Working Paper Number 25

The Financing and Technology Decisions of SMEs: II. Technology and Policy

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This paper surveys the theoretical and empirical literature on technology investment by SMEs to complement previous analysis of financial constraints on Southern European SMEs. The finding of the previous paper was that finance is a determinant of the nature as well as the level of technology investment; we now add detailed examination of the literature specifically on technology. The resulting life cycle model of the firm combines financing and technological typologies and provides the basis for policy in banking and venture capital. The analytical model for which the foundations are laid here will be presented in full in the subsequent paper.

July 1999

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COMMISSION OF THE EUROPEAN COMMUNITIES

Research Project

Investing in Southern Europe: Technological and Financial Decisions in Manufacturing Firms in Southern Europe

Actual Cost Contract no. SOE1-CT96-1037 (DG XII - SOLS)

Financing SMEs' technology investments in Southern Europe

This is a series of five papers which forms the financing section of the above EC project, addressing the problems facing technology-based manufacturing SMEs in Southern Europe with particular reference to the changes initiated by economic and monetary union in Europe (EMU). This is the second of two papers which make up jointly the foundation of the series. Together they will consider the range of decisions facing small firms which seek to make investments in technology. Although largely survey papers, they will represent an original contribution as a synthesis of the existing research into a development application. The third paper will present a rigorous model of the conclusions reached here, the fourth will analyse the results of survey and interview data collected by project partners in Greece, Spain and Portugal, and a final paper will consider the likely impact of EMU and make policy recommendations on this basis. While the previous paper (Cobham, 1999) addressed questions of SMEs' ability to obtain financing for investment projects, this second foundation paper will focus on the specifics of the technology decision and then bring together the two strands to consider policy options.

The financing and technology decisions of SMEs:
II. Technology and policy

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.

Section 2 will present an overview of the technological investment decision. The previous paper provided conclusions on the financing options of firms at various stages of their life cycle - notably that increased use of bank finance will become possible with the length of the SME-bank relationship and the SME's credit history, while private equity financing - risk-sharing finance - will be more suited to early stage investment. This section will use the same life cycle format to bring together a variety of different results on the technology choices of firms at different stages.

The significant contribution of this paper is to present an archetype of the SME, upon which it is possible to base a specifically southern European(or indeed any other) variation. This will then provide the hypotheses which will be tested in a subsequent paper. It will be seen that the key feature of the acquisition typology is that R&D becomes progressively more likely as a strategy while purchasing dominates among start-up firms. Furthermore, the technology involved may be regarded as either product or process technology, and this will play a role in determining the availability of finance. The impact of the technology's resale

value and its specificity to the firm will also be a significant factor in assessing the project from the perspective of both the firm and the supplier of funds.

Although it will not be discussed in detail here, the role of capital goods suppliers is also important in affecting the success and cost of technology purchase and hence the make/buy decision. These suppliers may - by providing training and back-up services - improve the quality of the investment, and thus affect the decision of potential suppliers of funds.[1] Where SMEs act as subcontractors, the input of the contractor - in providing guarantees to the bank, for instance - may be important in the same way.

Section 3 will bring together the conclusions of the previous paper (Cobham, 1999) with those of section II in a comprehensive life-cycle model, and this will form the basis for a discussion of policy measures in section 4. By identifying breakpoints in the financing of SMEs, the impact of policy measures will be opened up to detailed analysis in terms of their employment, innovation and national production implications. Some conclusions on the nature of specifically southern European SMEs' decisions to invest in technology will be presented, along with possible policy implications.

These conclusions will form the basis for the analytical model of the decision which will be elaborated in a subsequent paper. First, however, we consider the decision process of the SME, and see how this reinforces the finding of the previous paper that the finance is the dominant factor in the technology investment.

Section 1: Investment project appraisal

1.i: Applying the real options approach to SMEs' investment

We make use of the real options approach to analyse the investment decisions of SMEs. Dixit & Pindyck (1994, 1996) characterise the opportunity to invest as analogous to a call option. This instrument of financial markets, when purchased, grants the owner the right,

[1] Demandt (1999) will concentrate on the role of capital goods suppliers, and their interaction with SMEs. Here we consider only the financial aspects of this relationship.

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.[2]

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 cashflow 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 cashflow 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

[2]NB. 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.

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, say, IBM shares at $1 each, is in effect limited by the number of shares the owner can afford.[3] 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.[4] Presumably they apply this by waiting, similarly, until the value of 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 IBM 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

[3]NB. The call option on IBM shares may be sold of course, but the investment opportunity of the SME is unlikely to be similarly transferable.

[4]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.

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.

1.ii: 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.[5]

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 expected. [Although of course if the capital goods supplier is rational and aware of this game situation, their strategy may mitigate against the value of the information gathered by the SME - i.e. the supplier has an incentive to use preliminary sales as 'loss leaders' and provide a higher quality of product and support than is profitable, in order to encourage larger purchases by the SME.]

[5]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.

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.

At a more general level it has been argued (Eaton et al., 1998) that European technology initiatives will have most economic effect by increasing the ability of firms to absorb external innovations, rather than focussing on patent protection or promotion of R&D. Any assessment of firm's R&D seems only to highlight the difficulties for financiers of choosing which projects to fund, as was seen in the previous paper (Cobham, 1999). Finally, as other work in this project will indicate (Demandt, 1999), the role of capital goods suppliers - the providers for technology acquisition strategies - in reducing the information gap faced by potential investors can be great. Lending their technical expertise as well as their reputation will be seen to have a dual positive impact on the chances of SMEs receiving funding.

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[6] 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. And of course, the backing of a bank through long-term lending has a number of benefits as detailed in the Cobham, 1999.

[6]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.

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.

As an example, consider a manufacturing firm with 50 employees which wishes to expand production by building a new processing line. Since the required investment is estimated by the firm to be £2.5m, and retained profits from the entire three years of operation total just 20% of that figure, the firm requires external financing of the outstanding amount. The firm might seem to have two immediate choices - it may (at little cost) approach a capital goods supplier, and discuss the possibilities and the willingness of the supplier to extend credit, or intervene on the firm's behalf with potential financiers; or, alternatively, the firm may begin research (at some cost) to reduce the uncertainty surrounding the cost and feasibility of producing the new processing line in-house. Clearly, these approaches are non-exclusive. Armed with the findings, the firm may then seek out bank lending managers, venture capitalists and third-party non-market equity investors (TNEs), and attempt to obtain the necessary finance.

Although apparently plausible, however, this scenario should be treated with caution. For instance, the firm should be aware that with its relatively short (and not especially distinguished) track record, any bank is likely to look unfavourably on a request for a loan of £2m - equivalent to 12 years of past retained profit - for an internally designed and engineered system produced by a firm with no history of success in innovation. In fact, if the firm is looking to obtain repayment finance of this kind, the investment should embody significant resale value (or guarantees, e.g. collateral) and will be improved - from the lender's point of view - by the involvement of a reputable capital goods supplier or a product which has performed strongly in other (e.g. international) markets.

If the processing line will be a genuine innovation by the firm, then obtaining an initial tranche of venture capital (or private equity investment) to back further research will be the

only option. The firm has neither sufficient credit history nor collateral value for repayment finance to be a likely option, given the extent of agency and information problems. Risk-sharing finance, however, allows for the elimination of the first of these - since incentives for the owner/manager and the private equity investors are more or less identical (and the investor now has a greater element of control), and the dilution of the second where the investor takes a boardroom position.

In essence, the value of the firm's idea in either case - the option value of the unmade investment - is only real insofar as finance is available (in the absence of other binding constraints). For this reason, I have treated the financing as necessarily previous to the investment assessment in structuring these two papers. The nature of the complementarities between financing and technology over the life cycle of firms will be elaborated upon in the following section.

