

PILOT NEWSLETTER

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The PILOT project is funded within the European Commission's Key Action
Improving the Socio-economic Knowledge Base.

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Editorial

Dear readers,

This is the first issue of the PILOT-NEWSletter which will be published each May and November for at least the coming three years. The major objective of this newsletter is to provide you with first hand information about progress, findings and preliminary conclusions of the project Policy and Innovation in Low Tech – Knowledge Formation, Employment and Growth Contributions of the “Old Economy” Industries in Europe (PILOT). This multidisciplinary and international research project is funded within the European Commissions Key Action “Improving the Socio-economic Knowledge Base”.

In this issue we want to present the basic ideas behind PILOT and the work we are going to do. The first article gives you an overview of the project’s objectives and methodology. The following two papers are revised versions of talks held at the PILOT Kick-off Conference on 14 February in Dortmund. I would like to thank the authors for this extra work.

The PILOT-NEWSletter is by no means a “closed shop”. We will occasionally invite academic colleagues, businessmen and policy makers working in the field for contributions. We would be happy in particular if so called low-tech companies would present themselves in this newsletter.

If you want to use this newsletter to present your work or company to a broader audience do not hesitate do get in contact with the editor.

I hope you will enjoy this issue!

Gerd Bender

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The PILOT took off: Research on the Importance of Low-tech Industries in High-tech countries

by Gerd Bender

The PILOT project started in December 2002 and will run over a period of three years. Social scientist from nine European countries investigate the contribution of so called low-tech industries for employment and growth for Europe on the threshold of what many label the knowledge society.

Project Idea

It is a general understanding that mature industrialised nations currently undergo a fundamental transformation into “knowledge societies”. And the competence to generate, take up and utilise new knowledge is seen as decisive factor for both economic success and societal progress. Permanent innovation demands flexible adaptation of production processes, organisational structures and the workforce. There is a firm belief that in this situation the improvement of “high-tech” industries is the key to welfare.

Correspondingly, in this scenario so called “low-tech” sectors appear to be less important in and for the major industrialised countries. Depending on the political attitude they are regarded either as an obsolescent model or as an endangered species. Due to the global division of labour the appropriate place for producers of seemingly mundane goods such as simple gaskets, office material, corrugated paper boxes,

standard kitchen furniture, and bath tubs are less developed and low-wage regions. Hence, so the argument continues, up-to-date economic and technological policy should primarily support the emergence and development of competitive, knowledge-intensive high-tech sectors.

Starting point of the PILOT project is a fundamental critique of this widely held belief. Basically, the reasoning just sketched conjures away the role of low-tech industries – in manufacturing as well as in service sectors – for the current structural change in advanced economies. Our somewhat provocative thesis is that there is no empirical reason to do so. In fact, much of the progress we witness today is based on developments outside the realm of high-tech. As studies show,

- low-tech industries are – and will be in the foreseeable future – important not only for employment and growth but also for knowledge formation in European economies,
- the usually underestimated innovative capabilities of these industries support rapid technological change elsewhere,
- low-tech products and companies are very often a crucial precondition for the innovative ability of whole value chains and for the design, fabrication and application of high-tech products of various kinds.

Project Objectives

The project aims at deepening the understanding of growing knowledge intensity of the economic and social development in Europe. It is assumed that the process depends not only on industries with frontline technological knowledge but also on low-tech industries. These are not necessarily low-growth industries; many companies and branches within these sectors are growing fast, are inter-linked with high-tech and service branches and provide an important basis for growth and employment in the future. The role and importance of these industries in different European nations and for the economic and social prospects of Europe as a whole are analysed.

Mapping and analysing learning processes and innovation patterns, the PILOT project tends to identify the deep, complex and systemic knowledge base that contributes to innovation and knowledge creation in low-tech industries and particularly in individual companies. This will also allow to identify systemic interdependencies between low-tech and high-tech sectors in a network perspective.

