact on investment decisions*. Equity raising and debt finance often involve higher costs than internal fina nce due to information asymmetries and agency costs (Myers & Majluf, 1984). The above marks a clear departure from the frictionless world of the Modigliani -Miller theorem, whereby the financing pattern does not matter for a firm's investment decisions. In the real "imperfect" world, the availability of internal funds may be an important determinant for investment. This

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<sup>4</sup> For example, exchange rate policies framed corporate de cisions on the speed of the modernisation of production processes and furthermore on the selection of suppliers of equipment and engineering services.

<sup>5</sup> See, among others, Faini et. al (1992), Giudisi and Paleri (2000) and Garcia and Arias (2000). And fo r comparative trends with the USA, see Levenson and Willard (2000).

view is supported by the financing patterns characterising OECD member states. However, a vast empirical literature suggests that different types of firms appear to have different financial needs, therefore, the importance of internal finance is not the same for all types of firms.

The second related issue concerns *the relationship between financial constraints and investment*. Financial constraints can be particularly disabling for R&D investment mainly because R&D investment is very much affected by asymmetric information and capital market imperfections. The general conclusion of the empirical literature is that the actual level of investment (in physical capital and /or R&D) undertaken by a firm is influenced by their *cash flow*, among other things. This implies that investment can be finance - constrained, to a greater or lesser extent. What appears to be interesting in this respect is the finding that financial constraints tend to be more severe in economies characterised by market-oriented financial systems (such as the United States and the United Kingdom) (Tsuru, 2000)<sup>6</sup>.

Useful as it might be, though, the availability of internal funds is double edged. As the “free cash flow” theory suggests, excessive internal funds may induce inefficient over - investment. In this light, debt financing (and the financial pressure it entails) can act as a motivating force ensuring organisational efficiency and growth. Thus, for firms with more internally generated funds than investment opportunities, high levels of debt or high interest rates can act as a necessary disciplining force in order to maintain a high level of productivity.

A number of empirical studies testify to the double-edged role of cash-flow, which is cheap capital since it involves almost zero agency costs, but which potentially promotes over-investment when profitable investment opportunities are few. The same argument more or less applies in the case of *internal capital markets* (in other words in the question of how a firm can efficiently allocate its funds within the firm). Although there exist divergent views in the relevant literature (ranging from views stressing the efficiency of internal capital markets to the opposite view emphasising the inefficiency and misallocation of resources in internal capital markets), it appears that in the end, the efficiency of internal capital markets might depend on several external factors, among which the development of external capital markets might be an important one. Thus, different dynamics are expected to be triggered in countries with different level of development. As recent empirical work suggests, the relative value of diversification in a country is correlated to the country’s income level. Thus, there exists a diversification premium or no discount in low -income countries, while there is a significant diversification discount in high-income countries. This finding hints that there might be a potential trade-off between the efficiency of conglomerates and the development of capital markets.

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<sup>6</sup> As Tsuru (2000) put it, this “could imply either that the marginal cost of capital is excessive in market - oriented economies, or that for some firms at least, *their level of investment is excessive in less market - oriented economies*”.

To wind up the preceding discussion, internal funds and/or internal capital markets have double-edged effects. Under severe financial constraints due to capital market imperfections, the availability of internal funds could promote the required investments. In the same context, internal capital markets may help allocate funds to divisions that would be unable to get them externally due to the imperfections of the capital markets. However, when internal funds are excessively abundant or in cases where there exist fewer capital markets imperfections (highly developed financial systems), the availability of internal funds or internal capital markets could well lead to unproductive investment and a misallocation of resources.

The third issue concerning the effects of alternative sources of financing on the performance of firms is the *role of venture capital provision* as a hybrid source of finance (an “in-between” case sharing some common features with bank-centred and market-based financing). It is well established in the literature that venture capital firms can act as catalysts of technological innovation. Entrepreneurial start-up firms in the Silicon Valley specialise in the development of innovative products for niche markets. In a highly uncertain and competitive technological and market environment, entrepreneurial firms need to continually process and share general information associated with the evolving industrial frame. But they also need to integrate specific information crucial to their product in order to maintain their competitive edge. These dual requirements result in the intense information exchanges and sharing across firms clustering in Silicon Valley and venture capitalists play an important role in mediating and co-ordinating these informational flows and knowledge sharing processes.

To conclude then, in a macroeconomic context, financial development appears to be important for growth and productivity increase. However, it remains an open question whether (and under what conditions) the bank-based or the stock exchange-based financial system is more conducive to growth. In a microeconomic context, internally generated funds (the cheapest source of acquisition) are conducive to investment in the quantitative sense, but it remains questionable whether (and to what extent) they promote qualitative investment. When capital is relatively scarce a relationship-based system (banks) will have a similar effect as internal funds (and internal capital markets): it will alleviate financial pressure and enhance investment, thus spurring economic growth. In such a context, market-based systems are incapable of reducing agency costs and generating the appropriate level of investment. However, when investment opportunities are relatively few, then a market-based system can “guide” and “dictate” the most appropriate investment decisions as well as alleviating misallocation problems stemming from free cash flow. As far as high-tech investment decisions are concerned, capital market imperfections and the necessity to promote extensive flows of information and knowledge sharing, it seems that one needs to envisage a combination of the two pure forms of financial systems. This combination can acquire the form of venture capital as a financing tool, which combines characteristics of both relationship-based and arm’s length financial systems. While clearly it is a variant of relationship-based financing, it nevertheless depends strongly on a well-functioning arm’s length financial system.

This investment problem has severe consequences at a number of levels. First, these firms are responsible for the greater part of manufacturing employment and productive skills. If they cannot survive and develop, then the workforce becomes rapidly de-skilled and migrates. Second, a thriving regional economy requires a strong network of innovative manufacturing firms which will stimulate further investment in suppliers, services, transport etc. Third, national industrial strategies in Southern Europe are necessarily based on the reconversion of inefficient large-scale corporations (often in public ownership) in traditional industrial sectors and the promotion of dynamic and innovative firms in new sectors. To a great extent, such modernisation necessarily involves the transfer of technologies from advanced industrial centres, but its adsorption requires considerable managerial and financial resources, while subsequent corporate growth will require endogenous innovation.

It would appear that “market failure” in commercial finance for manufacturing firms modernisation arises because banks lack adequate information about, and insufficient capacity to monitor, borrowers of this kind.<sup>7</sup> In addition, the uncertainty inherent in new technologies (which, unlike risk, cannot be insured against) means that even for larger client firms, banks tend to prefer existing (imported) process technologies or product franchises which have been ‘proven’ in another market. In addition, the deregulation of the banking system seems to have led to a search for short-term yields and liquidity, and a weaker relationship with (and thus less information about) clients. The type of technology chosen and the success in developing it are thus conditioned by the form of corporate finance involved.

Technological acquisition, R&D and innovations in both products and processes by firms all involve investment decisions, and thus require a financial decision as well as a technological one. In consequence, as the structure and behaviour of the capital market strongly affects investment decisions, it will also affect technological development. Specifically, the macroeconomic changes and new market structures arising from European integration have a determinate effect on the investment decisions of the small and medium enterprises (SMEs) in the manufacturing sectors of the Southern European economies that are the subject of this study.

One main differences between our work and that carried out in this field deserve to be noted here. We are not trying to focus on the macro-economics of technology and development, nor on the micro-economics of individual entrepreneurial decisions in the field of technological investment. We are looking at what might be called the “meso-economic” level of interactions, namely financial institutions, firms and technology suppliers. Our main hypothesis is that technological acquisition, R&D and innovations in both products and processes by firms all involve investment decisions, and thus require a financial decision as well as a technological one. In consequence, as the structure and behaviour of the capital market strongly affects investment decisions, it will also affect

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<sup>7</sup> For a useful discussion on credit creation and regional economic development highly relevant to the problems of Southern European economies, see Dow (1996).

technological development. Specifically, the macroeconomic changes and new market structures arising from European integration have a determinate effect on the investment decisions of the small and medium enterprises (SMEs) in the manufacturing sectors of the Southern European economies that are the subject of this study.

It is thus necessary for us to consider three poles of decision-making - firms, banks and suppliers - and combine current research on both technological innovation and corporate finance, in the dynamic context of European institutional change. Technology acquisition requires finance because it is really about investment; but this is not merely a financial question because it involves the restructuring of ownership and control as the firm expands. In this context, therefore, we understand 'capital markets' to include bank lending, securities issues, unquoted equity participation and government funding schemes as well as domestic and international stock exchanges as such.<sup>8</sup>

The study was conducted at three levels, each of which complemented the others and provide the basis for the integrated final report. The first level consists in the establishment of a rigorous and practical methodology for testing the propositions put forward above. This involved a comprehensive survey of the existing theoretical and methodological studies in the fields of technology transfer, innovation systems, corporate finance and banking practice. From this survey, a coherent analytical method will be derived, which will be not only essential for the empirical part of the study, but also has relevance for other practitioners in the fields of manufacturing firms development and technology policy. The second level was that of the study of existing empirical material. Local teams provided a general assessment of financial and technological trends in their countries. They also provided a detailed investigation of three key industrial branches in each country (textiles, mechanical engineering and one third sector specific to each country). The third level is that of field work for the three country case studies. These were carried out in Greece, Portugal and Spain. We surveyed individual firms, using a standardised questionnaire to assess the impact of investment decisions on individual firms technological learning, growth in productivity and corporate performance.

In accordance with the two-legged approach defined for the case studies, two questionnaires were developed: one for the interviews with firms, and another for banks.

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<sup>8</sup> Research partners agreed in the first project meeting that the focus on national systems financing technological development and innovation could improve our understanding of firm behaviour in the context of structural characteristics and macroeconomic trends at the national level. An important special problem is that the terms of incorporation of technologies into industrial investments in these countries are importantly affected by the fact that much of the technology has to be imported from other countries - a point which will need particular attention. In addition, members of the group have argued that the Southern European experience is relevant to the "second phase" of industrial development in the Newly Industrialising Countries (NICs); when they face the problem of reconversion of the manufacturing base and investment in value added activities and sophisticated products under conditions of declining protection of the domestic market. There was agreement that we should try to draw some comparisons by bringing together, in follow-up work, the research findings of this group and the work of other research groups in industrialising countries.

The questionnaire for firms included three main groups of items: (i) general information on the firm (age, employment, main products, main markets, growth factors and strategic orientations); (ii) corporate finance issues, with a view to understand firms financial structure, financing options, the relationships with the banking system and the main reasons for obtaining external funds; and (iii) technological capabilities and investments, identifying the main sources of information and barriers in innovation processes, the factors behind technology options and the main steps in designing, funding and implementing technology investments. The questionnaire was designed in a way so to highlight the rationale and issues relating to technological and financial decisions in the context of investment projects. The questions are, with a few exceptions, closed and most of them framed in a 5-point *likert* scale enabling easier statistical exploration.

The questionnaire was designed to give a broad description of the activities, characteristics and strategies followed by a set of manufacturing firm in Southern Europe. The sample included firms from three sectors: textiles, food processing and electrical machinery. We collected data on the following activities: corporate performance, capital structure, sources of finance, investment intensity, sources of innovation and technological accumulation processes at the firm level.

The strength of this questionnaire lies in the degree to which innovation and technological development can be compared to other characteristics and activities of the firm. In addition, the survey will provide administrative data on employment, turnover, sales, profitability and productivity, in order to provide a rich set of characteristics for further analysis. We examined investment decisions with several complementary questions. Firms were asked to rank the importance of different factors explaining the growth of their company: management skills, marketing capability, cost of capital, access to capital, technological capability and labour force skills. A second question probes the firms' assessment of their capabilities. Another set of questions examines specific directions which are being pursued in input utilisation, marketing strategies, management and human resources strategies. Another section of the questionnaire required firms to rate the importance of innovation capability and the ability to adopt technology, along with more typical factors such as management and labour skills, as factors of corporate growth.

A different format was followed in designing the questionnaire for banks. The focus here was more qualitative: "given the small number of respondents, the critical factor of the interview results is their value as a qualitative, behavioural analysis rather than as quantitative data"<sup>9</sup>. Four main topics were addressed in the survey instrument. First, how banks organise for SME lending, namely on what regards the segmentation of lending activities according to firm size, the characteristics of the decision process, the locus of decision, and centralisation/decentralisation trends in this regard. Second, how banks envisage their role, criteria and involvement in SME technology lending; three aspects were given particular attention – criteria for assessing risks, relevance of relationships with SMEs, and involvement or support in technology choices. Bank managers were also

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<sup>9</sup> Taken from the interviewer instructions for administering the questionnaire for banks.

questioned about the possible factors constraining SME lending decisions, and which actions might be taken by SMEs, public authorities and the banks themselves to ease those constraints. The last topic dealt with future developments in terms of specialisation and international competitiveness in banking. The purpose was more to launch an exchange of views and to elicit respondents to discuss decision processes and behaviours on SME lending than to get quantitative answers to be subject to econometric analysis.<sup>10</sup>

In summary, by introducing the concept of technological investment in this project we could eventually capture impact of investment patterns and conditions of access to funds on the technological upgrading process. Furthermore, this way we could introduce a clear link from investment to technological modernisation, productivity and competitiveness. This approach is more relevant to Southern Europe, in view of the medium level of technological development in these countries and the small size of local firms in the three selected countries. It was suggested that a detailed analysis of technological investment at the sectoral level could throw some light to the funding requirements of investment projects at the firm level. It could also improve our understanding of the link of specific categories of technology investment to financial constraints and difficult access to credit.

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<sup>10</sup> Having in mind the problems raised by postal surveys and their low response rate, it was decided since the inception of the project that questionnaires to firms would be administered through face-to-face interviews, instead of being sent to a large sample of firms. In order to devise an acceptable sample of firms to approach – companies with some experience of technological investments and with majority Portuguese/Greek ownership<sup>10</sup> – research teams contacted technological infrastructures and/or industrial associations asking for lists of relevant firms. The Spanish team had to deal with a much larger number of firms and in that case random sampling selection was applied.

### **3. SCIENTIFIC DESCRIPTION OF THE PROJECT RESULTS AND METHODOLOGY**

#### **Finance structure and technological investment**

The conditions for successful manufacturing have changed considerably in recent years. The allocation of industrial investment in plant, equipment and intangibles is changing considerably and new products and processes encompass a greater number of different technologies. These trends involve different investment needs. The main distinction is between “core technological investment” (comprising the bulk of technological investment) and ‘complementary investment’ (which guarantees the efficiency of the “core investment”). Another dimension is the distinction between tangible and intangible investment, with the understanding that the latter comprises the bulk of technological investment. In a product-cycle model we can define technological investment in three different stages: R&D, production preparation, production launch.<sup>11</sup>

The decision to invest in new technologies is constrained by uncertainty and information costs. Uncertainty is particularly high when technologies are new and still changing rapidly and investments are considerable. The process of decision making gives rise to propositions linking the nature and timing of adoption decisions to characteristics such as the size of the firm and the relative cost of investment. Technology diffusion analysis is concerned with changes in the economic significance of new investment over time and how these may be measured by process innovation and product efficiency or by a product’s market share. An investment decision can take place earlier and more quickly when net investment in new applications, at the sectoral level, is growing and technological change is less conditioned by replacement investment. However, high expectations of rapid technological change may very well delay the adoption of new technology. It may be rational to wait while new technologies are still competing with each other and/or with old ones, when technology suppliers are still being formed and when the scale of investment is relatively high.

The technological role, or involvement, of a bank in manufacturing investment projects in advancing industrializing countries is not so much because of their role in the financing of research activities or the direct promotion of industrial innovation but rather because of their direct and indirect influence in the conception, design and execution of investment projects. Any project initiated and financed by banks includes important technological elements: machinery has to be purchased from local and foreign suppliers, workers have to be trained and consulting and engineering firms have to be hired to prepare the project and supervise its implementation. The technology embodied in any project is composed both

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<sup>11</sup> The distinction between embodied and not embodied technology in capital goods is important from a policy perspective. When technology is embodied to capital, policies designed to increase capital spending will promote growth through investment and TFP increases. If technology is not significantly embodied in capital, then quite different policies related to the flow of ideas are likely to be more relevant.

of hardware and software. In practice it is usually rather difficult to determine precisely what share of the total cost of a project is accounted for technology. Some projects furthermore are much more technology-intensive than others. In the same way, some projects can be technologically rather simple as far as the hardware is concerned and sophisticated as far as the assimilation of embodied knowledge is concerned.