Section 2: SMEs' technology investment decisions

2.i: The 'make' or 'buy' decision

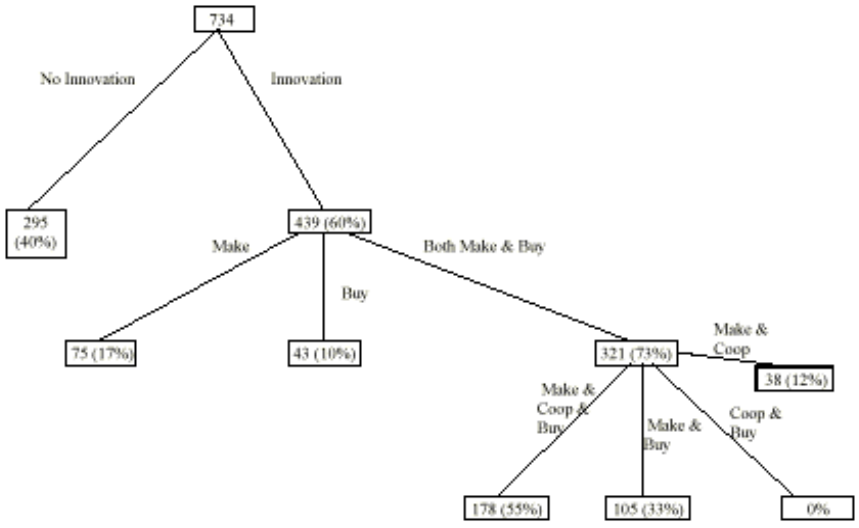
We consider first the most basic element of the technology investment - whether to source the innovation internally (the 'make' decision) or externally ('buy'). Historically, the literature has referred to this as an exclusive choice - both Coase (1937) and Arrow (1962) talk of the make *or* buy decision. Later work however offered strong support for the importance of making to successful buying - both the ability to absorb external knowledge (Allen, 1986) and the capacity to accurately assess external products may be assumed to depend to a degree on the extent of internal innovative capabilities.

The European CIS or *Community Innovation Survey* (Eurostat, 1993) provides data on the make/buy decision for European countries, including those which are our subject. Veugelers & Cassiman (1999) produced a study of Belgian manufacturing firms, in which they consider a two-stage decision process whereby firms first decide to innovate, and then decide how to source their innovation. Figure I below presents this interpretation of the CIS data. Innovating firms are defined as those who answered that they had innovated in the last two

years, i.e. developed or introduced new or improved products or processes during that period, but who also had (non-zero) expenditure on innovation: 60% of the firms in the sample innovate by this definition.

This methodology is perhaps questionable. While Veugelers & Cassiman see the process as starting with the SMEs' decision to be innovative, the approach taken here has been that financing must be the first hurdle crossed by the SME, and that this will then have an impact on the type of technology investment (and thus its source). In a sense, only when the financing and source of the innovation have been finalised, is the SME in a position to decide whether or not to innovate. The definition of firms as innovative or non-innovative is also clearly fairly subjective, and will depend on the firms' self-perception and accounting practices as much as their actual innovativeness.

Fig.I: Innovation strategies in Veugelers & Cassiman CIS sample



Source: Veugelers & Cassiman, 1998; Eurostat data.

The same objection can be made to the distinction drawn between 'make' and 'buy' - firms are said to follow a 'make' strategy if they claim to do R&D and also report non-zero R&D expenditure. Originally, firms which acquired 'disembodied' technology by licensing or through contracting R&D or consultancy services, or 'embodied' technology through

purchasing another enterprise or hiring skilled employees, were said to be following a 'buy' strategy. Fortunately - for the usefulness of these results to this paper - too many firms responded positively to the 'embodied' acquisition question, so this category was ignored. The technology strategies are now closer to the type of investments which we are interested in here.

It can be clearly seen that of firms who innovate, the combination approach (73% of innovators) is greatly preferred to exclusive internal (17%) or external (10%) sourcing. The results of estimation allow more detail to be added to the picture. In terms of size, small firms are the group most likely to source exclusively while large firms use the combination. This result may be considered as analogous to the position of small and large firms with respect to diversification in many areas - small firms are more risky than large companies because they lack the range of suppliers, of customers, of products and so forth. Large companies also tend to be more diversified in their operations and investments, and make take advantage of scale economies more easily.

Once the firm size effect is controlled for, companies which rely on internal information during the innovation process are more likely to combine sources. Companies which use their competitors as an important source of information are more likely to exclusively purchase. These two results of Veugelers & Cassiman suggest respectively that in-house capabilities are indeed important for external sourcing, and that the degree of competition has a positive correlation with imitation as a strategy.[7] A final result is that increased protection - through intellectual property law or firm secrecy - reduces the chances of external sourcing only, as does the existence of internal resistance to change.

What conclusions can be drawn from these results for technology-based SMEs? The most likely category of firms to pursue a policy of external sourcing only will be small less internally innovative firms. Since technology-based firms are more likely to be innovative, however**,** this does not shed much light on our subject. Given that the CIS is a firm-level

[7]The impact of competition in reducing the waiting time to assess an investment was seen in the real options approach as discussed in section 1. As might have been expected then, these results imply that increased competition will increase the speed of innovation through imitation.

(rather than plant- or project-level) survey, there is an inbuilt bias in favour of combination sourcing - multi-plant or multi-project firms may use different strategies where appropriate to different projects, and thus it is necessary to take care not to overstate the results on the complementarity of strategies. Veugelers and Cassiman do not consider the finance data provided by the CIS either.[8]

There is also a concern that as with the investment-finance process which we have shown in the reverse order to the literature, the simple two-step of technology acquisition may also be inverted. A firm may choose to use an external supplier, rather than make the broad innovation decision and then consider whether to innovate internally or externally. However, the data are unaffected by the model's chronology. We may take two main points; firstly, that size of firm is positively related to innovation of either type, and secondly, that information internal to the firm (or, particularly, the owners) will be a significant factor in encouraging innovation whether sourced internally or externally.

This is interesting in relation to the conclusion of Eaton et al. (1998) that improving the capacity of existing firms to absorb existing technology - as *opposed to* encouraging R&D - will produce optimal Europe-wide results for productivity. Together, these results suggest that improving the capabilities of firms to innovate while encouraging external acquisition as the innovation strategy may be the most successful policy.

Eaton et al. build a framework to assess international technology policy, which builds equilibrium conditions from three relationships: those between ideas and productivity, between research and idea generation, and between markets and research incentives. They then find steady-state solutions for levels of research intensity, international patenting and labour productivity. By using established values of parameters where possible, and estimations elsewhere (see Tables 1 and 2), the model can now be used as the basis of a general equilibrium assessment of technology policy. The main finding is that increasing EU research levels will raise productivity in Japan and the USA as well as in Europe, while

[8] This dataset (and the finance data in particular) will be used in a subsequent paper, which will analyse among other things the robustness of Veugelers & Cassiman's results, and the relevance of their model to SMEs in southern European economies.

national policy differences will allow free riding within Europe: the policy which will both retain benefits within Europe and spread them most evenly across the members will be one which "facilitates the adoption of innovations." (Eaton et al., 1998, p.2).[9]

Table 1: Calibrated parameters in Eaton et al. (1998)

Description	Value	Source
Real interest rate	0.07	Stock returns
Capital elasticity (KE)	0.3	Capital share
Labour share in research	0.478	OECD avg, 1989-91
Employment growth	0.0097	OECD avg, 1986-96
Labour productivity growth (LPG)	0.0136	OECD avg, 1986-96
Total factor productivity growth	0.0952	(1-KE)LPG
Markets per country	1.5m	Calibrated to fit LPG = 0.0136
Staff per researcher	1.43	OECD avg, 1988-90
Domestic non-patent imitation	0.41	Mansfield
Foreign non-patent imitation	0.25	Mansfield

Source: Eaton et al. (1998). 'Research drag' is also found by algebraic manipulation of calibrated parameters.