The main objectives of the project are:

- to formulate viable concepts of “knowledge and technological intensity” and “learning process” with a wider applicability and a deeper analytical basis than those currently available;
 - to determine the role and importance of specific low-tech industrial sectors
- for the innovative abilities of regions and/or nations;
- to identify the knowledge base that enables innovation and knowledge creation in low-tech industries;
 - to ascertain the relevance of firm-level knowledge from a network perspective to gain an understanding of innovative ability along whole value-chains, including high-tech and service companies;
 - To contribute to the formulation of policies on industrial restructuring which pays appropriate attention to the significance of low-tech industries for the further economic and social development of Europe.

Project Methodology

The PILOT project is subdivided into six work packages. Research pursues a double-tracked methodology.

On the one hand, conceptual, taxonomic and data issues are tackled. The currently dominating concepts of “technology and knowledge intensity” and of the “learning process” in firms do not contribute very much to an understanding of low-tech industries and their relevance for innovation and growth. Hence, it is inevitable to depart from both the high-tech concept and from the industry classification based upon it and to develop a new conceptual framework. There is a dedicated work package within the project which addresses questions like these.

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The second work package is devoted to an empirical investigation of the role and function of low-tech industries for economic growth and more general to statistical analysis of the extent to which growth is based on innovation.

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On the other hand, single low-tech firms and interactions between such companies are scrutinised. The empirical core of the project is an extensive series of case studies in ten countries across Europe. Emphasis is placed on their use of technologies, on typical patterns of innovation and of knowledge creation as well as on the importance of (which) formal skills and qualifications (cf. Laestadius in this issue). This is basically the content of the third work package.

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Other issues are the collaborative behaviour of firms in different regions and the quality of employment and qualification structures in low-tech industries in the future.

Analysis focuses on three levels:

- individual companies
- inter-firm networks (fourth work package)

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- impact of innovation and industrial policies on the development of low-tech sectors (fifth work package);

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cf. Jacobson & Heanue in this issue.

Expected Results

The project will determine the importance of low-tech industries for innovative and sustainable growth in Europe; it will be the first large-scale integrated project to do this. An enhanced theoretical and empirical understanding of industrial structures will allow valid assessments of low-tech industries' contribution to growth, employment and knowledge creation in the economy. Furthermore, policy implications for employment, welfare and cohesion in Europe will be elaborated and corresponding recommendations will be prepared.

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Know-how in a Low-tech Company: Chances for Being Competitive in a Globalised Economy

by Staffan Laestadius

There are strong reasons to assume that the dominant discourse on knowledge formation in industry underestimates activities which are not classified as “scientific” or “R&D”. That may lead not only to a tunnel vision as regards identifying creativity and innovativity but also to unwise decisions within management and policy. The high tech snobbery of the late 90s turned into a dramatic decline of the ICT industry. Today’s fast growing firms and industries are not necessarily high-tech in the narrow understanding dominant some years ago. That is the context for the PILOT project.

During the second half of the last decade four empirical studies were carried out on knowledge and competence formation processes in firms and industries with low R&D intensity. An in depth analysis of a world leading producer of anchor chains showed the importance of tacit knowledge, significant acquisition capacity and competence to synthesise knowledge from different sources.

A broad study on sixteen Swedish low- or medium-tech manufacturing firms showed significant performance achievement due to organisational innovations and mobilising the creativity from all of the employees. The combined creativity far exceeded what the R&D department had achieved before.

A detailed analysis of a well defined innovation project (Thermopulp) carried

out by SCA (pulp & paper) and Sunds (equipment producer) not only showed the tight user-producer relation in the innovation process but also the hidden parts of innovativity. Only 20 percent of all innovation expenditures were identified as R&D in the accountancy. This phenomenon contributes to a significant reliability problem for those Science & Technology indicators which are based on R&D statistics.

The installation of a new paper machine in Sweden was also analysed. That project, which costed 300 MEUR was connected with almost no identified R&D expenditures. Nevertheless there were a lot of innovations taking place in the intense relation between the paper mill and the equipment producer. Running competence was embodied in the new machinery, thus creating new high performance capability.