The technological role of a bank should be viewed essentially as a process of interaction, operating through the project's life, with the firm and other partners involved in the project. One should not overlook the basic conflict between the role of banks as financial intermediaries and their largely unrecognized role as institutions with accumulated knowledge on product markets and firms' competencies. This conflict stems from the opposition between the necessary financial prudence of the banker and the inherent risks involved in technological innovation. The imperatives of financial prudence mean that when a bank is acting as a technological institution, it will tend to be rather conservative. When making a loan to an industrial firm for the purchase of new machinery, for example, it will usually feel more confident, and therefore more willing to lend money, if the supplier of that machinery is a well established foreign manufacturer rather than a smaller and less experienced local firm.

Every manufacturing project financed by a bank goes through a certain number of stages, beginning with the identification of the project, and ending with the economic evaluation carried out once the project has been completed. These various stages form what is called the project cycle and it serves in this TSER project as a tool for analyzing the role of banks as technological institutions. The preparation stage involves not only the bank and the consulting firm(s) working on the technical and financial aspects of the project, but also the agents which will be executing the project and more widely, all those which are concerned in one way or another with the project. This preparatory phase may require detailed investigations, for example, local conditions for the feasibility of the project, and in some cases the generation of entirely new types of knowledge about certain aspects of the project. The appraisal stage, which accounts for the largest part of the bank's staff working time spent on the project, is the exclusive responsibility of the bank and is the only stage in the project cycle where the bank is working essentially on its own. The next stage - negotiation - is very much a bilateral affair, involving the bank and the partners in the project. The final decision about the project, taken by the bank can be seen formally as the exclusive preserve of the bank, but is in fact largely conditioned by the results of its negotiation with the local partners. The implementation stage is essentially the responsibility of the borrower and not of the bank. Through its supervision role, the bank however is involved in that phase and the interactions with the various partners in the project at this stage are somewhat similar in their complexity to the interactions which can be found at the identification phase. The evaluation stage is formally the responsibility of the bank, in the sense that it makes its own assessment as to whether the project has achieved its objectives.

This very brief sketch suggests that a bank's role as a technological institution is conditioned to a large extent by the nature of its interactions with the numerous partners

involved in the various stages of the project. When analyzing the technological role of banks, we should keep in mind that the various stages in the project cycle do not have the same importance as far as technology is concerned. The appraisal phase, for example, might appear at first sight as the most important phase in this respect, since it often specifically includes a technical appraisal, in addition to the usual financial, economic and institutional assessment of the feasibility of the project. In fact, once a project has reached this stage, all the important technological decisions have already been made, and there is little scope for redesigning any of its main technical features.

Because liquidity risk is positively related to firm size and because barriers to credit increase the risk of doing business, entrepreneurs unable to self-insure against large risks may prefer to remain small and to diversify their activities in whatever way they can. For instance they may start a new firm instead of expanding the one they currently operate. Barriers to credit also affect technology choices. If access to credit is partly determined by the collateral value of the investment, purchases of land, buildings, and vehicles are facilitated while the building up of stocks, wage fund, and credit to customers are not. This may result in the adoption by large firms of capital intensive methods of production and in an emphasis on production instead of marketing and product improvement, even though labor intensive methods may be more efficient and an improvement in marketing much needed. Moreover, in areas of fast changing technologies, small firms and start-ups may be unable to afford the best available technique of production. Risk also makes firms reluctant to experiment with unknown. They may reduce risk by opting for a flexible organization of their business. For instance, investors may prefer multi-purpose technologies that can easily be affected to new tasks, even if it means bypassing state of the art specialized equipment. They may avoid investments in equipment and technology not because they could not get a bank to finance it but because rigid loan repayment obligations would put the firm at risk. In all these cases, some of the gains from specialization and learning by doing are not captured and the size distribution of firms remains inefficient.

### **Allocative efficiency and sectoral investment**

Barriers to credit generate allocative inefficiencies and pull resources away from manufacturing. These problems are being generated because the investment projects that get financed may not be those with the highest return. This is true whenever there is not a perfect match between investment opportunities and the allocation of credit. If firms that have long been in existence find it easier to access credit while new firms cannot, certain firms will outlive their usefulness and competition through firm entry will be thwarted. The sectoral allocation of investment is affected because lost investment opportunities and inefficient production choices reduce aggregate returns to industrial capital. As a result, funds are channeled to uses other than manufacturing -- commerce, government bonds, and capital flight. This process gets reinforced if, to reduce their exposure to risk, investors are drawn toward operations with a rapid turnover like commerce, or to financial investments with a safe return.

If the economy is affected by a large aggregate shock, like structural adjustment, the existence of barriers to credit slows economic response to changes in relative prices. Large established firms may survive thanks to better access to credit even though their profitability has eroded. But because the emergence and growth of new firms is stifled by barriers to credit, the new investment opportunities opened by macroeconomic adjustment are not fully taken advantage of. This effect is particularly noticeable in manufacturing exports.

In a world with asymmetric information and weak legal enforcement, the relative importance of various types of financial intermediaries and the relative use of various financial instruments depends on the structure of the economy itself. To make this clear, consider the following example which is a stylization of Southern European realities. Suppose there are two types of intermediaries, banks and firms, and two types of financial contracts, fully collateralized bank loans and trade credit. Moreover, suppose that large firms qualify for both bank loans and trade credit, medium firms qualify only for trade credit, and small firms do not receive either. Then the financial structure of the economy is entirely determined by the size distribution of firms.

The relationship between the size distribution of firms and the financial structure of the economy has an effect on economic performance. First, the size of the market for specialized financial services depends on the number of firms who would potentially qualify for such services. If only a few large firms exist that could take advantage of them, the market may be so small as to discourage the investment required to provide them. Such examples are: organized markets for equity and bonds, stock market operations brokering, underwriting services, the handling of letters of credit, the endorsement of bills and post-dated checks, credit reference services, futures markets in currency and commodities, the use of warehousing and transport documents as a basis for short-term credit, etc. The absence of many of these specialized services has been blamed for low firm profitability and for the resulting low levels of direct foreign investment.

In addition, growth and development imply structural transformation and the emergence of new firms undertaking new economic activities. Adjustment to macroeconomic shocks similarly requires that certain economic activities and firms disappear and that others emerge in their place. Suppose that most firms start with little capital, an assumption largely true in the case of Southern Europe, and that corporate growth depends on their ability to accumulate retained earnings and to raise outside funds. If start-ups have no or little access to credit, the adjustment and growth processes are slowed. Short of changing the size distribution of firms directly, one can support growth and adjustment by lowering the boundaries that determine access to credit.

Third, the financial structure is to some extent self-fulfilling. If certain categories of firms do not qualify for credit, they are more subject to shocks than if they did. As a result they are less able to face contractual obligations and are less reliable borrowers. The probability of repayment problem is thus positively related to access to credit in general. Those who

try to lend to sharply credit constrained firms indeed encounter repayment problems, not just because some of the firms they face are intrinsically bad payers -- i.e., that are not profitable and poorly managed -- but also because many of them have insufficient access to credit. Expectations, and thus statistical discrimination become self-fulfilling as individual lenders' experiences comfort them in their expectations of poor repayment performance.

If financial markets are underdeveloped, then people will choose poorly productive, but flexible technologies. Given these technologies, producers do not experience much risk, and hence there is little incentive to develop financial markets. Conversely, if financial markets are developed, technology will be more specialised and risky, thereby creating the need for financial (and assets) markets. A particular resource (capital) can be specialised into a narrow range of tasks without being harmed through the increase of risk because financial institutions are used in order to deal with it. Thus, financial markets contribute to growth by facilitating a greater division of labour. In the absence of financial markets, diversification is taking place at the firm level through technology "options". Firms will choose technologies that are less risky, with many applications, but less productive. Firms are reluctant to engage in sophisticated technologies as long as they cannot share the risk they incur with financial markets. Indeed, there is a strategic complementarity between financial markets and technology, because both are instruments that can be used for diversification and technological upgrading.

All firms face some degree of financial constraint, in the sense that available external finance is not equal to the optimal full information level, due to asymmetric information and agency problems. These are particularly acute both for small and medium sized enterprises (SMEs) and for firms making technology investments. In order to understand how policy may improve the efficiency of financing in this area, this paper will survey some of the literature on technology-based SMEs and allow more specific insights to be gained into the effect of financial constraints on technology investments. The combination of finance and technology life cycles will be used to create an archetypal model of the technology-based SME which provides original insights into the potential for policy to affect both SMEs in general and also their technology investments, which ultimately drive much of economies' innovation. Analysis of some policy applications in banking and venture capital markets will provide further detail.

We make use of the real options approach to analyse the investment decisions of SMEs. Dixit & Pindyck (1994) characterise the opportunity to invest as analogous to a call option. This instrument of financial markets, when purchased, grants the owner the right, but not the obligation, to make a given purchase at a given price within a given time period. The associated literature talks of the option as being 'in the money' when the price per share under the option is less than the current market value - i.e. if the owner exercised the option and sold the shares immediately back to the market, she would be 'in the money.' The focus is therefore on when the value of the option will be maximised, or most deeply 'in the money.'

In terms of SMEs' technology investments, the opportunity is not explicitly purchased as the financial instrument is, but the costs of identifying the opportunity are analogous to the option price. There are also costs associated with raising the necessary financing to be able to exert the option or undertake the investment. Waiting and gathering information on the opportunity may be costly; but since it may also reduce the uncertainty over the outcome of the investment, for sufficiently high levels of uncertainty there will exist a real, positive value to waiting.<sup>12</sup>

The value of *not* exercising the option is positive when this uncertainty over the outcome will be diminished by choosing not to exercise the option at the precise moment but delaying to accumulate information instead. Thus an option to invest, which by simple discounted cash flow methods would seem to be 'in the money,' should not always be exercised. The degree of competition in the market will be negatively related to the optimal delay since the risk of being beaten to the investment will be higher and thus waiting more costly.

The option is only exercised when it is 'deep in the money' - the net present value (NPV) of the investment is sufficiently large that the value of waiting for more information - learning more about the technology in this case - is counterbalanced. This calculation is in stark contrast to 'naive' use of the discounted cash flow methods (such as the NPV) which analyse the value of investment decisions in terms of estimates of future cost and revenue flows, *as if with certainty*. On the face of it, the option value approach is far more suited to the case of SME's technological innovation investment, where uncertainty over future revenues resulting from the investment, and also over the future viability of the SME, may be great. However, there are complications to this story.

A firm cannot be considered to own a call option on an investment until it actually has a guarantee of funding which will allow it to exercise the option when it is sufficiently in the money - the value of a call option to buy corporate shares at \$1 each, is in effect limited by the number of shares the owner can afford.<sup>13</sup> The first uncertainty the firm must eliminate then is that over financing arrangements. If it is optimal for SMEs to use the real options approach to assess their investment opportunities, this must also be true for potential investors in the firm.<sup>14</sup> Presumably they apply this by waiting, similarly, until the value of

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<sup>12</sup>Where a firm chooses to adopt a known technology rather than innovate through internal R&D, a greater amount of information will be more easily available and thus the optimal waiting time will be less to reflect the reduced uncertainty and necessary embodied risk of the investment.

<sup>13</sup> The call option on IBM shares may be sold of course, but the investment opportunity of the SME is unlikely to be similarly transferable.

<sup>14</sup>This is true as long as the investments in the firm are 'lumpy' - which is the case for bank loans or venture capital investments (even if staged) - and a significant part of the investors' portfolio - this is more likely to be satisfied for a venture capital fund.

their option to invest in the firm is deep enough in the money to overcome the opportunity cost of foregoing further information. As has been discussed in the previous paper, however, in many cases a bank will decide not to accept even the *option* (as offered by the SME) because the information does not simply *become* available, there are costs attached to its acquisition which may be prohibitive. Alternatively, a potential equity investor may be waiting for the firm to build up a sufficient track record of profitability - which may not occur without the investment.

There are a number of ways around the inefficiencies of information and principal-agent problems which exist in stock markets - economies of scale are variously exploited by pension funds and ratings agencies, for instance, and much private research is certainly carried out. A unit trust fund selling corporate shares may signal that their research has cast doubt over future profits, and thus the option-holder may decide that, having waited until this point, it is time to exercise the option because prices may be as deep 'in the money' as they will ever be. Do there exist analogous signals for firms? Firms can learn more in the waiting period by observing the market, and the actions and products of competitors, and possibly through publicly available research, but the situation is different for firms following different strategies. The degree of competition in the firm's market will determine how long they can reasonably wait without losing the option to a rival's pre-emptive investment, so for example a monopolist will best be able to exploit the option value of an investment but at the same time such an industry is likely to be characterised by less innovative investments than a more competitive one.

### **Implications for SMEs' technology investments**

A product innovator cannot seriously hope to assess the value of a new product which its R&D will produce, nor get any closer to that assessment, by simply waiting - and researching the idea itself would be research. On the other hand, through marketing analysis more may reasonably be learnt about potential technology acquisitions by observing their performance elsewhere (which is not R&D). The value of specific R&D projects may however be so uncertain as to nullify that of information gathered while waiting, which provides a good reason for the decision not to innovate which many SMEs take. While research may helpfully be conducted into the effects of R&D expenditures at an industry or sector level, on an individual basis the uncertainty is surely too great.<sup>15</sup>

Preliminary purchases from a capital goods supplier are more likely to yield useful information about this avenue of investment, and such suppliers will provide as much (positive) information about their products and other users as possible. That is, if the SME chooses a 'buy' strategy rather than 'make,' it may reduce the uncertainty over its purchase from a capital goods supplier by making smaller purchases first and gathering information about the standards of technical support, training and value that may be

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<sup>15</sup>Note that this provides a justification for the involvement of public bodies when the effect of an industry's R&D efforts have been shown to be positive, but may not be so in individual cases, i.e. when the social value of the industry's R&D is greater than the sum of the private values to individual firms.

expected. Again then, the implication of our discussion seems to be that acquisition and absorption of technology are where the focus should be. Recent literature on the efficiency of R&D by firm size (e.g. Tether, 1998) seems to be moving away from the idea of small firms' superiority, suggesting that the research which supported this view was biased because it assumed that small firms' innovations were equally valuable to those of larger firms - Tether disputes this by using post-innovation data to estimate innovation value.

Continuing with the real options approach, there are clearly useful signals to be gleaned by potential investors which will not necessarily reflect the value of a particular project but some assessment of the firm's capabilities in more general terms. Private equity investment<sup>16</sup> is probably the weakest signal, but it suggests the involvement of a backer with either some expertise and perhaps the time to investigate the firm more fully (a 'business angel'), or one whose investment is based more on the 'social guarantee' of family or friendship. Venture capital investment is not only a signal of previous value of the firm but also implies a strong managerial provision, with clear financial goals.

In each case, then, further investment by another backer should increase the information - and thus reduce the value of *not* exercising the call option - of any given potential investor. In much the same way, obtaining further information from either the potential customers or technology suppliers should also reduce uncertainty. So the picture is clearer for the option value of investing in a technology-based SME. But as we have seen, the call option of the SME to make the investment relies for its existence on the agreement of funding.

We may conclude this section with a brief sketch of the archetypal successful technology-based SME. Originally a product innovator with an exclusive make or buy strategy (most likely buying), the SME spreads its range of operations as it grows and combines sourcing strategies and product and process innovation - truly comprehensive - before process innovation becomes the focus, and (more tenuously) non-innovation in the stage of maturity. Over this process, the SME has also been increasingly likely to invest in firm-specific technology with lower resale or collateral value and perhaps to move away from subcontracting. We concentrate on financing effects such as the former in the next section, to extend the range of this archetype, before considering in section 4 the specific constraints which characterise the southern European version.

We may identify the following four breakpoints in the financing life cycle of SMEs:

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<sup>16</sup>We distinguish between market equity, as might be accessed only by a very small number of SMEs, and non-market equity provided by third-party investors who *are not insiders* of the firm. The former we refer to as public equity, and the latter as private equity. Note that the 'business angels' of Anglo-Saxon economies are a significant group in this latter category, although their prevalence in southern European economies is less well-established - private equity investments are more likely to be made on the basis of social guarantees.

1. SMEs which are unlikely to grow further, but which may require ongoing assistance to ensure their survival.
2. product innovators seeking early (private) equity finance for (possibly exclusive 'buy') investment.
3. comprehensive innovators seeking (long -term) debt for comprehensive (make and buy) investment projects.
4. comprehensive or process innovators seeking venture capital or possibly IPOs before they have built up sufficient retained earnings for self -financing of (make and buy) acquisitions, or a track record of sufficient length to reduce asymmetric information problems to obtain enough funds from financial institutions.