Veugelers & Cassiman's findings indicate that the capacity of firms to absorb external knowledge - i.e. their ability to adopt innovations - will be increased by the capacity for internal R&D (not necessarily utilised). The joint implication then is that the role of firms in encouraging EU growth will be maximised by devoting policy and resources to

[9]Again, however, their model does not consider the impact of financing issues; nor are issues of firm size examined.

encouraging those firms best able to engage in internal innovation to innovate *but source externally*. Now, the firms best able to engage in innovation may well be the technology-based firms we are studying, so their ability to finance innovative acquisitions externally may be their most important stumbling block.

Table 2: Estimated parameters in Eaton et al. (1998)

Description	Value	Standard error
Domestic patent imitation	0.046	0.111
Foreign patent imitation	0.237	0.001
Stronger IP protection	0.023	0.006
Fraction of mistaken patents	0.055	0.007
Home bias of diffusion	0.28	0.16
Distance effect on diffusion	-0.14	0.02
Squared distance effect	0.0054	0.0012
Human capital effect	4.5	2.3
Import effect on diffusion	0.11	0.03
Technological catch-up	3.3	1.0
Size distribution parameter	5.4	0.9
Research skill elasticity	0.19	0.04

Source: Eaton et al. (1998) Research productivity values for individual countries are also estimated.

2.ii: A typology of innovators

Before the explicit consideration of finance, however, we add one more means of differentiating between firms according to their investments. Baldwin & Johnson (1997) produce a taxonomy of innovation among firms through principal components analysis of Statistics Canada's *Survey of Growing Small and Medium Size Enterprises*. They break the stages of a firm's growth down into four constituent parts. The first phase consists of product innovators; firms who - as Schumpeterian entrepreneurs - focus on product innovation, and introducing their innovation(s) to the market.[10] Investment is targeted in this area at the expense of improving technological capabilities or production efficiency.

The second phase strategy of comprehensive innovation combines both product and process innovation, as the firm strives to improve its market share through greater production efficiency as well as further new products. They tend to pursue a wider variety of innovative strategies, and more avenues of innovation sourcing. The third phase of the firm's development sees them intent on innovation only in the production process, emphasising efficiency gains and capability improvements. The fourth category - of non-innovation - is considered to refer to firms who operate in markets in which the product has entered the mature stage of *its* life cycle.[11]

For this distinction between firms to be convincing, it is necessary to define innovation less strictly than the literature tends to do. Consider innovations as referring to the market, rather than being globally distinct products or processes; thus the first MacDonald's franchise holder in a town will now meet the criteria to rank as an innovator, as might the first Cuban to bring a sugar alcohol-powered vehicle to the UK market. These innovations, although not

[10]It is possible that firms go through an earlier period of pure imitation before they reach this stage; but as we are treating innovation essentially as updating the knowledge in a given market (for products) or firm (for processes); even this imitation may well be an innovation within the particular (geographical) market.

[11]Thanks are due to Sanjaya Lall and others present at the April 1999 conference of the TSER project ('SMEs in Europe and Asia: Collaboration, Competition and Lessons for Policy Support') for raising questions on the coincidence of the product life cycle with that of the firm, and Guy Gellatly of Statistics Canada for later helping unravel confusion in this area.

strictly new products or processes, are new to the markets they serve. Some features of the categorisation are seen in Table 3a.

Table 3a shows, firstly, innovation as a percentage of investment, secondly the (subjective) ranking by the firm of the importance to their success of R&D capabilities and technology adoption, and thirdly the relative R&D expenditure of each group compared to their market competitors. The first row shows a clear trend - product innovators invest more in product innovation than comprehensive innovators, who in turn invest more than process innovators and non-innovators. Process innovation however is most heavily invested in by process and product innovators, with comprehensive and non-innovators lagging.

Table 3a. Average scores on innovation-related variables for firms in each group

Variables	Product innovator	Comprehensive innovator	Process innovator	Non-innovator
Percentage of investment devoted to product innovation	12.9%	7.7%	5.2%	1.2%
Percentage of investment devoted to process innovation	2.4%	1.5%	2.8%	1.0%
Importance of R&D and innovation capabilities as a factor in success	1.9	2.7	1.7	0.6
Importance of ability to adopt technology as a factor in success	2.4	3.5	3.0	2.4
R&D spending relative to competitors	1.8	2.4	1.6	0.8

Source: Baldwin & Johnson, 1998, Table 2, p.232.

Product innovators are then the heaviest (relative) investors in innovation - 15.3% of investment in total, compared with comprehensive innovators (9.2%), process innovators (8%) and non-innovators (2.2%). Of the three innovative groups, however, product

innovators rate the importance of R&D and innovation capabilities, and the ability to adopt technology, as least important to their success. This is contradicted in turn by their relative R&D spending, which outstrips process innovators (comprehensive innovators fare best).

Table 3b provides some answers - product innovators appear to be the most narrowly focussed group, pursuing this strategy at the expense of all others. If the first four rows of the table are considered to refer to technological innovation generally, it is clear that is not a great concern for product innovators. The same is true of process innovation and production efficiency (the next four rows), where product innovators actually underperform non-innovators. It is only the final four rows of strategies specifically concerned with product innovation that this group performs at all well.

Contrast this with the much more balanced approach of the process innovator, and each group's respective stage of the life cycle is emphasised - the product innovator as typical early-stage young firm, the process innovator as the considerably older firm with a considerable track record. This goes some way toward explaining the results of Table 3a - the disregard of the product innovator for those variables associated with innovation but not specifically with bringing new products to market may be thought of as part of the early stage learning process.

Table 3b. Average scores on importance of innovation strategies for firms in each group

Innovation strategies	Product innovator	Comprehensive innovator	Process innovator	Non-innovator
Developing new technology	1.7	3.3	2.0	1.0
Refining others' technology	1.5	2.9	1.8	1.1
Using others' technology	1.9	3.1	2.4	1.9
Improving own technology	1.9	3.6	2.6	1.8
Using new materials	0.8	3.4	2.3	1.4
Using existing materials more efficiently	0.9	3.9	3.0	2.1
Reducing labour costs	1.4	4.1	3.8	3.0
Reducing energy costs	0.5	3.6	3.3	2.2
Introducing new products to existing markets	3.2	4.0	2.8	2.2
Introducing new products to new markets	2.9	3.8	2.2	1.8
Range of products relative to competition	3.5	3.9	3.2	3.0
Frequency of introduction of new products	3.2	3.6	2.6	2.1

Source: Baldwin & Johnson, 1998, Table 2, p.232.

Comprehensive innovators are those with a foot in both camps - both chronologically and in terms of the focus of their innovations. They are also the group which rates R&D, innovation capabilities and the capacity to adopt technology most highly for their success. It would seem that firms peak in their innovativeness during this phase. Process innovators continue to bring in product innovation, investing more heavily here than in processes, but emphasising efficiency of these more highly than the product innovators. Process innovators are much more general in their approach to innovation than product innovators.