The preliminary conclusions from these cases are:

- On the *analytical level* – the high-tech snobbery has only limited empirical support. High R&D intensities do not prevent firms/industries from decline. And low R&D intensities is no necessary obstacle for excellence and competitiveness. We need more nuanced criteria to understand the dynamics of industrial/technical change than the traditional S&T indicators.

- On the *political level* – the linear model in science policy is challenged. A knowledge society has no obvious relation to an R&D target on e.g. 3 percent of GDP (the EU position).
- On the *management level* – this may provide to a more nuanced view on the core competence regime and on the present escape from manufacturing and integrating systems. There may be a rediscovery

of tacit dimension in knowledge formation and of the potential of mobilisation of human resources rather than expanding R&D units.

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Low-tech Policy

by David Jacobson and Kevin Heanue

Introduction

A central component of the PILOT project is the identification and analysis of the particular policies that impact on low-tech industries in different countries in Europe. Our objective is to gain a better understanding of what policies help or hinder low-tech industries and why. At the end of the project, we want to be able to recommend policy initiatives that address the specific concerns of low-tech industries in terms of improving their innovative capabilities, sustaining their competitiveness and enabling them to continue to generate employment into the future. This paper presents a brief overview of the approach that will be taken in the PILOT project to the topic “low-tech policy” and highlights some of the issues involved by using Ireland as a case study.

Our focus is on unpacking the “policy” part of the title. The question of what constitutes “low-tech” firms and industries is being considered by others in the PILOT consortium. However, it should be emphasized that we do not mean to trivialize the question by ignoring it here. It is complex and its answer will surely impinge on the analysis of policy. For example, some “traditional” industries like clothing and furniture – usually considered low-tech – have high-tech production processes in

many plants, including the use of computers in sophisticated applications like CAD-CAM. At the same time, the computer industry itself has many plants – for example in assembly – in which low-tech, hand operated processes predominate.

Scope of Investigation

In terms of the investigation of low-tech industries and policy, the PILOT project is guided by two fundamental hypotheses.

- Many policies, at various levels, even those not explicitly focused on low-tech industries, have an influence on those industries
- Policy towards innovation and knowledge formation in low-tech industries can be improved

For our empirical investigations, there are several key questions that we consider are important. What policies impact on low-tech industries? How do these different policies impact on low-tech industries? How in particular do they affect innovation and knowledge formation in low-tech industries? What are the employment effects? To what extent are the different policies mutually reinforcing, and to what extent contradictory, in their impacts on low-tech industries? At what different levels of national governance – national, regional and local – are these different policies formulated and

implemented? How different are the policies towards low-tech industries in the localities, regions and countries of the EU? Although an ambitious task, we would hope to gain an insight into most of these topics.

Policies of all kinds – and at all levels – both explicitly aimed at encouraging innovation, and more generally impinging on industrial development, have an impact on the low-tech knowledge base. How these policies interact, however, and what their net effects are on low-tech industries have not been analysed. These omissions are partly consequences of the focus among social scientists in recent years on high-tech industries. Another consequence is a paucity of studies on how policies may be developed so as to facilitate innovation in low-tech industries, including through interactions between low-tech and high-tech industries.

At the end of the project, we wish to be able to identify what policies emerge as the relatively successful ones from the empirical examinations in this and other work packages? To what extent are these policies consistent with the theoretical conclusions of this project? What does this imply for the nature and level of appropriate policies toward low-tech industries in Europe?

Methodology for Policy Analysis

The methodology for the policy analysis in the PILOT project will involve identifying and analysing relevant policies. The *identification* of policies

will be achieved through two levels of research activity.