Break point 1 clearly represents the point of intervention if the aim of policy is to prolong the life span of relatively less successful SMEs and thus protect or generate employment through such firms. There are potential problems on both sides of the financing equation here: an aversion to (further) personal exposure on the part of the owner may mitigate against financing in the form of continued bank assistance being sought, while bank unwillingness to assist a business which is not noticeably successful will form an obstacle on the supply side. In terms of equity investment, such SMEs are clearly not potential venture capital targets because they will never go to market and are unlikely to ever be the subject of merger or acquisition attempts - while personal and insider finance may well have been fully exploited at start -up.

Breakpoint 2 would be that at which policy could encourage adoption of technology along the lines recommended by Eaton et al. (1998) for European productivity growth. There is here a problem specific to the organisational structure of SMEs as opposed to larger firms - selling an equity share to venture capitalists requires a breach in the ownership/control duality which the smaller SME has provided to its founder(s), and as such is a point at which resistance can be expected. On the supply side, the absence of private equity investment structures such as 'business angel' networks in Southern Europe is a constraint (as well as relatively less attractive exit expectations due to the absence of suitable regional stock markets and the difficulties for firms from relatively weak economies of floating on European exchanges).

At point 3, the firms seeking investment are most successful in terms of market share growth - on the one hand, this makes them a good investment and so policy might encourage sensible investment, but of course they are also more likely to be able to obtain finance without intervention. Finally, point 4 again refers to more successful firms, although here a policy to promote IPOs might well have a trickle -down effect of increasing expected returns from private equity investment at any stage of the SME life cycle. Breakpoints 1 and 2 are more likely to provide employment gains from policy.

### **The Greek case study**

The objective of the Greek case study was to examine the complex relationship between innovation-related investment in Greek small- and medium-sized enterprises on the one hand, and the supply of finance to that effect on the other.<sup>17</sup> The key questions concerning the Greek case study are the following:

a) what are the relations between the relatively weak innovative performance of the business sector and the financial system as it developed during the recent period of deregulation and increasing liberalisation?

b) how did globalisation affect the structure and performance of the financial markets in Greece and what were the implications of this process as far as development (in particular of SME's) is concerned?

The problems of adjustment and industrial restructuring have also a macroeconomic aspect. In view of the serious macroeconomic imbalances of the Greek economy up till the mid 1990s, high interest rates as well as uncertainties (concerning both the broader environment and the economic prospects of the firms themselves) have posed a constraint on the propensity of firms to invest. At the same time, the sheer magnitude of the budget deficit has absorbed funds which could otherwise have been directed for the financing of investment projects, thus crowding out investment in manufacturing projects. Furthermore, the urgent need to reduce public deficit led to the limited availability of public money to support investment (in the form of subsidies, grants and other supporting schemes).

The diminishing availability of public funds to finance investment coincides with sweeping reforms of the Greek financial system. The reforms have permitted to a range of small financial organisations to enter the market while new forms of lending emerged (factoring, leasing and to a smaller extent venture capital). In particular reforms have led to an increasingly broader range of financial products and to more intense forms of competition. It should also be noted that high lending bank rates, the "safer" option enjoyed by banks to invest their own funds in state bonds (so as to limit their risks while benefiting from commissions and discounts given to them), and the preference of banks to grant short-term rather than long-term credit are elements which continued to coexist and influence the availability of credit for industrial firms. The fast growth of the stock exchange has partly eased this financial constraint, but only for a small number of firms which already enjoyed good performance and a reputation with the markets. The possibility to borrow money denominated in foreign currency (at considerably lower interest rates) has been another way of dealing with the prevailing high interest rates. Again, however, this option has not been equally feasible for all industrial firms.

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<sup>17</sup> Detailed review of the Greek financial system, local technological capabilities and presentation of the research findings of field work is provided in the background reports: *The Dynamics of Financing and Innovation in the Greek Economy: Continuity and Change*, Tassos Giannitsis, Antigone Lyberaki & Nikolaos Milonas: June 1998 and *The Financing of Innovation and Technology of SMEs in Greece*, Antigone Lyberaki and Nikos Mylonas: June 2000.

### **Corporate strategies and technological change**

The performance, dynamics and relative weight of innovative firms is conditioned both from the demand and the supply of innovation finance. On the demand side, of crucial importance are the prevailing entrepreneurial attitudes that enhance or inhibit entrepreneurs from starting up a new firm and seeking external funding. Another critical factor relates to the national innovation system (including government support for R&D, education and training, as well as the prevailing relationships between Universities and Research Centres on the one hand and industry on the other). On the supply side, critical is the role played by the banking system as well as the availability of other sources of financing investment (equity financing, venture capital companies, business angels etc). The obvious problem, which arises when trying to assess innovation financing systems, is that the latter are embedded not only in local institutions but also in the wider socio-economic characteristics as well as the development path of any particular economy.

In terms of performance over the 1990-1998 period, a clear progress has been made in R&D investment intensity, net profitability and financial expenditure. These findings are in line with the general improvement of the Greek manufacturing over the 1990s (especially since the mid'90s onwards). Among the factors explaining growth, prominent appears to be the role of the linkages with customers as well as of management skills. What is interesting to mention is that while over the last five years the cost of capital has been a critical factor conditioning the growth performance of the firms, its importance appears to decline in the perceptions of entrepreneurs/managers in the near future. Its place is taken by marketing skills. The declining importance of the cost of capital is consistent with the state of things in the financial sector.

As far as the prevailing general development strategy is concerned, the empirical findings confirm the view on the predominance of defensive rather than dynamic attitudes at the firm level. For both markets and products there appears to predominate a defensive strategy (maintaining current production in present markets, introducing current products in new markets). As far as technology is concerned, again defensive and hesitant, lower risk attitudes form the general rule (improving own existing technology, using technology developed by others). In the terrain of the utilisation of production inputs, cutting labour costs, as well as using existing materials more efficiently make up the core of the answers. Again, this lends support to "defensive strategies": the main preoccupation is with costs, while labour is seen as a liability and not as an asset.

The average firm relies heavily on own (mainly personal) funds. The relative significance of personal funds appears to be declining, as a new source emerges in the form of corporate bonds. The prominent significance of personal funds in Greece has to be understood in the context of the peculiarities of the Greek financial system. These peculiarities include the existence of controls in the supply of bank credit (but not via the level of the interest rate), and the long-standing institutionalised relationships between

favoured clients and state-controlled banks) Furthermore, the prevalence of personal funds was also a by-product of tax evasion and unrecorded turnover that acted as a barrier to resorting to official channels of finance (as the financial picture of the firms was to a large extent distorted).

Exploring a bit further the question on the most common sources of information about investment in new technologies, the following seem to be especially relevant for the firms of our sample:

1. trade fairs
2. independent suppliers
3. publications

The least often quoted sources are other local firms, technological institutions and business associations. This poses an important problem, as the absence of externalities, the lack of pooling of resources and non-existence of experience and knowledge sharing appear to be stark. The lack of enabling institutions (external to the individual firms but internal to the production system) might be felt even more strongly for smaller and more innovative firms, thus hampering their investment potential.

The “traditional-defensive” business attitude of the majority of the firms in our sample is also mirrored in their views concerning the major obstacles inhibiting the increase of investment in new technologies. The answers given (by order of significance) are the following:

1. uncertain or insufficient demand for products
2. lack of internal financial resources
3. lack of assistance from major customers.

The least often quoted obstacles are concern about disrupting current operations and lack of help from universities and/or government. The most important obstacle, namely uncertain or insufficient demand, is indicative of a static view of demand. It is very different from a “market creation” approach that would emphasise the fragmentation of demand and the different growth potential of its various component parts (market niches).

Finally, turning to the obstacles identified by the firms which inhibit investment in new technologies, it seems that customers (and their lack of support in introducing innovative investment) have a greater relative weight in smaller firms. The picture emerging from the answers supplied, suggests that the larger the firm, the more important demand becomes in influencing its investment decisions. Also, the larger the firm, the more aware it becomes of the (alleged) fact that new technologies are not cost-effective.

It is worth pointing out that the sectoral picture does not reveal any substantial differentiation on the basis of sectoral characteristics. This points to the conclusion that the options and challenges are relatively uniformly spread throughout the business sector irrespective of the line of activity. To put it differently, innovative firms do share more features in common across sectors, than they do with non-innovative firms in the same sector. As the general picture of the three sectors (food processing, textiles and electrical equipment) seems to suggest, there are no marked differences between them, possibly with

the exception of the food and beverages sector, where the average size of firms tends to be larger. Another point of difference is the firms' involvement with licensing agreements. The incidence of such agreements in the electrical appliances sector is much more common than in the other two. The textile sector, although characterised by highest investment intensity, has at the same time the lowest net profitability (however, in terms of gross profitability - which is a more meaningful criterion - it did not do at all bad). As far as the main factors accounting for growth are concerned, a few differences can again be discerned between the sectors under examination. Government assistance has been an important factor accounting for growth in the foods sector, whereas linkages with customers appear to have played greater part in the case of textiles and electrical appliances. Furthermore, linkages with suppliers are perceived as very important in the food and electrical sector (but not in textiles). Turning now to the growth strategy of the firms, it seems that the food and beverages sector is more dynamic both technologically and in terms of its market strategy (it is more outward oriented also). Textiles seem to adopt the most defensive and traditional attitude, whereas electrical appliances are in the middle. Turning now to the main technological investment programs, it seems that again food and beverages tend to adopt a more radical and adventurous attitude compared to the other two sectors.

To wind up the discussion on sectoral similarities and differences, two further remarks could be made. First, there appears to exist a paradox concerning the obstacles inhibiting investment. Customers are reported to be at the same time the driving force and the obstacle to innovation. This paradox could be explained only if one distinguishes between different sub-groups of customers (one of which is conducive while the other is prohibitive to investment). Second, a very strong emphasis is being placed on inadequate/or insufficient demand. This can hardly mean that demand is constantly inadequate and insufficient throughout the board of different sectors (given the overall picture of the economy such a statement would grossly misread the facts). This uniform response on this score suggests that firms are either risk-averse or that they compete in mature product markets without a leading edge based on product market characteristics.

### **Greek SMEs and innovation financing**

Banks consider SME lending as a very important part of their asset portfolio mainly because of the high profit margins that such lending offers. On the one hand, this is due to the fact that the cost of funds for SMEs is higher relatively to that offered to large enterprises because of differences in credit risk. On the other hand, SMEs lack negotiating power so they cannot get better deals. As it is the case, most banks chase the business of very large enterprises without making extra efforts to get SME business, because the latter come to the banks for lending anyway.

Another reason banks are interested to get SME business is that they can develop relationships that lead to servicing other needs such as credit cards, cash management, imports, exports, etc. Also, by expanding their SME lending, banks can diversify better

their existing loans. Furthermore, the commissions that banks receive from SME business besides lending, add up revenues with small operating cost that do not carry credit risk since they are part of standardised intermediation. As it became clear from our interviews the role of commercial banks in supplying the SME lending is dominant.

The special role of banks with respect to SME lending includes the collection of information, the evaluation of the application, the monitoring and controls of borrowers' activities and in general, the maturity transformation along risk pooling. Because these multiple activities cannot easily be offered by an alternative capital source such as equity through the stock exchange, bank lending is not threatened in the next 5 years or so. This is true also for other specialised forms of financing such as business angels or venture capital firms.

Another aspect that banks have expressed in the interviews is their desire to abolish all central bank constraints in lending large firms or SMEs. These constraints impact negatively the overall amount available to SME lending, the quality of funded investments as well as the flexibility enjoyed by the banks. The specialised credit controls and the imposed central administered lending programs deprive banks from implementing their special role in loan evaluation to promote the proper resource allocation. Furthermore, the imposition of credit ceilings prevents the inclusion of risk premiums in lending rates. This is likely to lead to the exclusion of technological investments from receiving bank loans since such investments carry higher business risk and thus high risk *premia*. In the realm of full deregulation one would expect that the government should aim at the enhancement of competition among banks in SME lending among other things.

In evaluating a loan, banks use all typical criteria such as liquidity, financial ratios, guarantees, given subsidies and management experience. As expected in our banking structure these criteria are analysed differently. One bank uses the McKinsey model as a mechanism of credit analysis through a series of qualitative and quantitative variables, thus providing a more objective loan assessment. Other banks weight the above criteria before making assessments giving different weights depending on the bank and the company under evaluation. Also many banks consider the SME owners' personality as very crucial to reach a lending decision. Furthermore, if SMEs appear to have only one supplier this is taken negatively in evaluating the loan. This negative aspect lessens if the supplier happens to be a bank's customer for whom the bank has own information. On the other hand, the existence of at least 2-3 suppliers plays a positive role in loan evaluation. Banks are not willing to offer better terms to SMEs as a result of a long relationship they have with them.<sup>18</sup>

In the case of granting loans for technology based investments, the banks find that such loans are harder to evaluate and the criteria followed, are stricter. Besides the typical financing criteria mentioned earlier which are analysed by experienced technocrats they take into account the report analysis prepared by specialised engineers on behalf of the

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<sup>18</sup> In our representative Greek sample of banks, with one exception, what play the major role in loan evaluation are the economic situation of the company and its future potential of repaying the loan.

bank. This report provides the basis as to whether the technological investment under question is overvalued or not as well as whether it will enhance the company's productivity. The advisory role of banks in subjects of technological investments has been increased over the recent years. The banks prefer SMEs to arrive with complete costed projects rather than a variety of options for their consideration. Banks help SMEs in selecting the best possible investment plan using their own technical know-how. Furthermore, there appear to have great influence on the final plan but do not attempt to overturn the original proposal. From the moment of granting the loan, the bank pursues monitoring of investment and of the company. In doing so, banks more and more act like other primary sources of financing such as venture capital firms.

Banks do not consider all types of technological investments as being equal in receiving financing. While for most types of technological projects financing is rather easy, product innovation has rather a medium difficulty. More difficult financing appears to be for the projects of technology development and even harder for intangible technology. In these cases banks are sceptical due to increased uncertainty in these projects and the small business risk SMEs are willing to undertake. All banks feel that their lending decisions are not affected by the involvement of a state bank specialised in infrastructure projects, a case of implicit co-financing. What counts is the techno-economic condition of SME and its proposed investment. One thing that lending managers find out about technological investments is that entrepreneurs lack the necessary information regarding development laws and existing subsidies for the kind of proposed investment. Most banks agree that governmental agencies (Growth and Technology Ministry, Greek Organization of SMEs, etc.) do not co-operate very efficiently and they do not help promote the lending process. This in turn results in long delays especially in cases where investment projects fall under more than one development law or special provisions.

### **The Portuguese case study**

Recent literature on the Portuguese industrial and innovation policies suggests that there is a clear transformation in S&T and innovation capabilities in Portugal, involving a significant modernisation, the upgrading of technological competencies of many actors, and the creation of new infrastructures.<sup>19</sup>

There is, however, a need for promoting and nurturing new entrepreneurial initiatives, strengthening the role of users in innovation processes, using public organisations as demonstrators of new approaches, and further supporting intangible investments. Portugal has lacked so far a coherent innovation policy, due to the insufficient co-ordination between S&T and industrial policies. Innovation, envisaged as a triad of technological,

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<sup>19</sup> The background report *Innovation Behaviour and Financing Conditions: The Case of Portuguese SMEs*, by Vitor Corado Simoes provides additional information on the technological characteristics of the Portuguese manufacturing industry and an interesting presentation of different views on technological investment by the various actors involved in investment financing processes.

organisational and marketing change has to be taken to the forefront of public policies (Portuguese report, 1998).

The relationships between industrial policy and the financial sector deserve a closer analysis. In fact, PEDIP I was designed mainly as an instrument to supplement the insufficiencies of the financial system in providing funds firms. PEDIP I and the financial system were to a large extent envisaged as parallel, not interacting. The launching of venture capital firms is a clear testimony of such an approach: it was aimed at responding to the lack of concern of the banking system with innovative start-ups and innovation projects. Firms used, to some extent, PEDIP grants as a countervailing mechanism or as a cushion against high interest rates. Such a perspective was completely redressed under PEDIP II. Differently from its predecessor, PEDIP II was based on a close collaboration between the banking system and industrial policy makers, especially IAPMEI. Applications could be presented either to IAPMEI or to banks. Experience has, however, shown that firms preferred to continue to submit projects IAPMEI instead of banks. To some extent this appears to show that the degree of trust between firms and banks is not high. Meanwhile, financial institutions were encouraged to look for innovative firms and projects as a source of long term returns. More recently, collaboration between banks and PEDIP management enabled to leverage the possibilities for PEDIP to support investments projects: banks lent capital and PEDIP was responsible for the interest.