Baldwin & Johnson's typology allows us to draw the following conclusions. Although many firms will deviate from this pattern, the archetypal firm may be considered to change over

its life cycle as follows; originally focussed on new product advances,[12] it begins - assuming its continued existence - to look for production process improvements also, until its emphasis on new products has fallen considerably, and eventually it may cease to innovate. Baldwin & Johnson's empirical results show that comprehensive innovators are most successful in terms of market-share gains; product innovators generate the highest profit growth through product differentiation, but process innovators have better market-share growth and a superior profit-sales ratio. In other words, the typical successful firm brings a range of products to market, finds its forte, expands market share in this area, and then moves toward maximising the profit made for the given market share while continuing to seek expansion here.

Care must be taken in interpreting these results however, since it is not possible to isolate effects of innovation strategies within this taxonomy. For instance, the product innovator would of course be expected to have higher profit *growth* since this is the start-up period of the firm where profits are growing from a very low base. The survey is intended to capture the characteristics of successful firms, and is thus exclusively of 'growing' SMEs; unfortunately this will only increase the bias to strong profit performance of the younger firms.

When considering complementarities with modes of financing later, caution must be exercised with the results. Below, we return to Baldwin & Johnson's results for financing at the various stages of the cycle, and go on to consider how different characteristics of development will attract different types of investors. Technology is the focus of this section, though, so we turn finally to the impact of risk, and the likelihood of financing on the decision between types of technology.

SMEs are necessarily less diverse than LCs in their range of activities and markets. As a result, SMEs are more exposed to risk and this will impact on their financing opportunities. If they wish to improve their prospects of obtaining finance, SMEs will have an incentive

[12]NB. 'Product advances' need not be strict product innovations - the bringing to existing markets of new products will, for example, undoubtedly include many which are not significantly different from available products in the market. This 'imitation as innovation' would be a result of the product innovator's emphasis on range of products and frequency of new introduction.

to tailor the type of technology they acquire. Purchase of a multiple use technology - i.e. one with applications to other uses and other firms, and thus a wider resale market, possibly higher collateral value, and more value as a guarantee (to financial backers) of tangible reclaimable assets - may thus dominate purchase of more specialised (i.e. firm- or application-specific) technology.

This may have the concomitant of reducing the efficiency of the firm's technology, but the alternative is greater exposure to risk and a reduced likelihood of obtaining funds. The economic impact of firms choosing less efficient technology is negative however, so the provision of greater availability (or stability) of funding might beneficially reduce the incentive to choose range of usage over efficiency in a specific application when making technology investments.[13] Similarly, the relatively less risky option of subcontracting may dominate that of the SME taking full marketing responsibility for its operations (in the short term and at a younger age at least) but ultimately reduce the SME's possibilities for growth.

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.

[13]However, the increased risk associated with further specialisation would then increase the cost, and reduce the likelihood of receiving financing. It may be economically advisable for SMEs to follow the dictates of the financing constraint rather than increase their (already high) exposure to risk.

III: Finance and technology

In Cobham (1999) it was seen how investment at firm level and in the aggregate would be affected by financial constraints. The previous section highlighted how the form of innovation most obviously reliant on finance - external acquisition of innovations - may be the most significant in improving relative economic performance. It was seen that the need to secure financing before investments can be undertaken will seriously affect the nature of investments also. As has been seen, finance demands raise considerations of the collateral value of technology investments. There are a number of other ways in which the effect of finance will be felt, and these we examine here.

It is useful first to recap the results of Cobham (1999) on patterns of financing over the life cycle. At start-up, the problems of asymmetric information and agency problems are most keenly felt by SMEs since they have no track record or credit history and little or no collateral (excluding that of the entrepreneur). Financing at this stage then is largely informal, either through insider finance (including that obtained from banks as personal debt) or private equity investment by outsiders with expertise which reduces the information costs or status relative to the insiders which creates a 'social guarantee' which reduces the agency problems. For a small minority of SMEs - in particular those with anticipated market appeal, e.g. high-technology SMEs such as internet software companies - venture capital will be a realistic possibility.

Over time, the SME's credit history with its bank(s) will allow it - assuming its continued viability - to access greater amounts of debt and make larger lump-sum investments rather than the incremental type which may be possible through the use of overdrafts and trade credit in earlier stages. [The problems of asymmetric information which motivate Stiglitz-Weiss credit rationing are alleviated by the length of the SME's relationship with the bank.] Finally, for a small minority of very successful SMEs, the possibility of public equity will arise in the form of an initial public offering, or IPO - the favoured exit strategy of venture capitalists.

III.i: A financing typology

Baldwin & Johnson's (1998) classification of innovative firms can be combined with these results. Early stage SMEs are most likely to be product innovators and thus we would expect them to be largely financed by private equity investment, and through insider finance, and will have little bank debt. The next group, comprehensive innovators - having a longer track record of success and a more extensive credit history - will be better able to access bank debt, while process innovators as the most successful group may be able to access public (market) equity for the first time.

Baldwin & Johnson develop a typology of financing strategies which complements their innovator typology, and we find their analysis provides confirmation of the above tentative conclusions. Firstly, Baldwin & Johnson define a 'low debt, high equity, innovative financing' prototype, where the firm relies on equity - having access to relatively little debt.[14] Second, they define a 'high debt, diversified financing' type of firm which has a high debt-asset ratio, negligible retained earnings and makes use of both bank and equity financing. Finally, they specify a 'low debt, high equity, bank financing' type; these firms have a low debt-asset ratio but the debts are predominantly from banks, and equity is significant.

[14]NB. Baldwin & Johnson define (outside) equity as 'innovative' financing (as opposed to traditional bank financing).

Table 4. Weights for financing principle components

Financing	Low-debt innovative financing	High-debt diversified financing	Low-debt bank financing
Debt as a percentage of net assets	-0.19	0.66	-0.24
Share capital as a percentage of net assets	0.54	0.22	0.58
Retained earnings as a percentage of net assets	0.04	-0.69	0.11
Percentage of financing from venture capital, public equity and affiliates	0.64	0.16	0.04
Percentage of financing from financial institutions	-0.50	0.13	0.77

Source: Baldwin & Johnson, 1998, Table 3, p.236.

The weights shown for the financing principal components in Table 4 show the relative importance of share capital and debt, as types of finance.. At the same time, the sources of finance are shown to change rather differently. These results are best discussed in tandem with those of Table 5.

Table 5 shows the results of principal component analysis on the importance of each type of financing strategy for each type of innovative strategy as the dependent variable. The more positive the coefficient, the more important the financing strategy among the group of innovators. The results - as can be seen from the relative size of the standard errors - are far from conclusive, but they do represent the best available at this time. The data are from the *Survey of Growing Small and Medium-Size Enterprises* carried out by Statistics Canada in 1992, whose data collation in this field is unrivalled.

The only results which are significant at the 5% level are the importance of both the low debt, high equity, innovative financing prototype and the high debt, diversified financing prototype among product innovators, while high debt, diversified financing is best matched with the set of comprehensive innovators. The low debt, bank financing prototype is best suited to the process innovator while non-innovators score negatively on each of the three financing prototypes, suggesting less demanding level of investment which would confirm their non-innovative status.

Table 5: Results of principal component analysis for the Baldwin-Johnson typologies[15]

Independent variables: financing strategies	Dependent variable: innovator strategies			
	Product innovator	Comprehensive innovator	Process innovator	Non-innovator
High debt/diversified financing	0.20 [0.09]	0.26 [0.21]	-0.03 [0.14]	-0.19 [0.09]
Low debt/innovative financing	0.33 [0.14]	0.11 [0.12]	-0.18 [0.10]	-0.12 [0.06]
Low debt/bank financing	0.11 [0.11]	-0.04 [0.10]	0.03 [0.08]	-0.05 [0.05]

Source: Baldwin & Johnson, 1998, Table 6, p.241.