The *first* level on which the research on the identification of relevant policies will be undertaken is that of the policy-makers in various policy institutions. The target policy-makers include those in local, regional and national industrial development agencies, industry associations, trades unions, municipal authorities, central government, and European agencies. It is envisaged that 5 to 10 structured interviews will take place in these institutions in each chosen country. Therefore, this approach will explicitly differentiate between the various levels of political governance, local, regional and national and European. For the local level, for example, policy makers in the municipal or other local authority will be interviewed to obtain information on their perspectives on the particular policies. Interviews with the policy makers at the appropriate level will supplement any documentation that exists on the policies.

Second, the policy research will incorporate the results from the case studies of firms (i.e. work package 3; see Bender in this issue) in which decision-makers in the firms identify the nature and level of the policies that affect their firms and industries most significantly. How these policies affect their firms and industry – e.g. positively or negatively – will also be in question. Contributions from work package 4 on the impact of policy on

low-tech networks will also inform the identification process.

The *analysis* of the policies to determine which are successful will be based in part on the views – as expressed in interviews – of policy makers in the various political institutions and also on the impact of policies as identified by firm decision-makers. Together with statistical data on low-tech industries, this information on the views of policy makers and low-tech firms will identify which industries developed successfully and how. This will facilitate an examination of whether and how policies contributed to this success. For example, from a policy formulation perspective, a central research priority will be to examine in detail the heterogeneous characteristics of firms in selected low-tech industries and how these characteristics impact on the firms' responses to changing economic signals. Also, specific national and/or regional policy contexts and the relationship of these frameworks with the performance of selected low-tech industries will be taken into consideration.

A review of policy documentation within each partner country is an integral component of the analysis. However, as we are all aware, there can be huge discrepancies between “policy statements/objectives” and the instruments that are used to operationalise these policy objectives. Therefore, in most cases it may be more appropriate to “follow the money”, and examine how budgets are allocated and the specific instruments or initiatives

that are prioritised. In this way, the impact of policy may be revealed rather than getting sidetracked on the wording of policy documents.

Low-Tech Industries, Innovation and Policy

We are convinced, and available empirical evidence supports the contention, that low-tech industries are crucial sources of employment, innovation and growth for many developed countries, and are likely to remain so. In fact, these non-R&D-intensive industries still contribute approximately 85 percent of total manufacturing output, value-added and employment within the EU. We are less sure, however, about many of the processes that underlie this predominance, and how in particular policy initiatives impact on the capabilities of low-tech firms. Although this paper is not the place for a full review of all the issues involved, several key notions can be identified as important for policy and innovation in low-tech industries. These include horizontal vs selective industrial policy, networking policy, learning firms and regions, knowledge and training, and the role of institutions.

Horizontal vs Selective Industrial Policy

Policies impacting on firms and industries can be – among other typologies – horizontal or selective. Horizontal policies are more general, aiming for example at improving

productivity across the board. They may aim at general frameworks for business activity, including infrastructure, finance and regulation. Arguably such policies avoid the need for the state to “pick winners” and, as such, are more consistent with market-based approaches to industrial development. Selective policies are, on the other hand, those that do identify particular sectors or even sub-sectors, regions or localities, for special support. However, as Hospers (2001) has argued, even horizontal policies have differential impacts on different industries. “[E]ven if the objectives of industrial policy are generic, the tools used to achieve these goals often implicitly favour certain sectors. Public investments in a country’s science base or innovation subsidies simply cannot benefit all economic activities, but will always have a bias towards particular parts of the economy.” Even horizontal industrial policies have the effect – sometimes unintentional – of favouring some industries.

Networking Policy

The significance of encouraging linkages among firms to improve their efficiency and facilitate learning and information exchange has been highlighted by the theoretical and empirical research surrounding industrial districts, networks and clusters. In an attempt to foster inter-firm linkages where none previously existed, many countries have introduced “network programmes” aimed at encouraging firms to co-operate with each other. One of the first such

initiatives, the Danish network programme, has been implemented in various guises around the world. The evidence on network programmes is somewhat mixed. Some studies of publicly-funded programmes to promote networking suggest that embeddedness – the interdependence of economic behaviour and social relations (a necessary condition for trust) (Granovetter 1985) – can be created among previously non-cooperating firms once they are brought together (Cooke and Wills 1999, 232), thereby enabling them to benefit from economies of association (Cooke and Morgan, 1998). Huggins (1998) is more circumspect, arguing that the success of the British Training and Enterprise Centres (TECs) business networks policy is “open to debate”. According to Amin (2003), policies to encourage local networks are rarely successful. Most successful networks, while involving relational proximity, are spatially stretched, and frequently global.