### **Portuguese firms and technological capabilities**

Although much research still needs to be done, there is already a reasonable body of literature on the main features of innovative attitudes and behaviour by Portuguese manufacturing firms. Innovation is not a strategic concern for the majority of firms, except for NTBFs. Innovation is still envisaged as technological innovation, disregarding the increasingly important areas of commercial and organisational innovation. On the other hand, a close relationship was found between differentiation strategies, based on engineering and/or design improvements, and pro-active attitudes towards technological and commercial innovation. It seems that the innovative behaviour by Portuguese firms is more of a reactive nature, than the outcome of a strategy specifically aimed at using technology as a key factor in building competitive advantage.

As it was said above, PEDIP I generated a wave of investment in machinery and equipment, substituting old machinery for new vintages of more sophisticated and performing machinery. This behaviour is quite consistent with the opinion expressed by managers that equipment acquisition was the main factor of innovation. Such a reasoning led in several cases to an over-investment in machinery, purchasing equipment with a performance much higher than other further up or down in the manufacturing chain or too sophisticated for less educated operators. This over-investment was spurred by the existence of cash grants, making money-raising less demanding. A further point must be stressed: due to the weakness of domestic capital goods industry, investing in new machinery meant, in most instances, imports.

The PEDIP II programme provided a large room for the involvement by Banks in the support of investment initiatives. Applications for investment incentives could be channelled through banks, being expected that this would be easier for firms, since they maintain a working relationship with their banks. Simultaneously, the assessment of application merits would be improved, benefiting from banks experience in evaluating investment projects. What happened, however, was that, in general, firms preferred to submit their applications through the traditional administrative mechanisms instead of Banks. As it was pointed out above, this may be interpreted as indicating that the level of trust between firms and the Banking system is not high.

The 40 firms surveyed are dispersed throughout the country, with a relative concentration on the Lisbon and Oporto areas. Companies were questioned about the factors which might better explain their growth in the past 5 years and which were more likely to drive their development in the next years. The factors deemed to be most important in the recent past, with scores above 4 points, were linkages with customers and management skills, these were followed by the ability to adopt technologies, skilled labour and linkages with suppliers. Conversely, the lowest score concerned government assistance. Access to capital, design ability and marketing capabilities were also among the less relevant growth factors, exhibiting marks below 3. Interpretation of these data should be performed with caution, since firm managers tend to be biased in their answers, highlighting the influence of firms capabilities and downgrading the role of external support. Having said this, it seems that company growth has been mostly due to the convergence of three factors: (i) external inter-action capabilities, with both customers and suppliers; it is curious, however, that while linkages with customers are granted the first place, marketing capabilities were not considered to be strong, a feature that may be interpreted as indicating more competencies in customisation and nurturing linkages than on “broad spectrum” marketing; (ii) capacity to adopt external, usually foreign, technologies, at least partially embodied in equipment goods, which is not matched by a similar level of R&D and innovation capabilities; and (iii) in-house human resources, regarding both management and skilled labour, this being the factor which shows a smaller standard error, indicating the relevance ascribed to it by the bulk of firms.

An interesting finding was that financial issues are not envisaged as critical for growth. As pointed out above, “access to capital” had an average score below 3, being considered as “very important” or “critical” by 10 firms (out of 40) only. “Capital cost” was ranked higher (with a score slightly above 3), but again only 13 firms classified it in the highest positions. It is also noteworthy that most firms ascribe “access to capital” and “capital cost” the neutral classification (that is, 3); for both factors, however, the number of “negative” classifications was inferior to the “positive” ones. These findings suggest, in our opinion, two remarks. First, financial issues are not seen as drivers of growth but curiously they are not envisaged as serious hindrances to the implementation of company projects. In other words, “access to capital” and “cost of capital” are neither restrictions nor engines for company development. Second, the higher score of “capital cost” vis-à-vis

“access to capital” reflects the easing of the capital cost restriction in recent years as a result of interest rates decline and lower banking intermediation margins.

Proceeding to a sectoral analysis, different strategic pattern emerged. In food processing firms, the key drivers are market “extension” (entering new markets with current products, which means in most cases going from regional to the Portuguese market) and cost cutting, both in labour and energy; technology strategy is focussed on improving own existing technologies, all the other technology modernisation options falling below the neutral score (that is, 3.0), with very little effort on training and human resources improvement; such a pattern corresponds to a very traditional, passive, attitude towards strategy and innovation, more characterised by “keeping things moving” than by “making things change”, and exhibiting a very low concern with dynamic competitiveness factors; it seems that the discourse of “betting on the soft”, on intangible resources, was not assimilated by food processing firms. Strategic concerns by textile firms are, first of all, focussed on reducing energy costs, followed by market “consolidation” (betting on existing markets, with either current or new products, quality management and staff training, it is evident that the commitment to a technology oriented) strategy is low (all factors below 3.5 as an average), a finding which is in line with the trajectory of technology accumulation in the industry, very much supplier-dominated; but there are signs of change towards a more innovative attitude, expressed namely in the concerns to launch new products and to enhance human resources skills. Finally, the strategy pattern in the electrical machinery industry is led by a double concern, not necessarily paradoxical, of continuous staff training and cutting labour costs, suggesting that productivity improvement is a key strategic feature; contrary to the other industries, technology dynamics achieve relevance, although chiefly through the improvement of own existing technology, to launch new products in current markets; unfortunately, such a technology driver is not corresponded by a significant effort in the organisational field (one may wonder whether the reason for this is not associated with the very small size of most electrical machinery firms).

### **Portuguese SMEs and innovation financing**

Interviews with bank executives have shown that, although a broad common base does exist, banks follow different approaches, largely stemming from bank tradition, adjustments to past challenges, and bank characteristics. To the external observer, however, there appears to be a “profession standard” to which all banks adhere, defining a common ground from which differentiation emerges. A clear evidence of this fact is the definition of criteria for decisions to “go up” in the hierarchy : all banks stated that this was a function of the amount of loan, interest rate, loan duration and guarantees.

Segmentation of SME lending is extensively used in the banking industry. It can be done in two ways: through a value-based approach, matching delivery cost to customer value, examining the profit on the main banking products for every client; and “splitting”, based on the needs of the client. The interviews undertaken in Portuguese banks indicate that all

banks use some kind of segmentation, not only in terms of approaching SMEs, but also on what concerns lending decisions. Here we will mainly focus on the organisation of distribution channels and the delivery of services. While acknowledging the increasing importance of virtual banking – and its advantages, namely in terms of costs – all our counterparts strongly stressed that for SME lending face-to-face contacts (and relationships) are essential. Therefore, all agreed that branch offices are the most relevant distribution channel in dealing with SMEs.

The specialisation of SME business and the segmentation criteria, however, significantly differ from bank to bank. Almost all the banks surveyed discriminate their offices between firms and particulars (general public), provided that a certain level of turnover is exceeded. That is, below that level, the same branch office is in charge of dealing both with SMEs and with particulars; above it there are branch offices specialised in dealing with firms. However, the cut-off point may be very different: in at least two banks it is around 5 billion escudos (25 million EURO), leaving aside the vast majority of SMEs, while for another it was 200 million escudos (one million EURO). More often than not, banks have individual companies for project finance, dealing specifically with very large projects and, as a rule, with large companies. Some of them had also created venture capital firms, to which they refer projects whose characteristics or financial structure may demand the involvement of risk capital.

To sum up, although using different approaches, most banks make some kind of market segmentation according to firm size. This confirms that SME lending should, to a large extent, be seen in the context of relationship banking. Proximity is not so relevant as for particulars. But being close to firms generates two kinds of advantages for Portuguese banks: better knowledge of firms' track records and managers capabilities; and creation of barriers to entry by foreign competitors.

The whole picture indicates, thus, a heavy reliance on financial data as well as on collateral. Analysis of cash flow and financial ratios of the borrowing firm, together with the request for collateral, are the key factors in lending SMEs. Banks seem to feel much more secure when dealing with financial accounts (ultimately, the business of risk assessment department are figures) and when the company, or the project promoter himself, provides sound guarantees, which high levels of fundability, which may be appropriated by the bank in the case of default, and easily converted into money. The final objective of project risk evaluation is to keep risk at an acceptable level. Banks are very cautious: if the estimated project margin is small or if collateral is not strong enough, it is better not to take risks.

To get bank executives views about the types of technology investments most likely to be funded, we asked them to rank, from most likely to less likely, investments according to their characteristics and focus. Generally speaking, the responses obtained are very much in line with recent research findings on these issues. In fact, it was found in the Portuguese case that:

Process innovation is more likely to be financed than product innovation. With one exception (again based on the argument that a systemic analysis of the project is needed), all our counterparts considered that, from the bank's perspective, the financing of process innovation was easier. The reasons for such an attitude were associated with risk assessment. Process innovations are usually incremental innovations or, if otherwise, the advantages stemming from them are often amenable to quantification (savings in raw materials, in energy or in man/days due to the new process). In contrast, product innovation projects are more uncertain and have more degrees of freedom. What is at stake is not just a technological capability: is also a commercial performance. Anticipating market behaviour is very difficult and elusive. The observation of one bank executive about the insufficient ability of many SMEs to "understand" their markets (and especially, foreign markets) is perceived by banks as a barrier. This may be partially overcome when the product was already commercialised in leading markets outside Portugal, since the Portuguese market is to a large extent imitative; still there is some risk that the market will not behave as anticipated.

Technology purchase is easier to finance than technology adoption or development. Although two banks stated that the choice depends very much on the reliability and the capabilities of the firm concerned, there was an widespread agreement that technology purchases are the less risky. Curiously this was also the experience of SMEs. The preference for technology purchases is easily explained: in such case, there is less risk, since the technology in question had for sure been successfully applied elsewhere; risk decreases when the technology is embodied in machinery and equipment, immediately available for use at purchaser's premises. In other words, the less changes are required to put the technology into operation (when there is just importation without any adaptation effort), the less risky it is considered by banks. The only exception is second hand equipment.

Generic technologies are more likely to be financed than specialised ones. This position was expressed by all our interviewees, except one. The rationale for this is clear, and very much in line with the theoretical arguments about bank's behaviour: generic technologies, especially generic machinery, are much more fungible, since they are not firm specific. Therefore, in the case of default of the borrowing firm, they would be easily traded in the market. In other words, bank commitments would be much better protected with generic machinery and generic technologies, which might be used as collateral. Furthermore, the risks entailed by generic technologies might be better assessed, since it would probably be in operation in other companies.

Machinery and equipment as well as buildings for production are easier to finance than intangible technologies. It is remarkable the degree of convergence, in this respect, among the theoretical literature, firms' perspectives and banks' opinions. While several banks found difficult to establish a rank between machinery and equipment, and buildings for production, arguing that the preference depends very much on the particular conditions of projects, all of them ranked intangible technologies as the least desirable to finance. Exchanges of views with bank executives have shown that the reasons for this were two

fold, both associated with the main criteria for granting loans to SMEs. First, intangible technologies are more elusive and specific, and therefore less amenable to a sound use of risk assessment techniques. Second, they do not provide collateral. Banking decisions to finance intangible technologies cannot thus be based on the “usual” decision lending criteria. They somehow require shared visions and a high degree of mutual (business) trust between the organisations (company and bank) and even people involved, which are not much in line with loan contracts and traditional banking behaviour.

### **The Spanish case study**<sup>20</sup>

Spain's integration to the EEC -EU in 1986 made way for a new institutional framework of economic stabilisation, liberalisation, promotion of R&D and technological co -operation. The process of European unification itself has had consequences for the Spanish macroeconomic context. From 1986 to the beginning of the 1990s, the country's economy underwent an expansive phase that corresponded to EEC -EU trends. This was followed by a recession that started in 1991 then a significant recovery after 1994. Since the integration of the Iberian countries to the EU, the European project has been largely dominated by nominal convergence to the criteria of monetary unification. This process of economic integration has increased the interdependence of the different economies, and of the political co-ordination of economic policies, in particular, due to the Single European Act (1987), the European Economic and Monetary Union (Madrid Council 1989) and the Treaty on European Union (Maastricht Council 1992).

Real advances in technology policy in Spain became apparent at the beginning of the 1980s. Spain's official membership of the EC in 1986 provided a window of opportunity for the further improvement of technology policy. First, Spain profited by the economic boom which accompanied its EEC -EU membership. Second, there was broad consensus that Spain must take strides to 'catch up' with the advanced European countries in technological terms in order to improve its competitiveness on an international level. Third, since Spain's membership of the EEC -EU coincided with the announcement of a single market programme and the development of a European Technology Community, this meant that the country could take advantage of the prospect of greater access to markets and increased chances for Spain to modernise its technology policy within the EEC-EU framework. Policies towards SMEs are particularly important in Spain given the

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<sup>20</sup> The Spanish background report titled *Investing in Southern Europe: Technological and Financial Investment Decisions by Manufacturing Firms in Southern Europe -the case of Spain*, provides a comprehensive review of structural trends in the Spanish manufacturing industry and places investment decisions in the broader context of corporate strategies. This study of the complex relationship between technology investment and the availability of financial resources is justified not only by the contribution of SMEs to economic activity but also by the fact that, in the face of global industrial competitiveness, SMEs are being forced to restructure and innovate. Spain is a good reference point since its manufacturing firms have caught up with EU levels over the last two decades. Spanish innovation intensity increased from 18 to 38 per cent of the EU level. This increase was as significant in the high technology industries as in the low technology industries such as Textiles and Food.

structure of the industrial sector since the average size of the Spanish firm is well below the EU-15 average.

### **Financial deregulation and SMEs investment**

During the 1970s a set of government regulations came into force aimed at: first, increasing liberalisation to establish new banks and branch offices; second, intensifying operative homogenisation among entities (diminishing existing differences between industrial and non-industrial banks); and third, liberalising interest rates of long-term transactions. A new impulse to the process of reform came during the first half of the 1980s, with further advances in liberalisation of interest rates and bank commissions, progressive decreases (and the final disappearance) of the investment coefficient for credit entities, homogenisation among credit institutions and the freedom of opening new offices by private banks, savings banks and credit co-operatives. This period was characterised by an increase in the public sector's financing needs. The acceleration of inflation pressuring interest rates and the restrictive monetary policy gave rise to credit restrictions affecting SMEs in a particular manner.

Following the Spanish adhesion to the European Union in 1996, further progress was made towards the liberalisation of the financial system, harmonisation and co-ordination of laws, regulations and administrative provisions and national transposition of Community legislation. In 1991, an in-depth restructuring of Spanish public banks took place aimed at accommodating this sector to the requirements of a more competitive environment characterised by the liberalisation of capital movements and freedom to provide services. The main target was to adapt the functioning of public banks to market requirements forcing them into competition with private banks in funds lending and borrowing. In February 1992 full liberalisation of capital movements was attained. In the same year regulations in regard to banks' own resources and solvency ratios of credit institutions were adopted according to EU standards. It should be stressed that the crisis of the beginning of the 1990s corresponds to a period of public deficit and consequent monetary restriction. In 1994 significant laws concerning the regulation of the financial system were adopted. Today, the Spanish financial system bears more resemblance to the more advanced systems of other EU countries, sharing with them the main trends of modern financial activity: deregulation, growing competition, increasing internationalisation and financial innovation.

The profound transformation of the Spanish financial system during the last few decades was necessary in order to adapt this economic sector to the international environment. The structure of the financial system was clearly inappropriate and gave rise to three main effects: first, financial difficulties of public sector leading to deficits generating inflation. This situation led to restrictive economic policies causing a decrease in credit availability for enterprises; second, the rise in real interest rates with an unfavourable effect on private investment processes; and third, inappropriate financial structure of SMEs which have

problems to access medium and long-term financing required to carry out investment projects.

Accordingly, the successive reforms brought about some positive effects allowing the Spanish financial system to increasingly resemble its advanced EU counterparts. These positive effects can be summarised as follows: increased competition and financial innovation; the development of monetary markets including the appearance of new financial assets and intermediaries; improved access to international financial markets; modernisation of the securities market giving rise to an increase in financing of business activity; the inclusion of new specialised financing formulas, two of them particularly relevant for SMEs: the mutual guarantee companies and the venture-capital companies; better control of credit entities and their minimum solvency levels; and, finally, the modernisation of payment systems.