Using the weights in Table 4, it can again be seen how the results fit the story of a life-cycle which has been told so far. During the firm's early stages, as product innovators, they use low debt, innovative financing, have no significant debt or dealings with financial institutions and have a high proportion of their net assets held as equity - by insiders and private equity investors including venture capitalists. Further on in the cycle, the firms as comprehensive innovators avail themselves of more traditional financing - high-debt, diversified financing - and the relative importance of the equity investors from the previous stage is greatly reduced. Then, as process innovators using low-debt bank financing, the firms build up equity again (venture capital or public equity for the first time) and are more heavily reliant on financial institutions than before.

A problem with this typology is that there is no distinction made between private and public equity. Data on venture capital, public equity and equity from 'affiliates' are taken together. The natural interpretation (which fits the conclusions of the previous paper) is that very little of the equity is public - the Canadian SMEs, barring a small number of process innovators, have not yet gone through IPOs. Given the weakness of some results in Table 5, it would not be wise to overemphasise the strength of these conclusions, but the use of Baldwin &

[15]Standard errors are given in brackets; the full regression results and standard errors are given in, respectively, Table 6 (p.241) and Table A3 (p.251) of Baldwin & Johnson (1998).

Johnson is valuable and justifiable as part of a picture which has been brought together from various theories of finance and of technology.

Apart from the weakness of the results themselves, the taxonomy suffers from one particular problem - it describes what is seen through the data to happen, but sheds little light on the reasons. Clearly, the policy implications would be very different for each of these two scenarios - if, say, product innovators were actually turning down bank loans in favour of private equity, then the relative impact of policies aimed at the structure of banking or the stock market would differ strongly from the case where product innovators were unable to obtain bank loans and left with little choice but to seek equity finance. This second picture fits much more easily into the life cycle model of financing which was produced in Cobham (1999); using this, we may put together a full picture of the firm's choices (as well as lack thereof) throughout the life cycle.

III.ii: Combining finance and innovation life cycles of the firm

It is not unreasonable to imagine that product and firm life cycles will coincide to a certain extent. Firms may begin their lives, intent - as Schumpeterian entrepreneurs - on bringing in new products because they are seeking to break into the market, and therefore concentrate less on improving their production processes. At this stage, the funding they can obtain is primarily by short-term debt and private equity, of one sort or another, because they lack the credit history or market record to gain access to bank loans. In other words, the start-up firm is most likely to be a product innovator, using insider and possibly private equity financing. They are probably following an exclusively make or buy approach to technology acquisition, and purchase is the more likely of these for their (post-start-up, at least) technology investments.[16] At this stage, profit growth will be high.

They will, if they are in the minority who will become successful, perhaps be able to obtain venture capital as they begin to look for process innovation also. As they grow, they begin

[16]Remember that product innovation has been defined earlier in terms of a new product *for that particular market* rather than an international innovation; thus product innovators are not by definition prevented from purchasing technology innovations.

to focus on process as well as product innovation, improving their efficiency as well as their range, and take advantage of bank financing while continuing to rely on equity - the comprehensive innovator is able to diversify its financing because it has the history of success. With some track record then, they can begin to build a higher debt-asset ratio through their bank, although (non-market) equity will remain important. As they are building market share throughout this period, their financing will probably be sufficient to begin to combine the internal and external sourcing strategies. The technology they acquire is more likely to be specialised now also.

As they age, they will improve their profit-sales ratio by concentrating on process innovations almost exclusively. Finally, as a mature company, they are more able to finance incremental investment from retained profits, and their relationship with financial institutions allows them access to funds for large investments. For some firms, maturity will indicate an end to significant innovation. Again, note the possibly of the cycle re-starting, and the firm now having both significant retained earnings for internal finance and a credit history which maps a track record of success and thus greatly diminishes the difficulties of obtaining external finance. The multi-product firm - the firm which, after riding the life cycle of one product (or product group), picks another and begins again; or rides a number simultaneously at different stages of the cycle - will face similar technological problems each time, and garner experience, and also face reducing financial constraints as long as it remains sufficiently successful. It will of course also gather experience in selling its investment projects to potential financiers.

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

<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..

Breakpoint <1> clearly represents the point of intervention if the aim of policy is to prolong the lifespan 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).

<3> is the point at which 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, <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.

What can we learn from this for policy then? Support for the group of product innovators at breakpoint <2> - 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; at breakpoints <1> and, to an extent, <2>, rather than primarily at <4>. 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 which is high at both breakpoints <1> and <2>.

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.

Both this paper and the previous one have presented evidence on the complementarity of financing and technology investments, and the dominance of finance in affecting the nature of investments. The tendency to an exclusive 'buy' strategy at this stage is the result of bank finance being the dominant type available, and is thus a useful illustration of the dangers of combining work based on the CIS data and that based on the survey of *successful* Canadian firms. The average firm will never obtain venture capital, and is thus forced to tailor its investment plans to obtain bank finance - the exclusive 'buy' strategy. The most successful firm, however, will be taking higher risks with innovation but with the potential for much higher returns - a strategy which venture capital as a risk-sharing proposition for a diversified fund will allow.

So: 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.

Policy questions will be discussed further in section IV; as in section II, we should consider the results from the literature survey in the light of actual findings in Southern Europe. Policy seems to have focussed on the more successful firm, and certainly on the innovation element; although this project is primarily concerned with technology based (and innovative) SMEs, the value of survival and non-innovation (particularly where this is rational given a lack of risk-sharing finance) should not be discounted. The most relevant set of programs to encourage national R&D and innovation has perhaps been the promotion of both supply- and demand-driven innovation transfer in Spain (Martinez Gonzalez-Tablas & Diaz Fuentes, 1998). The encouragement of networks of science and technology institutions and firms to encourage innovation to meet firms' needs, and the work of the Offices of Innovation Transfer (to disseminate suppliers' innovations) clearly creates opposite emphasis behind this type of direct transfer. Specific technology financing policies will be discussed further, along with a variety of other measures tried elsewhere, in Section IV.

IV: Policy issues

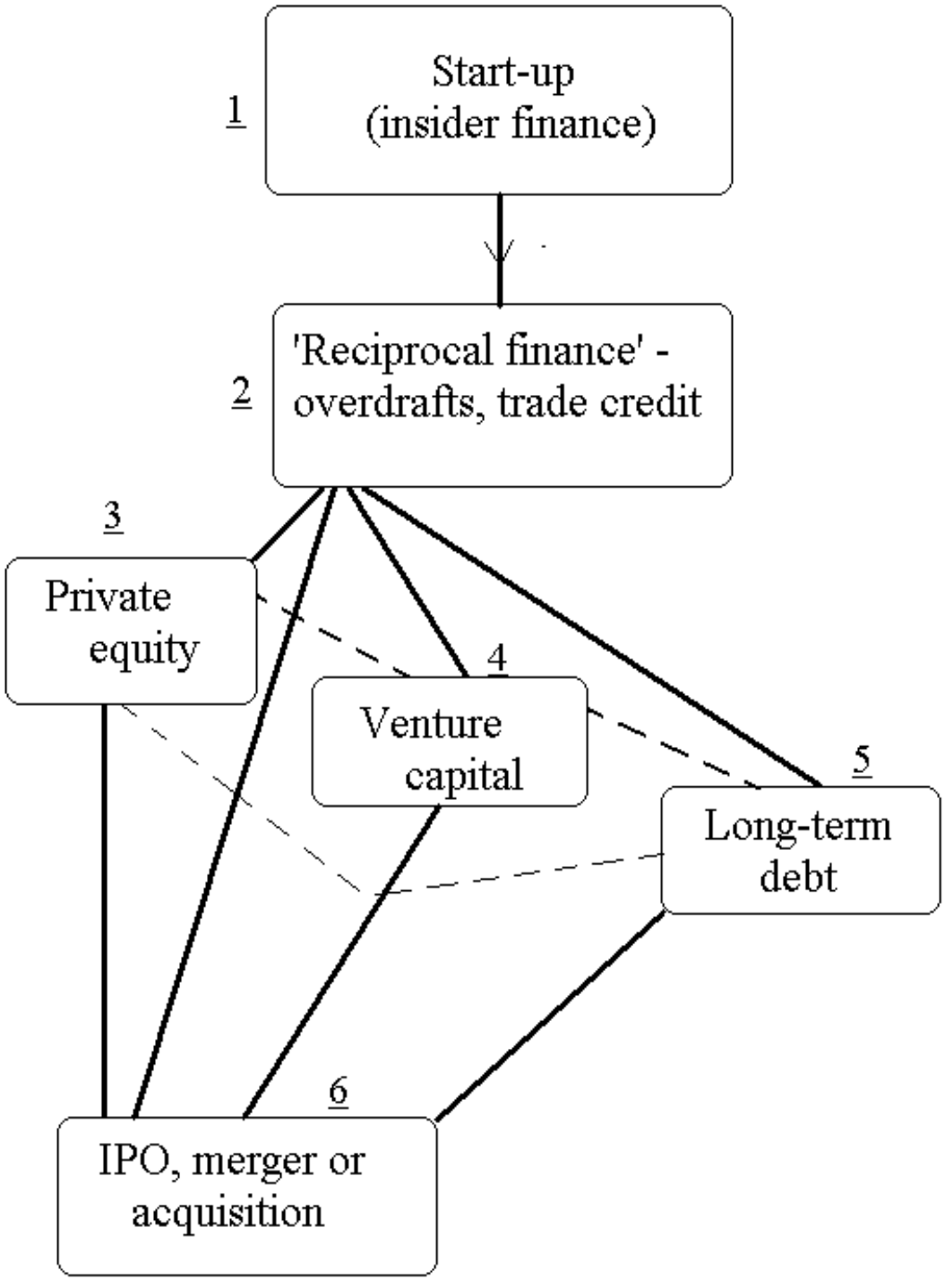
We are now in a position to consider the implications of various policies to support technology-based SMEs in Southern Europe. A full modelling of the situation - in order to allow more rigorous comparison - will be undertaken in the third paper of the five in this series. At this stage we are more concerned to glean an understanding of the types of potentially suitable policies, and their outcomes where they have been undertaken. First, however, it is necessary to detail the goals we intend policy to achieve.

Should government or European bodies be looking to encourage the growth of successful SMEs, or focussing on improving the survival rate of those at the other extreme? Or will policy aimed at the one group have a beneficial effect on the other also? It seems reasonable - given the nature of the complementarities outlined above - to think that there may be some 'trickle-down' effect among SMEs. In other words, if the likelihood of successful exit for backers is increased - e.g. by policy to encourage small scale IPOs - then the risk for

potential private investors at successive earlier stages is reduced while the expected return improves. SMEs at breakpoint <1> would thus be less likely to *fail* for lack of funding, and those at <2> more likely to *succeed* because of its availability. An increase in activity in the funding of SMEs would also generate positive externalities in terms of the availability of information.

On the other hand, a system of guarantees for small business loans from banks would

Fig.VIII: Schematic of SME financing



Notes. For 2, 'Reciprocal finance' refers simply to those sources which are a virtually inevitable result of engaging in a business relationship with the SME - banks provide (some) overdraft facilities, business partners trade credit. If this is not to be the ultimate limit of the firm's business (i.e. no further expansion), further finance will be required: from private equity investors, venture capitalists or banks . Once one of these sources has been obtained, the complementarities of financing should make each of the others relatively easier - that is, the path from private equity investment to venture capital should be a little easier than immediately obtaining the latter. Similarly, an IPO approached via the path of steady finance expansion, i.e. through each of the intermediate financing types, ought to involve significantly easier steps than simply taking venture capital after start-up and then going to the market with no other financier's involvement. Of course, the overall difficulty of more, shorter steps may be equal or greater.

presumably reduce the mortality rate, and if it encouraged an earlier or more rapid development of this important firm-financier relationship, would also have significant benefits to more successful SMEs as they reached later stages of the cycle. Not all policies will necessarily have beneficial effects for both the more and less successful groups, so it is useful to sketch a tree of possible SME stages of finance. Fig. VIII illustrates the paths taken by firms. The firms are portrayed as having the facility of various types of business credit throughout their lives, and potentially being able to tap the markets for angel, venture capital and bank finance. The routes to each are shorter if another type has already been obtained, to reflect the complementarities between financing types. At any point in the diagram, the firm may cease to expand its financing. From the (almost inevitably reached) reciprocal finance stage, this does not denote failure, merely an equilibrium in the relationship between firm value and personal income, exposure and control in the owner/manager's subjective success function.

The firm may also make retrograde steps in financing, for instance in divesting itself of private equity investors when disagreements on strategy can only be resolved such a measure, or when a venture capital sells back its shares (generally at a loss) after realising its profitable exit strategies of IPO, merger or acquisition have become infeasible The question of importance is how policy will affect the ability of firms to move along any given path, and how that in turn will affect the number of firms which finish at any given endpoint. In this context we discuss a range of policies.

Spain has put in place perhaps the most comprehensive program of innovation promotion: demand-driven innovation (i.e. to meet firms' precise needs) is catered for through networks encompassing scientists, technology suppliers and producers, while the Offices of Innovation Transfer promote supply-driven transfers from researchers to firms (Martinez Gonzalez-Tablas & Diaz Fuentes, 1998). These measures and others in the PATI (Industrial Technology Action Plans) have met with little success, however. Increases in R&D as a percentage of GDP were considerably below target, and the main aim of encouraging private R&D to replace public seems not to have been met either. A growing decentralisation of policy in the third Plan (1996-9) has had superior results, along with the widening of firms eligible, but the international gap seems little changed. It seems reasonable to assert that - given our hypothesis that the financial decision precedes the technological - policy will be more likely to succeed if it is aimed at the financial sector (through the provision of investment incentives, or improvements to institutional structures) rather than the technological.

IV.i: Policy to promote equity financing

Equity subsidies have received a range of support in recent research as development policies. We will consider in particular the model proposed by Razin et al. (1998). First we should ask why the provision of equity may be insufficient - and as discussed in section II, the answer is again that there exist problems of asymmetric information. Here though we wish to abstract from Myers & Majluf's (1984) finding that managers may prefer debt to equity since the latter may send the signal that the insiders of the firm perceive their equity to be overvalued - i.e. insiders sell at the moment they feel the market's valuation to be most at odds with their own (better informed) judgment.[17]

Instead, we are concerned with the general underdevelopment of stock markets which characterise not just developing countries but also those of southern Europe. Table 6

[17]The opposing argument that the cost of capital here is different for owner/managers and potential investors is clearly strong given the financial constraint on the former. An equation for the subjective maximisation problem facing owner/managers was put forward in the previous paper - this will be returned to in the subsequent empirical paper, but here we mainly consider the institutional supply side of the financing decision.

provides some representative statistics which indicate the differences between these markets and that of the UK. It is clear that the stock markets in the former group do not operate in a way which is at all comparable to the British case. There is a much smaller base of equity-holders in Southern Europe, and thus the largest shareholders wield much more power - see column (1). The extent of private equity investment is also much lower for this reason (2). New flotations (IPOs) by firms are much less common - by at least a factor of four - than in the UK (3), and these factors may all contribute to the resulting differences in the proportionate numbers of firms. Despite efforts to encourage stock market growth, and to create stock markets to cater for smaller firms, the take-up has been low and the southern European exchanges continue not to function as markets for corporate control as in the Anglo-Saxon countries.