Notwithstanding these positive aspects, the reforms also resulted in a set of negative effects upon general economic activity which particularly affected SMEs. These negative effects included: economic imbalances caused by the partial nature of the reform and the lack of uniformity in its temporal implementation not only inside the financial system but also in other areas of economic activity. This resulted in increased uncertainty for enterprises and financial institutions; negative effects on credit to the banking system, particularly during the crisis periods 1978-1985 and 1990-1993, caused by a public sector deficit and restrictive monetary policies. As a consequence, SMEs financing sources were deeply affected; and negative effects on investment processes due to the database of the Bank of Spain's enterprises annual report shows that: Spanish SMEs have more difficulties in accessing borrowed resources than large enterprises; that they are more dependent on banking financing, support higher financial costs when using borrowed resources; have a higher short-term indebtedness and face a worse bargaining position than large firms concerning banking credits. So, the information on enterprises' financing indicates that SMEs are much more dependent on internal sources of funds (owner's own capital and retained profits) than external sources of funds. SMEs clearly have problems in accessing bank loans at convenient rates or raising equity on the markets and frequently rely on informal sources for external funding. Tax systems discriminate in favour of debt financing and against equity financing discourages enterprises from building up their own equity base and reinvesting the retained profits in their business. In summary, the major problems are connected to under-capitalisation, difficulties in obtaining loans and the absence of appropriate capital markets oriented to SMEs.

In the case of Spain, several instruments have been introduced to deal with these problems. These include the venture capital scheme, the second stock exchange market, mutual guarantee companies and a kind of credit known as "participation credit". Venture capital is an important source of equity capital particularly for high technology SMEs, the range of actions undertaken by venture capitalists being able to cover the various stages of development, including seed-finance, start-up, early stage and expansion finance. In general, the aim of the venture capitalist is to turnover his/her portfolio, therefore the outcome of a solution is always an important feature in a deal. It is worth stating that the

creation and growth of dynamic companies depends to a large extent on the access to venture capital, so adequate measures aimed at improving the relationship between venture capitalists and technical innovation are necessary. The main relevant features of investment patterns can be summarised as follows: large volumes of funds are addressed toward expansion investment; main suppliers of funds are foreign investors, followed by public sector and domestic financial entities; a trend has been observed of an increase of investment in large companies with high profit possibilities.

### **Spanish SMEs and innovation -related activities**

Analysis of the MINER survey sheds light on technology policy in Spain during the first half of the 1990s. Public finance prioritises firms involved in R&D, though the level and kind of public support varies enormously depending on the sector in question. Examining the proportion of funding to R&D expenditures desegregated into six categories according to the number of workers, firms in the bracket 51 -100 receive the highest proportion of their R&D expenditure (16 per cent). Next, firms with between 10-20, 101-200 and 201-500 workers receive between 10-11 per cent. Firms with between 21 -50 workers and also large firms with over 500 workers both receive around 6 -7 per cent of their R&D expenditures. Thus, the figures do not show an active R&D public policy towards SMEs.

There is not such a strong pattern of public funding to R&D expenditures in comparison with innovation expenditures. By far the largest percentages also go to support public entrepreneurial related activities like shipbuilding (5 7.9 per cent) and aerospace (12.4 per cent). By contrast, a moderate negative correlation can be observed between both regional and EU funding with respect to technology intensity. These trends are similar to innovation results but, in this case, regional funding to low technology activities are less than transfers at the national level. In this sense, the results are similar to those from the MINER surveys on R&D activities, since regional funding complements, rather than substitutes, support to R&D expenditures at the national level.

Data from the INE survey show that the central government funding and lending to innovative activities corresponded with firm size and medium and high technology activities, while regional and EU funding prioritised SMEs and low technology activities. The sectoral analysis also exhibits the priority of the central government contribution to its entrepreneurial activities (aircraft and aerospace), and some high technology activities. However, the same INE survey shows a different result for public support to R&D activities. The Spanish R&D expenditures were more concentrated in high technology activities than innovation expenditure. The regional and EU funding to SMEs and low technology activities did not exceed central government support, and these different funding sources were complementary. Like in MINER, the R&D public support shows again governments own priorities for aerospace and shipbuilding, and activities under reconversion.

Investing in restructuring and innovation are a necessary condition for firm growth. This is considered a requirement to cope with international competitiveness. This contrasts with the lack of renovation that leads to the death of the firm and a declining economy. Some of the more relevant factors of growth in our sample, in terms of firm organisation (management, labour, linkage with customers or suppliers and marketing), technological innovation (R&D, technology adaptation, engineering abilities), finance (access and cost of capital) or institutional (government assistance). The identified factors of growth show a common pattern of behaviour among industries and firm sizes. The main factors with values over the average have been: first, Linkage with customers; second, Management skills (both linked to firm organisation); third, R&D innovation capacity; fourth, ability to transfer technology; fifth, design & project engineering (all of them linked to technology innovation capacity). By contrast, we observed that: the cost of capital, access to finance and government assistance were considered by the firms as the least relevant factors to explain their growth. However, these financial factors were more important for Small firms (less than 100 employees) than for Medium sized ones. This reveals that finance is not a significant restriction in terms of the predominant reorganisation and technological strategies of the firms. However, finance is a much more important restriction for smaller firms.

In terms of innovation all the three sectors follow conservative innovation strategies, but the strategies of Food and Electrical engineering firms differed from those of textiles. The Textile industry follows typically a niche strategy that requires new products to maintain current markets. For Electrical engineering and Food firms it was observed that the relevant behaviour is a niche strategy that seeks new markets for existing products. In terms of size, medium enterprises are more active than small ones -adopting niche or regular as much as conservative strategies-. In all cases, it was clear that the firms do not follow radical innovation strategies. In terms of their technological strategies, all three sectors revealed more defensive strategies based on improving their own existing technology and accepting in second place the importance of developing new technologies. In fact, Electrical engineering medium sized firms give more importance to defensive than to offensive strategies. Finally, in all sectors, SMEs estimate that dependent (using technologies developed by others) and adaptive (adapting technologies developed by others) strategies were not the most adequate path of growth.

Although in all three sectors the X-efficiency factor is the dominant production strategy of growth, there are different secondary factors in each sector. In the case of Textile firms, using new material was the most relevant factor and, in the Electrical engineering and Food group, the most relevant factor was reducing labour costs. The evaluation of production strategies by size shows again that the most important criterion was X-efficiency followed by cutting labour costs for small firms and using new material for medium sized ones. Management practices are clearly dominated by total quality management. Meanwhile, management incentives through compensation received one of the lowest values. It is highly possible that this is associated with the debate about the Spanish business community which included criticism of "Fat Cats" and the Stock Options of certain privatised public enterprises.

Firms' access to finance is a crucial element in the innovation process, particularly for smaller SMEs, so that the results of R&D can be translated into commercial outcomes. Investment in innovative SMEs generally involves: (1) an element of risk; (2) a long time-frame (a 3 to 7 year investment), (3) returns in the form of capital gains (rather than dividends) (4) a partnership with management. Venture capital is a specific type of finance provided by certain institutions that invest alongside management in young companies that are not quoted on the stock markets. Several financial institutions and scholars have overemphasised the importance of venture capital to support high-risk investment in SMEs. For a variety of reasons, it is very difficult for large companies to undertake high-risk innovation projects. These kinds of projects have a greater chance of success if they are undertaken in small technology-based firms. This idea was also supported by evidence that American technological revolutions, such as that of Silicon Valley, which have resulted in the transformation of industries, led by venture capital-backed firms. The venture capital market is small relative to other financial markets. However, its economic role is very significant because venture capitalists specialise in investing in high growth companies and high technology-based sectors.

In terms of the accessibility of sources of finance quoted previously, we established a ranking which rates the importance of each item by the accessibility attributed by the firms. Self-generated resources are less restricted financial resources than short or long term bank debt in Food and Textile Firms but, in Electrical engineering firms, short-term debt is the easiest to access. In terms of size, small enterprises found it easier to access short-term bank finance than their own resources, while the medium ones were in the opposite situation. However, for both of them their resources own and short-term bank debt are the least restricted sources. Finally, venture capital is a more restricted source of finance. However, it is, in relative terms, as easy to access in terms of long-term bank debt is to self-generated funds.

The significant dependence upon short term financial resources that has been observed, could be a consequence of cash flow problems that do not allow them to improve their leverage position. The cash flow problems can be caused by different reasons but mainly by external financial factors such as high interest rates, restricted loans or insufficient overdraft facilities and also by business financial factors such as the retention of old customers, delinquent debtors or suppliers. Obviously, the division of categories is not binary and external factors affect business and corporate decisions (over-investment can create a cash flow problem derived from high interest rates). In the three groups of SMEs, the main problems identified in terms of cash flow were the retention of old customers, delinquent buyers and delinquent debtors. Those commonly cited as having a lesser negative impact include insufficient overdraft facilities and low approval rate of loan applications. In contrast, while for Food and Textile firms, over-investment and interest rates have an important impact, this was relatively unimportant for Electrical engineering firms. In terms of size, smaller firms present more cash-flow problems related to financial business factors and medium ones to over-investment and high interest rates.

Considering that the main external financial supplier of firms is the bank, it is crucial to examine what determines the bank's lending decision from the firms' perspective. These criteria have been widely defined and include business performance, guarantees, other requirements, managerial capacity and commitment to the bank. The firms considered that the bank's decision to lend was mainly based on guarantees and performance criteria, such as: appraisal of borrower's assets, financial ratios of borrowing, centralised credit review and collateral. At the same time, three seemingly irrelevant factors emerged: previously approved subsidies, documentation requirements and managerial expertise. The importance of the relationship between the firm and the bank is quite relevant for small enterprises, which are more dependent upon this financial resource as it was pointed out before.

One of the most relevant sets of questions in accordance with the aim of this research was the relationship between innovation, technological investment and financial facilities. As is usual we have carried out the research at the sectoral and size level. We have also looked for different financial resources but, unfortunately, few of the firms surveyed answered the sets of questions related to venture capitalists, because most of the SMEs do not participate in these markets. The results by sectors show that the traditional financial investment approach was observed only in Food firms. In this case, traditional tangible investments (machinery and equipment, and buildings: MB) are easier to finance than innovations in products or process (PP). In turn, both of these are easier to finance than technology purchase, development or adoption (PDA). The least easy are intangible technology and innovation in services. While in Electrical engineering firms all the technology investments (PDA) are easier to finance than traditional tangible investment (MB), both of them are easier to finance than innovation investment in product, process or services (PPS). Again, intangible technology is the hardest to finance. In the case of Textiles, innovation in process and services and all the technology investments (PDA) are easier to finance than traditional tangible investments (MB). In general, innovation in process seems easier to finance than innovation in products or services. Considering that the finance of traditional tangible investments (MB) is at least as hard as the finance of technology and innovation investment categories, we should point out that there are no significant restrictions to finance innovation or technology investment.

A first step in the evaluation of the technological investment programmes conducted by the firms was to define the sort of activities (innovation in products or process, inputs such as human resources or energy, or regulation standards) and the impact of technology policy (public funding) in the projects. When assessing the technology programme undertaken by firms according to sector, the principal activities developed by the firms were: quality assurance, product development and design, manufacturing process set-up, human resources training and export promotion. These innovative programmes on process, products, human resources and markets received proportionally higher financial support from the EU or national or regional governments. Public support to product or market promotion or computer aided activities (CAD/CAE/CAM) encouraged the investment decision in Textile and Electrical engineering firms. Similar results can be seen in electronic data interchange, communications, local area networks (LAN) in Food firms;

computer aided design, engineering and manufacturing in Textile firms and automation robotic and computer control in Food and Textile firms. In terms of size there were no significant differences in the proportion of developed programmes, although the small enterprises developed proportionally more investment projects in electronic data interchange, communications, local area networks (LAN) and automation, robotic and computer control.

Technology investment decisions are promoted by the information available. However, there are other reasons that drive the firms to select an innovative tangible investment. Among the factors that have been proposed, investment is determined by compatibility with the existent equipment and after sale support services. Other important selection criteria are supplier's reliability and durability. The second and third categories show the importance of services in the acquisition of tangible capital goods embodied in R&D. In all kinds of sectors and firm sizes some of the conventional factors for the investment - such as price, familiarity or relocation - do not seem as important as technical characteristics or additional services.

The main internal sources of innovation in products, process and services are: customers and R&D units, followed by production and marketing units, management, competitors and suppliers. The results are ambiguous for the project and engineering unit, which are very important for the Electrical engineering firms and small firms while they are irrelevant for the Food firms. Finally, the least relevant sources for innovations are associated firms, patents, licenses & trademarks and government programmes. This indicates clearly that the technological investment decision is the result of business and corporate strategies (linked to customers, R&D, production and marketing units more than the transmission of exogenous information, such as competitors, suppliers, affiliated firms, patents or government).

In the analysis of technological innovation it is important to consider the factors that promote the process as much as those that restrain it. The obstacles can be classified as technical (operative disruptions, unsuitable hard or software), financial (lack of internal or external resources), commercial (lack of demand or customer reply), human resources, services or institutional. It has been observed that the main obstacles were commercial (uncertain or insufficient demand and, for Electrical engineering firms, lack of reply from customers), technical (especially operative disruption), lack of human resources skills and internal financial resources and the fear that new technologies will disrupt current operations. Interestingly, some of the factors were not considered a serious obstacle to invest in new technology. First, the lack of institutional technological support or co-operation from universities or government research organisations. Firms considered in some cases that this was as a lack of technology transfer or communication. Second, the cost of private consultants. Third, the "uncertainty" that new technology will not be cost effective, and this is associated with the financial risk. Fourth, the lack of financial external resources (banks or venture capital).

#### 4. CONCLUSIONS AND POLICY IMPLICATIONS

By focusing on technological investment at the firm level in this project, we also analysed the overall impact of the patterns of the mobilisation of resources in the technological upgrading process in Southern Europe. Furthermore, this way we could introduce a clear link from investment to technological modernisation, productivity and competitiveness. This approach is relevant to the specific conditions in Southern Europe, in view of the medium level of technological development in these countries and the small size of local firms in the three selected countries. It was suggested that a detailed analysis of technological investment at the sectoral level could throw some light to the funding requirements of investment projects at the firm level. It could also improve our understanding of the link of specific categories of technology investment to financial constraints and difficult access to credit.

In order to examine the relationship between technological development and finance with emphasis on SMEs, one has to situate the basic trends in the performance of firms within the wider context of globalisation, the process of European monetary integration and the stabilisation policies of the past decade. In order to evaluate the individual and combined effects of each of these processes (globalisation, EMU and stabilisation policies) one has also to take into account the institutional format of the economy under consideration. Institutions (banks, for instance) matter in an obvious way when financing of new firms, new investment projects and high risk investment projects is at stake. What is less easily perceived though is the fact that the institutional set up of an economy matters enormously not only because it influences the supply of funds but also because it conditions the demand for finance involving high risk, and shapes the overall economic behaviour (including investment behaviour and the attitudes vis -à-vis technology and innovation).

The literature appears to indicate that technological acquisition, R&D and innovations in both products and processes by firms all involve investment decisions, and thus require a financial decision as well as a technological one. In consequence, as the structure and behaviour of the capital market strongly affects investment decisions, it will also affect technological development. Because of the imperfect mastery of technology and the uncertainty about the intensity of future product demand investors prefer to hold liquid assets which has negative implications on productivity. Furthermore, the critical issue in industrialising countries is not the production of machinery but the degree to which embodied technology is being adopted. In any case there is a drop in productivity during the period of learning. New technologies cannot be used as productively as old ones, unless the economy has accumulated a certain amount of production experience. The risk of technological sophistication results in inefficient technological choices and limited specialisation: finally firms prefer less specialised and less productive technologies.

Specifically, the macroeconomic changes and new market structures arising from European integration have a determinate effect on the investment decisions of the SMEs in the manufacturing sectors of the Southern European economies that are the subject of this

study. It is thus necessary for us to consider three poles of decision -making - firms, banks and suppliers - and combine current research on both technological innovation and corporate finance, in the dynamic context of European institutional change. Technology acquisition requires finance because it is really about investment; but this is not merely a financial question because it involves the restructuring of ownership and control as the firm expands. In this context, therefore, we understand 'capital markets' to include bank lending, securities issues, unquoted equity participation and government funding schemes as well as domestic and international stock exchanges as such.

The competitiveness of firms is increasingly based on their innovative capabilities, through the development, absorption and upgrading of new solutions – not only on the technological domain, but also in the marketing and organisational fields. In Southern European countries, public authorities do not seem to have fully acknowledged the challenges of innovation, focussing more on relatively uncoordinated science and technology, and industrial policies than betting on an integrated innovation policy approach. In spite of this, several actions have been launched with an aim to support the strengthening of firms capabilities, especially on what technological issues are concerned. Either in the context of Community Support Frameworks or on a purely domestic basis, several policy instruments – such as financial incentives, tax holidays, training support and infrastructure provision – have been launched to achieve those objectives. However, their effectiveness has been limited by a lack of understanding of how firms are managed and actually make their investment decisions.