Table 6: Summary statistics of some European stock markets

Country	(1) Ownership concentration*		(2) External capitalisation/ GNP	(3) IPOs/ population	(4) Domestic firms/ population
	Mean	Median			
Greece	0.67	0.68	7.14	0.30	21.60
Portugal	0.52	0.59	8.04	0.50	19.50
Spain	0.51	0.50	16.59	0.07	9.71
UK	0.19	0.15	100.07	2.01	35.68

Source: Table 2, p.100, and Table 6, p.103, Berglof, 1997; from La Porta, R., F. Lopez-de-Silanes, A. Shleifer & R.Vishny, 1996, 'Legal Determinants of External Finance,' *mimeo*, Harvard Institute of Economic Research.
*Ownership concentration measured as the concentration of ownership in the hands of the three largest shareholders in the ten largest listed firms in each country.

Razin et al.'s model reaches the following conclusion based on reasonable assumptions concerning the presence of asymmetric information in a developing economy: that low-productivity firms will finance a low level of investment through equity markets, high-productivity firms will finance higher levels of investment through the debt market, while firms of 'medium' productivity will not invest at all. They find the debt market to be efficient (which corresponds to our finding that relationship banking, and the tools of debt

contracts available to banks, will reduce the information problems here), while the equity market suffers from too narrow a scope and too low a level of investment for each participating firm.

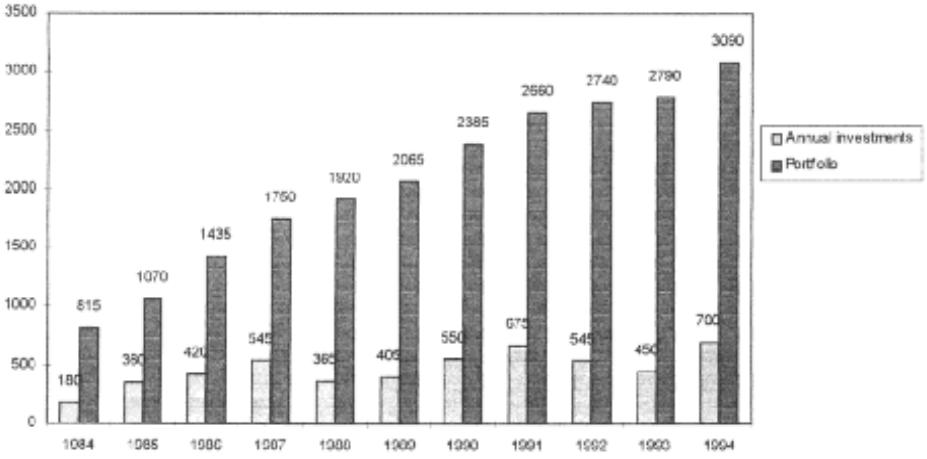
Although the paper is specifically focussed on an organised equity market, the result that firms who equity-finance are less productive fits otherwise with the findings of Baldwin & Johnson (1998). Product innovators, who have not yet begun to increase the efficiency of their production processes, are the prime users of private equity financing - equity financing without a developed equity market.[18]

The main conclusion of Razin et al. is that the optimal policy to encourage the financing of investment would be a lump-sum subsidy to those firms which make use of equity finance; 'equity-market-contingent grants.' In the context of Southern European SMEs, the equivalent conjecture would run as follows: such subsidies would lead to a growth in IPOs in secondary markets and the EASDAQ, and/or the development of new regional stock markets specialising in the area which the subsidy targeted - i.e. technology based industry. The resulting increase in productivity of listed firms, efficiency of equity markets and exit expectations of private equity investors would theoretically be self-enforcing. This implication suggests support (in target if not instrument) for the policies used by the Dutch government throughout the 1980s and early '90s.

Brouwer & Hendrix (1998) compare the experience of the Dutch and US venture capital booms across this period, and attempt to explain the reason for Dutch policy's apparent failure. Fig. IX indicates the rapid growth which was achieved in Dutch venture capital investments over the period, while Fig.X sheds light on the sources of this growth. There appears initially to be have been a great success in encouraging venture capital (although the main growth came from banks and then insurance companies, who were pressured by the government into taking positions in the market which were ultimately to prove costly). The initial impression of success was not borne out by subsequent events.

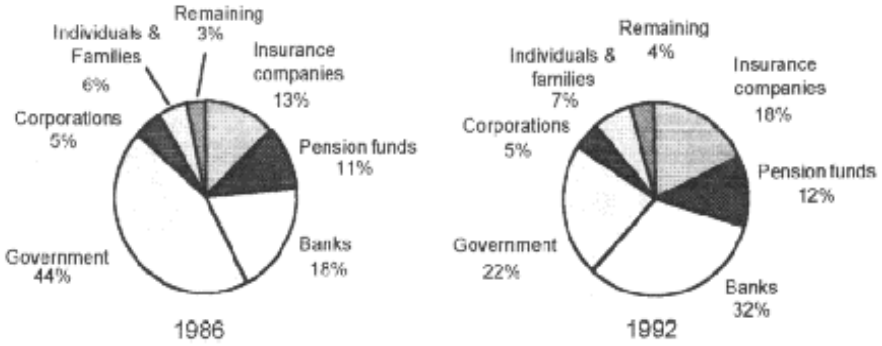
[18]The use of equity later in the life cycle by process innovators refers to a fully-developed public equity market which is relevant neither to Razin et al.'s discussion of developing country capital markets nor yet ours of SME financing, so represents no contradiction.

Fig. IX: Annual investments and total venture capital portfolio (in millions of guilders)



Source: Brouwer & Hendrix, 1998, p.337.

Fig.X: Changes in composition of investors in Dutch venture capital, 1986-1992



While early stage investment remained fairly constant (around 30% of total VC) throughout the US boom of venture capital, it fell by nearly half (in percentage terms, from 23% to 12%) in the Netherlands. This, the authors contend, resulted from a collapse in the expectations of investors. This in turn was caused by the loss of confidence in the Dutch Parallelmarket (the Netherlands' NASDAQ equivalent, which opened in 1982 and closed in 1993), which was itself triggered by certain high-profile under-performances. As was noted in the previous paper, SME investment by venture capitalists is driven by the skewed return schedule - those few firms which are eventually exited by means of an IPO are responsible

for excess returns which balance the many firms which exit less profitably. The disappearance of earlier optimism and subsidies offered by the Dutch government reduced the extent of the payoff from winners, to such an extent that the average willingness to back firms was greatly reduced.

Brouwer & Hendrix offer a number of reasons for the failure of the Parallelmarket. Firstly, the market itself became the victim of a bad reputation after a number of high profile casualties. Second, it could not compete with the Official Market (OM) - the good market drove out the 'bad.' These two reasons find a parallel in the explanations for the failure of the AMEX Emerging Companies Market in 1995; Aggarwal & Angel (1997) find that the three-year-old market closed because of a combination of a number of scandals which ruined its reputation, and the ECM's cooperative structure which reduced the scope for AMEX shareholders to make excess profits from its success, and thus their willingness to back it.

The third and perhaps most important reason Brouwer & Hendrix put forward questions the organisation of Dutch venture capital firms. While US funds are based on a limited lifespan, set out in the company papers, of 10 years, the Dutch funds had unlimited lifespans. US funds are thus able to credibly exit their investments - by floating companies in order to liquidate themselves and split the resulting assets among investors - without the suggestion that they believe the market to be overvaluing their shares, while Dutch funds found it harder to resolve this difficulty, especially in the climate of pessimism which overtook the Parallelmarket. The argument that a fund of indeterminate lifespan is more likely to build and benefit from a reputation and expertise is nullified by the nature of US funds which essentially operate sets of rolling companies, each at different stages of the ten year cycle and with close identification with the reputable fund backers and managers. This then certainly seems to have a strong implication for successful venture capital legislation.