The Greek case study examined the relationship between sources and availability of finance on the one hand, and economic performance at the firm level on the other (in particular innovation-related investment). We have attempted to situate our analysis within the broader issues concerning the financing of innovation-oriented investment, with particular emphasis on those issues that are considered more relevant for small and medium-sized firms. Furthermore, we have located our analysis against the background of a rapidly changing economic environment, which is speeding up restructuring among producers and financial institutions.

The main conclusions of the Greek case study can be summarised as follows. First, the typical firm profile (as it emerges from our sample) is a medium-sized enterprise, aged 35 years and employing 130 persons. It is primarily oriented towards the domestic market, but it increasingly shifts its interest in the European and Eastern European markets. The typical firm rests primarily on its own funds and owes a lot to its relations with customers. Although important in the past, the cost of capital is no longer seen as a critical factor affecting growth. This is reflected in the declining trend of financial expenditure throughout the 1990s. The main performance indicators of the average firm have improved over the 1990s. More specifically, progress has been clearly recorded in the terrain of profitability and new investment.

These positive trends notwithstanding, the prevailing development strategy remains in many respects traditional (path-dependent) and low-risk oriented. This applies for

products and markets, technology and the treatment of labour costs as primary targets for improving efficiency. Maintaining markets and products remains a more attractive option than creating new or improving products, or than expanding in more demanding new markets. As a corollary to this non-dynamic development strategy (which is consistent with the view expressed in the relevant literature stressing the lack of long-term commitment on the part of Greek entrepreneurs) comes the unwillingness of the entrepreneurs to be exposed with personal risk when contemplating new investment.

As far as its main sources of finance are concerned, personal funds remain very important, although easier access to bank credit (of both short- and long-term nature) has gone hand in hand with the decline in the cost of capital. This development should be partly seen as a result of the restructuring and liberalisation of the financial system itself, and partly as a by-product of the improvement of the macroeconomic performance of the Greek economy over the past few years. Albeit the modernisation drive of the financial system, the new tools of financing technology related investment (venture capital companies and business angels) remain marginal (at best) or irrelevant for the firms of our sample.

The Stock Exchange has offered a source of finance (in the form of public equity) for a small number of firms that were in a position to enjoy access to it. The dominant source of external finance however by and large remains the banking system (as well as what is often called "trade credit" extended to and from suppliers and customers). In view of the fact that cash-flow criteria still dominate the banks' decision to supply credit to the firms, and also taking into consideration the weaknesses of the banking system to assess the risks and potential benefits involved in particular technology-related investment projects, we could suggest that at least some promising investment plans will remain poorly funded. This is arguably more of a problem the smaller and the younger the firm applying for a loan.

The technological capabilities of the average firm, as reflected in our findings, are not particularly impressive. It looks as if innovation takes the shape of abrupt leaps into altogether new manufacturing processes with the wholesale introduction of new production lines. This is suggestive of a process lacking the checks and balances of incremental change and gradual improvement (the latter presupposing deeper knowledge and understanding of products and processes). Innovative investment is seen more as an internal process, rather than an interactive/creative one. Indicative in this respect is the prevalence of the view that a major obstacle to further investment is the lack of demand. Besides the problems of restricted technological capabilities, it appears that there also exist severe information problems concerning the investment incentives legislation (as reported in the interviews with banks).

Second, as far as the differences between various size classes are concerned, our findings do not support the view that smaller firms are systematically discriminated against or that they perform worse than larger firms. The main constituents of entrepreneurship do not seem to be systematically correlated with the size of the firm. It appears, though, that smaller firms have a systematically lower probability of being involved in mergers and acquisitions or of having licensing agreements, while their propensity to form strategic

alliances and partnerships is weaker compared to larger firms. Small firms are characterised by weaker investment (and R&D related investment) intensity, but medium-sized firms are at least as likely to invest as large firms (in general and in R&D oriented projects). The evidence from profitability suggests that there is a concentration of higher profitability in the two size extremes (small and large), with clearly lower profitability in the medium-sized category.

Third, innovative firms have more common characteristics which they share on the basis of being innovative, rather than common features with the rest of the firms in their respective sector (the characteristics of particular lines of production are becoming less important when the common denominator is involvement in innovative activities).

Fourth, it could be argued that the listed companies do not outperform in general terms the non-listed ones, although they do enjoy a healthier financial position. In fact, listed companies have a weaker R&D investment intensity and a weaker investment intensity in general if compared to the average firm of the sample. This finding runs contrary to what was expected to be the case, i.e. a clear positive correlation between access to the Stock Exchange and innovative investment.

The fifth conclusion that emerges from our empirical work is that the comparison between the 5 fastest growing and the 5 slowest growing firms does not provide any meaningful insights on the differences in entrepreneurial attitudes. It seems that the fastest growing firms are characterised by greater diversification in their market orientation, and that they are less closely linked with their customers. However, they also exhibit a more “traditional” and “risk-averting” approach to product, technology and production inputs management strategic issues. Probably the most interesting finding emerging from this comparison is that R&D related investment is not correlated with fast growth.

The sixth point is that the Greek financial system has been going through radical structural change over the 1990s. This change has not essentially affected the predominance of the Banks as the main financial institutions, but has triggered a process of internal differentiation of activities inside the Banks themselves. Other non-banking institutions remain few and far between, and their role is still rather marginal. Crucial in this light is the small number and weak role of venture capital firms, which normally provide seed capital and start-up capital. Interestingly, even the few venture capital firms that already exist, are primarily outward oriented (80% of the total of venture capital funding).

The virtual non-existence of alternative sources of finance, leads to the seventh concluding point, which is that the bulk of SME non-private financing comes in the form of bank loans. Banks do consider SME lending to constitute an important part of their asset portfolio, but they do not feel that they have to make any special effort to attract SME customers because the latter have nowhere else to go. Banks evaluate loan applications according to the standard commercial (but not developmental) criteria (liquidity, financial ratios, collateral and the like). Interestingly, the length of the relations with a customer does not enter in the evaluation process (contrary to what seems to be happening in the

rest of the world). Nor does exporting activity appear to be capable of relaxing the strict financial criteria. What is probably even more striking is the stated reluctance of bankers to finance R&D projects even when backed by partnerships with an established research institute. Implicit in the answers provided both by the Banks and the firms is the acknowledgement of the fact that the Banks lack the necessary capacity to evaluate an investment project in its own right.

Finally, the hesitant and traditional attitude to development strategies, is not solely confined to the entrepreneurs but extends also to the banks (the suppliers of credit). It could be argued that the weak innovation related entrepreneurship of the owners/managers of the firms is matched by a similar (traditional and risk -averting) attitude on the part of the existing financial institutions. Banks apply stricter criteria for technology-based investments; they have greater difficulty in financing process innovation, technology development and intangible technology. They prefer a situation in which SMEs come forward with concrete and completely costed projects rather than with a variety of options. The widely diffused notion concerning best practice and rewarding investment financing decisions underlies what we perceive to be the prevailing strategies of firms and financial institutions, and it should come as no surprise that there appear to exist some strong similarities. As is always the case with complementarities, they can have either a virtuous or a vicious circle effect. In the cases drawn from our sample, defensive and risk -averting attitudes are threatening to maintain innovative performance at a low level within the latter pattern of corporate strategy.

Taking into account our company survey and the interviews with bank executives in Portugal, there appears to be a “differentiated attachment” between firms and banks. The two partners don’t ascribe the relationship the same value: “firms value the relationship more than banks”. In fact, firms show a strong fidelity to their banks, and have a perception (probably, not fully justified) of reciprocity. Usually companies would not break a long established relationship with their bank, provided that interest rate differentials fall in an acceptable range. Banks, however, do not decide primarily on the basis of the relationship and firms’ characteristics and may often better conditions to new clients in order to attract them. It is possible, however, that in a context of increasing access to external sources of finance, Portuguese banks would increase their attachment to (some) relationships in order to prevent competition.

The existence of “market failures” in financial markets – and particularly with regard to SMEs and to innovative investments – provides a rationale for public policies in this regard. It is widely acknowledged that such policies should no longer be aimed at direct intervention, such as credit and interest rate controls, having in mind the globalisation of capital markets and the creation of EMU. But there is still much room, especially in Portugal, to introduce more transparency in the market, namely through the improvement of environmental conditions.

The strengthening and the dynamics of the Portuguese “national system of innovation financing” requires, therefore, actions – one might even say, concerted actions – from the

three main organisational players: banks, companies (in our case, SMEs) and public bodies. In this vein, bank executives were asked to provide their opinion concerning the most appropriate actions to be taken by the different players. Respondents were given, for each player, a closed list of improvement measures. Somewhat surprisingly, what we found was a focus of bank executives in a small number of options in each case. It would appear as if problems might be solved by focussing on a limited set of issues, as we will see below.

In this regard, the most critical theme seems to be accounting transparency. In fact, all our interlocutors ranked “improving accounting standards” in the two top levels of the scale used (very or quite important). Two other factors scored as important by all banks, but with less emphasis, were the involvement of more experienced entrepreneurs in the projects and the existence of a longer relationship with the bank beforehand. Having in mind the ranking of lending criteria presented above, these aspects are less relevant, since banks’ main focus is on financial analysis. Nevertheless, the rationale for looking for improvements in these areas is easily understandable. Banks complain about the lack of strategic and managerial capabilities of Portuguese entrepreneurs. So the involvement of experienced managers would increase the probability of project success. With regard to the advantage of long-established relationships, this is obvious: banks would know the company and its management better, and this would therefore improve risk assessment procedures.

It appears that bank managers know the issues, and that banks have been exploring the possibilities to be more efficient in delivering their services and closer to firms. Past experiences are incorporated in today’s behaviours. The waves of bad debts which occurred since the early 1980’s led banks to become more cautious when granting loans. There is, however, some room for improvement, the more so as the process is of a permanent moving nature. Solutions depend simultaneously of past trajectories, competitive pressures and visions of future. We may suggest that, in the present wave of mergers and acquisitions, being closer to firms is an asset which differentiates Portuguese from foreign banks. But larger firms business is still more appealing than SMEs one, and supporting innovation for its own sake is not banks business.

As indicated above, the view of banking sector executives on government incentives provided to companies is very cautious. In some instances incentives turned out to be negative, since they somewhat “vitiating” the investment decision process, “going from the incentive backwards to the project” and not the opposite; another negative consequence was the emergence of subsidy-dependence situations. With regard to the way that incentives should be tailored there were two different views: (1) tax incentives are more effective than financial ones, since they lead to healthier company behaviours, and (2) financial incentives at zero interest rate are a useful option but the ideal would be to introduce a build-in mechanism which would provide *a posteriori* incentives as a “premium” for good performance. These should not be so much aimed at encouraging and providing funds for

investment, but rather as the additional benefit to be granted to those which were able to launch profitable projects.<sup>21</sup>

The examination of the obstacles to technological investment in the Spanish case study indicated that the lack of internal financial resources, although significant, are no more important than the concern with commercial, technical or human restrictions. On the other hand, the lack of external financial resources was not considered a relevant obstacle for technological investment. Neither was the uncertainty about the financial effectiveness of new technology, the assistance of private consultants or the co-operation of public research institutions. We can conclude that SMEs' technological and innovation decisions are more determined by corporate and business strategies than by access to external financial resources or to institutional co-operative information. This does not imply the refusal of the hypothesis about the lack of financial resources for innovation, because the medium technology intensive SMEs (Electrical) indicate that the restructuring and renovation process is more significant. Moreover, the challenge of global competitiveness indicates that the low technology intensive SMEs are not only exposed to the uncertainty of innovation but also to the uncertainty of markets, human resources and technical disruptions.

The complex relationship between technology investment by SMEs has characteristics that are typical of the process of restructuring and technological upgrading under uncertainty and change for competitiveness. A significant proportion of the SMEs have led the catch up process to EU levels in sectors that are not characterised by radical innovations. The finance of restructuring, mainly based in tangible capital goods, was conditioned by collateral requirements. In this sense, public financial policy should continue facilitating the guarantees that led to specific successful investment projects. Finally, we have identified a process of investment where financial decisions or EU applications for funding are not the condition but a consequence of investment decisions. Financial investment decisions can

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<sup>21</sup> An interesting Portuguese initiative is the *PME Excelência (PME Excelência)* programme. The *PME Excelência* is an initiative launched by IAPMEI (together with Banco Nacional Ultramarino) in 1992 for manufacturing SMEs and later extended to other activities and other banking institutions. *PME Excelência* was much appreciated by banks since it takes a cooperative, and not an adversarial, perspective, its success requiring the involvement of all the partners in the SME lending process. They reconcile the requests of SMEs for lower interest rates and non-discrimination of well performing SMEs with banks' desires of more transparent information and good managerial capacities. Bank executives recognise that the initiative puts some additional pressure on banks since other firms, with good performance, want to profit from a similar treatment. But they welcome the role it plays in signalling transparency, performance and competence. This contributes to diminish the bias against SMEs. As the president of one of the biggest Portuguese banking groups put it, "what is relevant in defining the financing conditions granted to a firm is not the fact of being large or small, but rather the fact that it shows good economic and financial conditions, a modern management and organizational structure and well defined strategies". These firms are, by their behaviour, interesting targets for banks. They are the desired partners for relationship banking, through which banks are "available for, together with firms, finding the best solutions for their challenges, needs and requirements"

be completed through venture capital, but it is not clear that these SMEs will be an interesting option for investors in terms of uncertainty, innovation and evolution.

Investment and competitiveness are not simple processes. There is a complex connection between the investment process that guides the firm's modernisation through the renovation of equipment, systems and distribution channels, and innovation projects in a strict sense, that develop and/or introduce new products, processes or services. On the one hand, the modernisation investment process establishes the basic circumstances to compete and provides the conditions that make the innovation process possible. These circumstances can be summed up as financial resources and the productive and marketing environment for learning, developing and introducing innovation policies. On the other hand, innovation projects endow firms with a specific differentiation in products, processes or services that lead to competitive advantage.

Until recently, firms could survive just by modernising and, in some markets, the obstacles that existed allowed backward firms to stay in the market. This is not sustainable in the long term, and firms require investment funding to modernise as well as innovation capability to compete. Nevertheless, the financial circumstances necessary for both processes are not always present. In big corporations, modernisation funds are provided by the financial system, while innovation is often self-funded. Moreover, their growth, when there is a qualitative jump, is funded by the stock market. However, in the case of small and medium enterprises, the working of the market poses problems for the funding of modernisation and this makes the innovation process dependent on these difficulties and a downward spiralling effect is caused. Financial tools that provide resources for both processes are distinct but they reinforce each other in a positive or negative way. Without the modernisation process, innovation would not be possible, or the conditions that made innovation profitable would not be present. Without innovation, competitiveness is quickly eroded and the modernisation process itself is complicated.

It is difficult to differentiate between intention - demonstrated as sincere and comprehensive in interviews - with real practice. However we can draw some conclusions from this. It should not be forgotten that the two different types of long term funding, self-generated resources and debt, have qualitative differences with reference to risk, the terms and relative volume. The integration of these variables creates a level of compromise with the business and a type of relationship with a qualitatively distinct nature. These are questions that require different treatment. In regard to the processes of investment finance with outside capital it is worthwhile noting four characteristics:

The first problem when dealing with SME debt in the medium to long term is that many companies find it difficult to get credit access because it is nearly impossible for them to meet the bank's demanded guarantees. The difficulty is closely linked to firm size, age and credit terms. These factors are very much inter-related. The level of guarantees demanded by the banks affect objective and subjective factors that determine the risk level of a project. Firm size is related to both factors. The introduction of specialised mutual guarantees is a response to that in two ways. They facilitate interaction, through the

promotion of specialisation on SMEs problems within the local environment. This allows them to increase their knowledge about the enterprise and its environment, and through the direct assessment to SMEs with the financial project design. On the other hand, they operate directly in the size factor through the diversification of risk on reciprocal guarantees system. MGC activity is highly concentrated into two areas, the Comunidad Valenciana MGC and the Elcargi situated in the País Vasco. The importance of the MGC in both cases is closely linked to the support of the local authorities. This indicates that a more aggressive support (not direct intervention) policy in other regions is very important. This shows that there is currently a territorial concentration of this activity due to the underdevelopment of the mutual guarantee system in Spain. There is a lot of growth potential for this activity over the next few years.

The second problem encountered is the terms of guarantees. Again, we have to distinguish between objective and subjective factors. In terms of subjective factors, those that affect risk perception can be significant such as the success of the growth of ICO financial credit lines for SMEs started in 1993 with the so-called "bank intermediation credit lines". In fact, bank funding and enterprise habits have changed over the years with regard to the terms. Financial companies have been obliged to accept higher rates of risk because they are forced to compete in an increasingly competitive SME market due to the ICO financial credit lines. However, once they have entered the market, experience and learning have changed the risk perception over the last few years.

The third problem in SME funding is the volume of resources available. One of the general problems in SME funding is the difficulty of channelling funds towards enterprises because of the risks related to the size of the firm. This reason alone limits the supply of funds. Securitization aims to reduce credit risk and unlock financial companies' own resources in order to increase the supply of funds for the SMEs. From the point of view of individual enterprises, the situation remains the same because access to credit is the same and has the same conditions. Taking this into account, the important thing is not the absolute quantity of resources mobilised but the effect created by the practices applied. At the margin of the increase of quantities assigned to each one of the tools mentioned, it is important to highlight the significance of three qualitative aspects: agent specialisation, the improvement of the process of learning, and, finally, the consolidation of the distinct agents and tools. In the first place, it is worth stressing that, as has been argued in other parts of the report, information and knowledge, as well as their correct management, have a central role in changing the subjective risk perception. In this field, specialisation is essential, as much as for the banking institutions as for venture capitalists and administrative agents. The need for a process of specialisation from distinct agents is essential in order to respond to the challenges of rapid technological change and globalisation.

In the second place, the process of learning by private and public agents in relation to the market and among themselves is an essential factor for the development of an adequate institutional framework. This means that the institutional framework cannot be imposed voluntarily, but is the fruit of a mature consensus between different agents. This does not

imply that the process does not require stimulus that is the responsibility of the administration, orientating intervention or presenting possibilities through a regulatory framework freely accepted by private agents. Finally, one of the factors of success for the modification of conditions of the working of financial markets is the articulation of the distinct public and private agents who intervene in the market to the point of constituting an articulated and coherent institutional framework. This synergetic effect could operate through multiple relationships. All these examples show the way in which the institutional framework changes the broad conditions of market operations and increases the impact of financial incentives and other interventions supporting technological development and industrial restructuring.

Several programmes have been designed to reduce the financial constraints faced by firms – namely SMEs –, and to provide them with additional funds to launch more innovative projects. In many instances, such programmes together with the decline in interest rates, spurred investments and contributed to the upgrading of firms productive structures, at least on what fixed capital is concerned. But the financial restriction still holds. The relationship between SMEs and the banking system is not an easy one: in general, banks are being more interested in reducing their risks to a minimum than with the development of firms initiatives; on the other hand, banks refer that SME do not present investment proposals attractive enough, while their accounts are not transparent to enable an accurate assessment of risks. Nevertheless, having in mind the financial structure of SMEs and their difficulties in competitive markets, there is a clear need for policies that will overcome information problems in technological investment project cycles.

It has been seen in this project how technology innovation and financing interact, and how this interaction changes with the age and size of the firm. The choices between policies to support R&D or external acquisition, to support more or less successful SMEs and to support venture capital as part of a big push for some firms, or improvements in banking provision as part of a general policy to increase the efficiency of financing, have been discussed. The effect of policy has been considered in terms not only of the type of firm to benefit, but also the type of investment being implicitly targeted and how this might be affected by policy.

Policies have been considered which impact both on the availability of (public and private) equity, and that of bank finance. Investment efficiency must be the guiding light which determines the ultimate policy recommendations of this project, and on that basis it would be very easy to conclude here in favour of competition-enhancing measures to the banking sector in Southern Europe and against the introduction of further distortions in the equity market in the form of tax breaks or subsidies. At this stage however, the arguments in this area such as Faini et al.'s (1992) have not been completely convincing.

Four breakpoints in SME financing have been highlighted - firstly, where the firm needs support to ensure its continuing survival; secondly, where young product innovators are seeking private equity finance for an expansionary technology acquisition; thirdly, where a more established firm seeks long-term debt for a range of expansionary technology

projects; and fourthly, where a firm is seeking private or public equity to finance technology investments to strengthen and consolidate their successful market position.

What can we learn from this for policy then? Support for product innovators - where the chances of failure are greatest, but so also is the ability to absorb new (external) innovation, which may be the most successful avenue for regional productivity growth - would be in the form either of subsidies and/or tax incentives to a suitable stock market, to increase the expected return for investors throughout the life cycle, or in efforts to promote more efficient screening and competition in the banking sector. Alternatively, policy aimed at the group of comprehensive innovators at 3 would take the form of increasing the availability of long-term debt to medium-sized companies, perhaps through guarantee systems or, again, the encouragement of more efficient screening and competition.

Tax incentives to equity investors - at market or pre-market stage - would have different effects in terms of the number of firms to benefit, the degree of benefit and the relative success level of the firms to benefit. For example, a reduction of dividend or capital gains tax on listed shares in technology-based SMEs would impact those firms at the margin of being able to come to market, because the number of investors and amount of funds available in the market would be increased. This might also have some trickle-down effect in terms of encouraging equity investment pre-market - backing potential IPO candidates. On the other hand, allowing private equity investors more flexibility to use SME investment losses as tax write-offs would have an immediate impact at the lower end of the scale. In other words, the market policy will help in the main those SMEs which are already relatively much more successful, while the private equity policy will have an impact in reducing the mortality rate.

The question which cannot be answered yet is whether the story which we have told of the SMEs' life cycle, and in particular the financing aspects, reflect the preferences of the SMEs - who are, after all, the main characters - or more likely just the availability. For example, do product innovators who make the expansionary investment at breakpoint 2 prefer to have risk-sharing partners than a bank loan demanding fixed repayments? Or is it the case that the only way they can obtain the necessary finance is to allow a dilution of their own control because bank finance continues not to be available to them?

The different implications of these scenarios are important. In the first case, policy of giving tax breaks to early stage private equity investors would directly allow many more firms to survive the breakpoint, while policy focussed on banking efficiency would be much less effective. In the second case however, government guarantees to banks making such loans (say) would not only be preferred by those firms currently making use of private equity investment, but also encourage others who might otherwise have not crossed the breakpoint because of their preference for bank finance.

Thus, focussing on private equity investment with policy will be to target the high-risk, high-return set of firms from which the most successful SMEs will be distilled, while to

target the SME-bank relationship will have a much wider effect on the general population of firms. More interestingly, the first would encourage firms to follow their more innovative strategies and conduct R&D into new products especially, while the second enhances the relative frequency of the exclusive 'buy' strategy. Using tax policy to encourage (non-venture capitalist) private equity investors might be a more neutral intervention, although it will lean toward the higher innovation outcome.

Clearly, the effect of focussing policy on each of these will be very different. The choice between targeting the first and last might be considered as one between 'breadline' and 'headline' SMEs - the former group are important to the economy in terms primarily of their role as employment providers, and policy will aim to generate sufficient (low level) finance to prevent mortality, while the latter are the success stories which may encourage investment throughout the SME sector and thus improvements in the economy through superior production and innovation. There may be internal organisation problems to be overcome in making financing attractive to SME owner/managers at the first breakpoint, while at the fourth no such obstacles will exist.

To focus policy on the second or third of the breakpoints in SMEs financing involves a more subtle choice of emphasis - between risk-sharing and repayment finance markets, between earlier and later stage SME development, and between the more likely technology acquisition strategies of exclusive 'buy' or comprehensive 'make and buy.' Policy for the second breakpoint must address the apparent absence of business angel networks in southern Europe, and the effects of the tax system on incentives for private equity investments. The technological capabilities being encouraged here may be the most productive set for improving the innovation performance of the economy. Policy for the third breakpoint will instead target banking structures and efficiency, and can be expected to have more of an impact on the extent of R&D and internal innovation by SMEs. Again, firms in each case may decide against pursuing further financing (and growth) for internal reasons.

The key distortion in the story of SMEs' technology and investment may be the role of their owner/managers, in particular at the four breakpoints outlined above. For this reason, analysis at the firm level of choices between equity and bank finance is crucial to understanding the potential of policy options. What is required is an attempt to model the decisions of the SME - the underlying preferences as well as the outcomes which seem primarily the result of financing availability - and thus gain the understanding necessary to mediate on the question of policy in equity or bank finance structures. The effects of encouraging different types of technology investment at the expense of others must also be taken into account, and the robustness of the results on SME technology and investments which have been utilised here must be further established.

## 5. DISSEMINATION AND /OR EXPLOITATION OF RESULTS

The approach that was adopted for the design of the work programme of this project as far as dissemination is concerned is that we should try as early as possible to develop links with other research teams and policy analysts with relevant experience in this area of research. Three steps were taken in this direction. First, collaboration with other research teams either with commissioned papers or with invited contributions to project workshops. Resources had been budgeted for that purpose in the co-ordinator's budget. This initiative proved to be a successful one and provided us with valuable insights, comments and additional background papers for the project workshops. These papers have been included in the list of background papers and most of them will become available for downloading on the project web -page. By commissioning these additional studies, additional value added was achieved by examining research questions complementary to our main research focus such as the issue of corporate governance and the evolution of European financial markets. Invited speakers were also asked to give comments on project background papers and that worked fairly well also.

The second initiative was the involvement of project participants in two international conferences, financed by the Human Capital and Mobility Programme of DG Research in the first year in the implementation of our project.<sup>22</sup> These two conferences examined the impact of the European integration process on the R&D systems and the adjustment of industrial structure in Southern European countries. Several project participants presented papers in these conferences and benefited directly from comments on their work and indirectly with additional material and feedback for the final formulation of research questions for the field work in our project.

The third dissemination initiative was the organisation of local workshops for the presentation of the country case studies. One day meetings were held in Lisbon on 31 May 2000 and Athens on 5 July 2000. A third one will take place in Autumn 2000 in Madrid. Presentations included a comparative analysis of the results of the project by the co-ordinator, detailed presentation of the country case study by the local research teams and invited discussants from academia and the banking sector. The programmes of the two meetings are attached at the end of this annex. In both cases the workshops served their dual purpose, i.e. to improve the quality of the final country case study reports and to inform local research communities and policy makers on the policy relevance of the research findings of the project. In the case of the Greek workshop, many managers from companies that had been interviewed attended the workshop and expressed their interest

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<sup>22</sup> The first of these conferences focused on *Technology Policy and Less Developed Research and Development Systems in Europe* and it was organised in Seville, October 17-18. Sessions ranged over a number of theoretical and empirical issues in respect to technology policy and economic integration processes. The second conference on *The Economics of Industrial Structure, Innovation Dynamics and Technology Policy* took place in October 1998 in Lisbon, Portugal. Forty-five papers were presented at this conference.

in the research findings of the project. In addition, we are going to present the main findings of our project to a workshop organised by DG Research on the regional level for the implementation of technology policy on 23 and 24 November 2000. Finally, members of the project research teams presented papers to many meetings and workshops in the last two years and they will continue to do so as they continue their work on the empirical findings of the project (see ANNEX III).

In the course of this project we have constructed a unique data base of 220 firms in southern Europe. It provides detailed information on corporate patterns of growth and factors facilitating this process. It also gives detailed information on technological profiles and the impact of financial systems and innovation policy instruments in the three chosen countries. Further elaboration of these data is taking place after the completion of the project for the preparation of a book manuscript that will be submitted for publication to Oxford University Press.

**LISBOA SEMINÁRIO, 31 Maio 2000**

**ISEG - Instituto Superior de Economia e Gestão  
Auditório 1  
Rua do Quelhas 6, Lisboa**

14:30 – Abertura

António Mendonça (Presidente do Conselho Directivo, ISEG)

14:40 – O Projecto no Contexto da Investigação Socio -Económica da União Europeia

Virgínia Vitorino (Comissão Europeia)

14:50 – The Project "Investing in Southern Europe": Overall Perspective

Anthony Bartzokas (INTECH, U. N. University)

15:30 – O Financiamento da Modernização Tecnológica nas PME Portuguesas

Vitor Corado Simões (CEDE, ISEG)

16:15 – Intervalo para Café

16:30 – Comentários

António Castro Guerra (ISEG)

Ferreira Rodrigues (CGD)

17:15 – Debate

18:30 – Encerramento do Seminário

Jorge Santos (Presidente do Conselho Científico, ISEG)

**INVESTMENT AND TECHNOLOGY DECISIONS OF FIRMS  
IN SOUTHERN EUROPE**

**UNIVERSITY OF ATHENS - PANTEION UNIVERSITY**

Dr. Anthony Bartzokas  
Senior Research Fellow, INTECH, United Nations University

18:45 *"The Financing of Innovation and Technology of SME's in Greece "*

Prof. Antigoni Lyberaki  
Panteion University

Prof. Nikolaos Mylonas  
University of Athens, Department of Economics

19:30 *"Venture Capital and SME's: Myth and Reality "*

Dr. Kyriakos Mitsotakis  
Managing Director , "National" Holding S.A.

19:45 *Comments*

Dr. George Papakonstantinou  
Advisor to the Prime Minister

20:00 Open Discussion

20:30 Conclusions

20:45 Cocktail

## **BACKGROUND REPORTS**

1. The Economics of Investment in Technology: Literature Review and Project Methodology, A Bartzokas: February 1998.
2. Country Report: Portugal, Vitor Corado Simoes & Rita Biscaya: June 1998.
3. The Dynamics of Financing and Innovation in the Greek Economy: Continuity and Change, Tassos Giannitsis, Antigone Lyberaki & Nikolaos Milonas: June 1998.
4. The Financing and Technology Decisions of SMEs: I. Finance as a determinant of investment, Alexander Cobham: May 1999.
5. The Financing and Technology Decisions of SMEs: II. Technology and policy, Alexander Cobham: October 1999.
6. Making bad decisions: Firm size and investment under uncertainty, Alexander Cobham: April 2000.
7. The Financing of Innovation and Technology of SMEs in Greece, Antigone Lyberaki and Nikos Mylonas: June 2000.
8. Investing in Southern Europe: Technological and Financial Investment Decisions by Manufacturing Firms in Southern Europe -the case of Spain, Dr. Daniel Diaz Fuentes and Prof. Angel Martinez Gonzalez -Tablas: July 2000.
9. Innovation Behaviour and Financing Conditions: The Case of Portuguese SMEs, Vitor Corado Simoes: August, 2000.
10. The Impact of EMU on Southern European Technology -based SMEs, Alexander Cobham: August 2000.

## **COMMISSIONED PAPERS AND INVITED CONTRIBUTIONS**

1. Industrial Development and Technology Policies in the East Asian NIEs: Convergence or divergence ? Poh-Kam Wong: September 1998.
2. New Growth Theories and Technology Policy in Small Open Economies, Michael Stolpe: April 1998.
3. Small and Medium Enterprises and East Asia: Competition, Collaboration and Lessons for Policy Support, M Albu: June 1998.
4. The Asian Crisis: What Lessons Can we Learn, Valpy FitzGerald: June 1998.
5. Will the Euro bring Economic Crisis to Europe? Philip Arestis and Malcolm Sawyer: March 2000.
6. Finance and Innovation: System or Chaos, Jesper Lindgaard Chris tensen & Ina Drejer: March 1999.
7. Corporate Governance: Effects on Firm Performance and Economic Growth, Maria Maher and Thomas Andersson: February 2000.
8. Competitiveness and Innovation : The Local and International Embeddedness of SMEs in the Global and t he Greek Information Technology industry, V. Arapoglou, T.B. Palaskas, M. Tsampra: September, 2000.
9. Innovation Finance: Barriers and Policies in Greece, Lena J. Tsipouri: September 2000.

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Daniel Diaz Fuentes and Prof. Angel Martinez Gonzalez -Tablas (2000) *Investing in Southern Europe: Technological and Financial Investment Decisions by Manufacturing Firms in Southern Europe-the case of Spain*, Background Report -TSER project Investing in Southern Europe.

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Tassos Giannitsis, Antigone Lyberaki & Nikolaos Milonas (1998) *The Dynamics of Financing and Innovation in the Greek Economy: Continuity and Change*, Background Report -TSER project Investing in Southern Europe.

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\* The country case studies provide extensive literature reviews of country -specific references.