In terms of Fig.VIII, the difficulty of reaching stage 6 remains high, and thus there exists the opportunity for policy to reduce this and hence the difficulty associated with each further financing step of obtaining private equity, venture capital or long-term bank loans - steps 3, 4 and 5. In other words, policy can play a role in easing every positive step in the financing of SMEs through stock market-oriented legislation and action. The problem remains one of

how strong the 'trickle-down' effect is - how far the effect penetrates back past the movements 3-6, 4-6 and 5-6 - and thus how much the general population of SMEs is assisted rather than just the particular few.

IV.ii: Policy to promote debt finance

There has also been much research into banking market structures, and the role of policy. We will look at one particular case which has a direct bearing. First, the case of Italian efforts to support and improve the banking industry (and thus the economy) of Southern Italy clearly has strong parallels with the country cases we are considering. Faini et al. (1992) assess the North-South structure of banking in Italy, which provides a very pertinent comparison to our European equivalent.

Southern Europe has benefited much as has Southern Italy from "forty years of regional development policy [which has] stimulated massive capital inflows and real income transfers, but... failed to close the income gap between [North and South]. In turn, the absence of convergence can be explained by a variety of factors, ranging from deficient infrastructure, inefficiency of government services, ..., localised learning, etc. [The question is] whether inefficiency of the financial sector can be legitimately added to the list of explanatory factors." (p.3).

Faini et al.'s results are consistent with the idea discussed in section II.ii on relationship banking, that - although banks may not actively seek to informationally capture their small business customers - there are informational advantages which allow some banks to impose higher costs on some customers but remain successful in attracting their business. Firstly, Faini et al. find - as expected - that Southern firms tend to be riskier than their Northern counterparts.[19] This, however, can only explain half of the average interest rate differential between North and South - Southern banks charge more than one full percentage point more, on average, than do Northern banks, *after* allowing for the difference in customer risk. Most

[19]This is established by analysis of mortality rates - through the proportion of employees affected, this is found to be 3.5% in the north-west, 3.8% in the north-east and 4.8% in the south. References to previous work (i.e. Siracusano & Tresoldi, 1988, and D'Amico et al., 1990) showing higher variability of profit levels in Southern firms supports this conclusion.

of this remaining difference can then be explained by higher operating costs at Southern banks, which Faini et al. interpret as evidence of these institutions being somehow sheltered from competition.

This raises a number of interesting questions, and answers which go some way to explaining the problems facing SMEs in Southern Europe. Southern Italian firms do not borrow a great deal from Northern banks (at their lower interest rates) because Northern banks are informationally disadvantaged.[20] The effort required to assess the risk of a Southern firm can be sufficient to cause immediate rejection, and the risk of attracting higher-risk borrowers (i.e. those rejected already by informationally advantaged Southern lenders) leads to rationing. This is supported by evidence that when the province of borrower and lender matches in the South, average interest rates are a full percentage point higher; there is no such effect in the North. Finally, it is shown that Southern firms are not systematically more difficult to screen, and thus that Southern banks are systematically less efficient at screening their potential customers.[21]

The key implication of Faini et al.'s results is that effective competition between banks is a prerequisite to improved financing in the South. *Effective* competition, according to the authors, means not simply opening up the market to new entrants, but making the property of local banks (in the form of e.g. their loan books or franchises) contestable so that entrants can more quickly overcome their informational disadvantage. They also emphasise the important positive effects on competition of mergers and acquisitions as less efficient regional banks become part of more successful international institutions. At the same time, continued separation of markets for short-term credit (dominated by commercial banks) and long-term credit (mainly operated by special credit institutions with strong lending guidelines from government) is highlighted in terms of its negative impact on competitive pressures.

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[20]Or possibly wary of business involvements with elements of organised crime in the South.

[21]Faini et al. test the residuals of the cross-section regression of banks' and firms' fixed effects on the lending rate of individual agreements; if screening is efficient, these should be zero. When effects of firm size and sector are allowed for, the result is not that Southern firms have significantly different residuals regardless of the lender, but rather that Southern banks have higher residuals than Central, and in turn Northern, banks. Although Faini et al. are reluctant to overemphasise the quality of their sample and thus the extrapolation, the implication is "this indicates that Southern firms are no harder to screen than others; it is Southern banks that perform the screening less efficiently." (p.35).

There does exist an alternative interpretation of Faini et al.'s results however. If southern banks are systematically worse at screening, and southern firms are not systematically more difficult to screen, why does the role of northern banks remain so limited for southern firms? If, on the one hand, this result is wrong, then avenues of policy are opened up such as the promotion of superior auditing standards among southern firms. If we accept the result, we must question the reluctance of southern firms to help themselves by banking further afield. The suspicion must arise that southern firms are at the least less efficient at financing themselves, but certainly that conclusions about policy to promote competition in banking may be misplaced if there exists a problem of some sort to do with the internal processes of the firm in seeking finance. Again, these processes will be an important part of the model which is presented and tested in the subsequent paper.

Elsewhere in Southern Europe, the extent of such separation - and other historical results - in the banking sector is less evident, but may still be significant. To illustrate the extent of the gains which were available from liberalisation, borrowing costs for firms in Greece fell from 39% of their total expenses in 1985 to 22% in 1995 after the deregulatory process which followed the report recommendations of the "Committee for the Reshaping and Modernisation of the Banking System." These largely consisted of reducing the role of government in banking, by both granting a degree of independence to the Bank of Greece and divesting much of the government's 90% control of commercial banking.

Whether the opportunity for large gains still exists is debatable, but the idea of favouring continuous SME-bank relationships is certainly one which this paper has provided support for. Obtaining bank loans (in Fig.VIII reaching stage 5, either when no other finance has been obtained, or after the receipt of private equity and/or venture capital) may be the hardest obstacle to overcome, but it may also be the path by which SMEs' mortality rate is most effectively reduced and their growth rate increased.

The role of mergers in increasing competition, and their other effects on SME lending, will be considered in a subsequent paper. The ultimate focus of this project is on the impact of EMU on the financial markets (and hence technology-based SMEs) of Southern Europe, and the final paper of this series will focus particularly on the future of banking. We may note

here that there is a strongly supported alternative view of mergers and acquisitions in the banking industry as being possibly detrimental to small business lending; Berger et al. (1997) survey the arguments and provide substantial North American evidence.

Looking at more than 6000 mergers and acquisitions since the 1970s, they decompose the effects on small business lending into static, one-off effects of the amalgamation of lending books, and dynamic effects of restructuring within the new banking firm. The main finding is that the static effects tend to be off-set by the reaction of competitors, and in some cases the dynamic effects. This work has been followed by many others arguing a variety of different views (e.g. Akhavein et al., 1997, Berger et al., 1998, Peek & Rosengren, 1998); these will be examined in detail in a subsequent paper.

V. Conclusions

It has been seen in this paper 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.

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 breakpoints 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.

A subsequent paper will present this research, and with the strength of the archetypal model quantified, the specific constraints associated with the southern European economies will be examined. The importance of the SMEs' life cycle to both their financing and (hence) their technology decisions has been argued for strongly here, and the story of the archetypal SME may form the basis for subsequent work to establish the exact nature of the interlinkages which shape the ultimate effect of policy initiatives with respect to employment, technology investment and innovation.

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