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Acknowledgements

## 7. ANNEXES

### ANNEX I: AN ANALYTICAL MODEL OF TECHNOLOGICAL INVESTMENT IN SOUTHERN EUROPE

The general implication of EMU on the financial system can be summarised as follows: \*

- a. An increase in competition due to a narrower integration of financial markets. Entities will have to consider changes in size and strategy to be able to compete in a wider market. The disappearance of exchange risk will imply the elimination of one of the last potential obstacles to banking competition.
- b. The financial entities' relative position in their relevant business areas will be probably altered, segmentation of financial products and customers among different types of entities will be reduced.
- c. In the first stages of EMU financial entities will have to face high adapting costs including the modification of accounting and information systems, staff training, internal organisation and costs related to change of current notes and coins.
- d. Profits coming from foreign currency business and exchange risks covering will decrease. Nevertheless, this profit reduction should not be very significant for Spanish financial entities, the US dollar being the main currency used in foreign currency operations.
- e. Decreases in interest rates may also affect banking margins. Financial entities will have to consider adjustments in their costs structures to be able to preserve appropriate profitability. This is nevertheless a process already present in Spanish banking system, since operating expenditures having been constantly reduced since 1993.
- f. Wholesale banking will probably be affected by an increased globalisation of European financial markets. On the one hand, large enterprises may decide to concentrate their financial activities in the most important markets giving rise to an increase in market quotas for the main financial institutions operating in those markets. On the other hand, an increase in enterprises demand of financial services, mainly cross-border payments and advisory services is to be expected, being essential the supply differentiation based on better knowledge of legal, fiscal and accounting environment, improved access to customers and better position to evaluate specific risks.
- g. Retail banking will be probably affected to a lesser extent, at least in the first stages of EMU, and the existence of a wide network of offices guaranteeing physical proximity to the client and direct knowledge of the customers will be important. Notwithstanding the

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\* See also the background reports # 6 and # 10

existing obstacles to integration of this market, a potential increase in competition is to be expected in those areas perceived as more accessible.

Economic and monetary union (EMU) in Europe will affect Southern European SMEs through three main channels. Firstly, a single monetary policy, applied by the European Central Bank (ECB), has ramifications for interest rates in the European periphery, which includes countries in the south. Secondly, the creation of a single capital market in the eurozone has triggered, or rather accelerated, a number of trends in both the banking and stock market sectors of European financial markets. These reflexes have particular resonance for the financing of Southern European businesses. The third channel of EMU impact on SMEs is through the changing nature of the competitive conditions faced. This paper will consider in turn each of the EMU-driven trends affecting (in particular, technology-based) Southern European SMEs.

Of the two dominant views - (i) that consolidation will create bigger banks devoting less resources to small business finance, and (ii) that the larger market will open avenues to profitable industrial and regional specialisation - neither is preferred. The proposed view is that the creation of larger banks is underway and will continue, but without the implied effect on lending, while specialisation is far from inevitable. The fact that Southern European stock markets operate less as markets for corporate control than those in the USA will probably slow the rate of mergers and acquisitions.

The chief cause for concern is that the expected ability of smaller businesses to attract bank financing during upturns, an ability which contracts in downturns (through the credit channel of monetary policy), may not be operating in this upturn in the same way. Given the absence of strong upward pressure on consumer prices, SMEs involved in the sale of consumption goods may find it difficult to attract funds, and thus may be under-investing compared to the level which would ensure their stability as employment providers in the subsequent downturn. The following sections consider the structural effects of EMU on financial markets, in order to reach an understanding of the overall impact on SMEs.

Lending banks are becoming more and more closely concerned with risk assessment, both its accuracy and its costs. Non-bank financial intermediaries are not only taking more of the deposit market, but channelling more of the funds out of European capital markets (or at least away from local lending use). This creates the motive for a third type of (strategic) M&A: tie-ups with other financial institutions that are designed to ensure banks are not isolated by the process of disintermediation (or at least diversify these risks). These M&As may be considered as being driven by changes in information flows.

SMEs also risk being increasingly isolated, but have no such option to diversify. As a result not only of information costs associated with lending to them, but of increasing mobilisation of funds at a supranational level, SMEs may find that local funding for investment becomes increasingly scarce. As international investment information becomes increasingly accurate and cheaply available, and the allocation decisions of banks increasingly automated according to credit-risk models and capital adequacy requirements,

the relative costs of allocating funds from a bank's portfolio to small business lending are rising. This may be the key danger of EMU-driven changes in capital markets to SMEs.

To understand the likely effects of financial market changes on investment by firms of different sizes, a model of investment was developed to allow this analysis. This model is presented briefly below, with the main conclusions, and the following sections detail policy options for SMEs (Cobham, 2000).

The Cobham (2000) model combines the real options approach to investment under uncertainty with the assumption of a financial market characterised by asymmetric information. It follows the model of McDonald & Siegel (1986), who studied the optimal timing of paying a sunk cost  $I$  for a project of value  $V$ , where  $V$  follows a geometric Brownian motion. Rather than their geometric Brownian motion, however, a partially generalised form is chosen. Specifically:

$$dV = aVdt + b(V,t)Vdz \quad \dots(1).$$

where  $dz$  is the increment of a Wiener process, and  $\alpha$  and  $\sigma$  are drift and variance parameters, respectively. If  $b(V,t) = \sigma V$ , then equation 1 implies that the current value of the project is known, but future values are lognormally distributed with a variance that grows linearly over time [ $\text{var}(V) = \sigma^2 t$ ]. The function trends upwards over time, according to the first term on the RHS, but the firm's uncertainty over market conditions ( $\sigma$ ) increases the deviation of the path from its drift path (determined by the parameter  $\alpha$ ). A time-dependency may be incorporated into the underlying level of uncertainty as follows:

$$b(V,t) = \sigma(W)V \quad \dots(2),$$

where  $W$  denotes the time waited before investment. Equations 1 and 2 state that, while the variance of  $V$  still grows linearly with the time horizon, the value of the underlying constant is a function of the time in which the firm was able to gather information *prior* to investing.

Uncertainty,  $\sigma(W)$ , is reduced by the (time-consuming) collection of information, and so will fall as waiting time ( $W$ ) increases, in a standard exponential decay function. The strength of this relationship will be denoted by  $\beta_\sigma$ , which itself depends on two factors. Firstly, managerial expertise ( $m$ ) dictates the efficiency with which the firm uses information gained during additional waiting time in order to reduce uncertainty. Maximum expertise implies a value for  $m$  of unity, minimum expertise a value of zero.

Secondly, the strength of the relationship between uncertainty and waiting time depends on the speed of flows of information about market conditions to the firm ( $\gamma$ ). Again, unity

represents maximum speed and zero the minimum. \*  $\beta_\sigma$  will determine the rate of the standard (exponential) informational decay process with which marginal uncertainty reduction from additional time waited falls,  $c$  is a scaling factor:

$$\sigma(W) = ce^{-\beta_\sigma W}; \quad \beta_\sigma = \gamma m; \quad 0 < \gamma, m < 1 \quad \dots(3).$$

Equation 3 shows the relationship between time waited and uncertainty, for a given firm considering a given decision. Note that both the speed of information flow and especially the level of managerial expertise are constants – for a given project, they do not change over time. Firms gain expertise through learning -by-doing, from one project to the next, but *not* within a given project process.

It is useful now to differentiate between firms, using the fact that the real options approach requires investments to exhibit three main characteristics: at least partial irreversibility (by way of a sunk cost), uncertainty about future values, and the ability of the investor to wait. It is a key characteristic of SMEs that their ability to wait is significantly less than that of LCs. Greater constraints on SMEs, through relatively less obtainable financing, reduce their potential waiting time. This reduces their ability to eliminate uncertainty over investment prospects, and thus forces them into the position of making ‘bad’ decisions – ‘bad,’ that is, in so far as they are relatively more constrained. This constraint is modelled accordingly.

Financial risk ( $r_f$ ) represents the risk of losing the investment opportunity due to financial market imperfections and problems of informational asymmetry.  $r_f$  depends on the interaction between two factors – the information contained in the firm’s financial history and the informational efficiency of the financial market in which the firm operates. The extent of credit rationing in a market will depend on these two factors, since they represent the firm’s ability to cheaply and effectively transmit credible information to financial markets, and the financial market’s ability to cheaply and effectively use information about a firm to assess its creditworthiness.

A financial market’s informational efficiency reflects how well information is managed by the market, and thus how flows of information from the firm are used. The firm’s financial transparency encompasses its financial history and its level of accounting. The former signals to financial markets the firm having previously been a good risk. It indicates the extent to which the market’s informational inefficiency will reduce the firm’s prospects of obtaining financing, since this depends on the informational asymmetries relevant for the firm and a long and successful history with repeated rounds of financing will effectively reduce information problems.

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\* This information flow speed is concerned with the flow of (primarily public) information about industry- and economy-wide conditions for the firm’s market. Private information enters the firm’s maximisation differently, as will be seen below.

Financial history reflects the length of the firm's successful trading (its age), asset value (as collateral or indicator of depth of resources ) and previous rounds of financing – these may each send strong signals about the firm's creditworthiness. The accounting standard of the firm affects the credibility of the financial data which the firm provides to the financial market.

Let  $\delta_{fm}$  and  $\delta_{ft}$  represent the level of 'perfection' of the financial market and the firm's financial transparency respectively, defined between zero and unity where zero represents complete 'imperfection' and unity perfection. As either of these factors tends to zero (i.e. the firm's financial position becomes more precarious), the risk of losing the investment option due to these imperfections is increasing. The strength of the firm's financial position is a product of these imperfections, and is denoted by:

$$\beta_f = \delta_{fm} \cdot \delta_{ft} \quad \text{where } 0 < \delta_{fm}, \delta_{ft} < 1 \quad \dots(4)$$

The more imperfect the financial market's informational efficiency and the firm's financial transparency, the closer is  $\beta_f$  to zero – the greater the effective imperfection and hence the associated risk. To complete the picture, it is useful to examine the growth of risk over time. Consider a small, young firm with little track record or credit history. It perceives a risk of losing the option to invest which escalates rapidly from some point where financing has been agreed throughout the process of gathering information. The slope of this risk function will be declining in the later stages as the risk reaches unity. After being initially 'rationed in,' the firm's risk of not having financing rises sharply as they must choose to wait and thereby expose themselves to going through the lottery of rationing again.

After the first rise, risk continues to increase but only slowly – the incremental effects of moving further from the point of being 'rationed in' are relatively small. Even a large firm with an established credit history and successful track record will face an increasing risk of losing the option through financing, as long as there is some uncertainty over the availability of future debt, equity or retained profits for investment. Finally,  $r_f$  is bounded at unity, so the following form is specified:

$$r_f = 1 - \left[ \ln(e + \beta_f^{-1} W) \right]^{-1} \quad \dots(5).$$

This risk in equation 5 forms a constraint on firms' ability to wait. The way this is expressed here is to assume that firms have some threshold level of risk, a critical level at which they will not tolerate further waiting. The risk of losing financing rises over time, and one of two scenarios will emerge. Either the value of the investment reaches  $V^*$  and the firm makes its investment on a real options approach basis, or at some point, the level of risk becomes too much for the firm to continue waiting, and at this point they take a net present value investment decision.

This generates a solution of the following form: each firm's maximum waiting time,  $W^*$ , is determined as the time at which their risk function (equation 5) reaches the threshold risk level,  $r_f^*$  - which is where:

$$r_f = r_f^* = 1 - \left[ \ln(e + \beta_f^{-1} W^*) \right]^{-1} \quad \dots(6).$$

### *Implications of the model and policy conclusions*

The model explains SMEs' high death rates, and relatively low growth rates, as the result of two factors: the higher uncertainty they face, and their lesser ability to reduce uncertainty through waiting. The first of these factors rests on the combination of (probable) lower managerial expertise in smaller firms and their greater difficulties in tapping information flows about market conditions. The second rests on smaller firms' higher informational opacity and the efficiency of financial markets. Given the discussion of financial market changes in the preceding sections, a number of conclusions for SMEs can be reached.

Competition and information flows to SMEs: flows of market information to SMEs should be improved by the increased competition resulting from the union. The initial impact of the changes may however be to increase the relative disadvantage of smaller firms, as they try to learn about and adapt to the new marketplace.

Bank size and small business lending: the increasing average size of banks may reduce the proportion of small business lending, although the active role of smaller banks will diminish this effect. The internal growth strategy being followed by Spanish banks will protect SMEs – at least in the short term – from M&A strategies which might reduce the extent of small business lending.

Bank activities and information efficiency: the main danger for SMEs probably lies in the potential disintermediationary impulse of EMU, as banks devote more of their portfolios to capital markets where information is readily and freely available, and risks can be managed most cheaply, according to set rules. The increasing relative costs of obtaining reliable information about SMEs' prospects could seriously inhibit total small business lending.

Equity market integration and homogenisation: the coming integration of European (and world) stock markets will lead to an increase in total European capitalisation, and also a clearer picture of the burden of information and listing requirements on firms. This should in turn give a positive impulse to the movement for minimum international accounting standards, and in turn make it easier for smaller firms to understand and attain these standards. It is crucial however that smaller firms are not left behind by this process, and left to face what may become a significant barrier to equity market access.

The key conclusion is this: that the relative informational opacity of SMEs is the biggest

barrier to the efficiency of their interactions with financial markets. As a result of the partly EMU-driven changes in the size and activity of eurozone banks, and the homogenisation of equity markets, SMEs risk being further rationed in their access to finance, and hence suffering even greater uncertainty in their investments – and making even worse decisions. The homogenisation of information standards may create a key role for policy to play in ensuring that SMEs are able to reach the standards of informational accessibility necessary for access to financing. This will be true for access not just to equity markets but ultimately for bank finance also.

Given the importance of SMEs in Southern European economies especially, as providers and stabilisers of employment, and drivers of growth in a number of technology sectors, policy must be addressed to preventing a reduction in SME investment – in the quality as well as in quantity – with potentially critical impacts on the economies of the periphery.

## **ANNEX II: DELIVERABLES**

**WORKPROGRAMME DELIVERABLES STATUS** (titles extracted from the workprogramme)

A survey of the existing theoretical and methodological studies in the fields of technology transfer, innovation systems, corporate finance and banking practice: **COMPLETED.**

Local teams will provide a general assessment of financial and technological trends in their countries: **COMPLETED.**

The three country case studies: **COMPLETED.**

Econometric studies on factors determining investment decisions and corporate performance will provide additional empirical documentation: Due to limited resources that part of the project was covered in the first round of country reports with a review of available literature and access to firms' balance sheets analysis conducted by Central Banks (only in the case of Spain and Portugal).

The final phase of the project will be devoted to revising the earlier studies and producing a synthesis of the main findings of the project: **COMPLETED.**

Formal modelling of enterprise behaviour and aggregate investment functions will also be undertaken: **COMPLETED.**

### **ANNEX III: Presentations and Conferences attended by members of the project \***

#### Dr Anthony Bartzokas

25./06/1997: Conference on Industrial Policy for Europe, London, UK

Several meetings in 1998: Contributed to EU workshops of the EC on “Globalization & The Learning Economy”, Brussels

11/12/1998: Expert Meeting on NIS at OECD, Paris

11/3/1999: UN senior expert group meeting on S&T policies for the 21<sup>st</sup> century

17/6/1999: To present a paper at a Symposium on R&D Strategy, Hebrew University

28/04/2000: 10<sup>th</sup> annual P Minsky Conference on Financial Structure, Levy Institute

25/10/2000: Invited lecture at the METU, Ankara

23/11/2000: Technology Policy Implementation at the regional Level, EU DG Research workshop

7/12/2000: EUNIP workshop on Industrial Policy, Tilburg University

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#### Díaz Fuentes, Daniel

11 March 1999: Conference of Innovation and Competition, ESRC Centre for Research on Innovation & Competition, University of Manchester, UMIST Manchester

21-23 June 1999: [World Bank Conference Development Economics -Europe](#), Paris

19-20 June 2000: International Conference on Technology Transfer for Economic Development: Experience for Countries in Transition, United Nations -Economic Commission for Europe, Zagreb -Croatia

28-31 August 2000: IV International Conference on Technology Policy and Innovation Curitiba, Brazil.

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#### Vitor Corado Simoes

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\* Papers presented in the three workshops and other dissemination meetings organised in the framework on this project are not included in this list

18 September 2000: “Gestão de Empresas Familiares”, Delivered at Oporto,

“Inovação e Financiamento nas PME Portuguesas”

(to be delivered soon at ISEG in the context of Business Administration Department Workshops)

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Alex Cobham

London, 6-8 September 2000: Money Macro & Finance Group Annual Conference, at South Bank University.

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