Learning/Localised learning

The importance of learning and particularly localised learning has been increasingly highlighted in research on innovation, competitiveness and regional development. The argument that much learning is localised is based on the view that regional development is dependent on co-localised and interconnected processes of technological development (innovation), and evolution of a range

of social institutions (institutional learning). In an age of globalisation of production and codification of product and process knowledge, localised creation and utilization of some non-ubiquitous product and process factors – most notably, tacit knowledge – is viewed as a valuable regional asset (Lorenzen 2001, 164). However, Lorenzen (2001) argues that the policy prescriptions that flow from this research, are as yet, relatively un-researched. Amin's (2003) argument is to some extent at odds with Lorenzen's, in that for Amin knowledge is inherently mobile. Even cities, apparently containing sticky production activities, do not in practice, but rather provide a kind of transaction cost minimising role in the global circulation of components, finished products and knowledge transfers.

Types of Knowledge

Knowledge for low-tech production (and services) is predominantly "practical" or "application-oriented" as distinct from "theoretical" or "scientific" knowledge. Much of it is "tacit" rather than "formal" or "codified". It can be argued that Amin's (2003) idea of knowledge networks with distanced nodes applies particularly to more sophisticated, technical knowledge that is theory-intensive and that knowledge of a practical nature is often more localised. The knowledge a taxi driver has of a place is particular to that place, for example, but an electronic engineer can get a job anywhere.

The role of institutions

According to Langlois and Robertson (1995, 103) "Institutions may either retard or encourage innovation". They categorise institutions as "exogenous" and "endogenous". The former are those that are "features of the economy or society at large". Relevant examples would include the tax system and the education system. "Endogenous" institutions are "those that are specific to a particular firm or industry, including research and development departments, codified and uncoded corporate rules and procedures, and trade associations and lobbying groups". What emerges from this and other studies of institutions is the fact that, as discussed above, apparently generic – or horizontal – policies and institutions, can provide support for some industries at some times and others at other times. Thus "some firms may find that a hitherto excellent system of education has become a source of inertia, while other firms, which were not well-served with educational facilities to cope with the old technology, discover that types of education that they had thought to be impractical or useless do, in fact, mesh well with the needs created by innovation." (Langlois and Robertson 1995, 103-4)

Ireland

Industry in Ireland exhibits a dual structure – a high-tech foreign-owned sector and a low and medium-tech

Irish-owned sector. Although a simplification, this characterisation of Irish-based industry is generally accepted. Since adopting an export led growth strategy in 1958, Ireland has successfully attracted foreign direct investment, particularly from the United States, and particularly in industries like electronics (including computers), software and pharmaceuticals, all industries in which there are relatively high R&D expenditures. There is less agreement on such questions as how technologically advanced the activities of the multinational corporation subsidiaries in Ireland are. It is also unclear as to how embedded they are into the Irish economy. Nevertheless, foreign direct investment in Ireland accounts for half of all industrial employment and over the past decade, these firms have recorded high output, productivity, employment and export growth. The remainder of industrial employment arises in low-tech indigenous companies, which sell two thirds of their output on the domestic market. This sector of Irish industry has consistently shown less impressive rates of output, productivity, exports and employment growth. During the 1990s when Ireland was experiencing unprecedented growth rates – the Celtic Tiger – the buoyancy of domestic demand sustained indigenous companies. Although some commentators have argued that the performance of indigenous industry has improved substantially (O'Malley 1998), others are not as convinced (O'Hearn 1998).

With the apparent demise of the Celtic Tiger, concern has begun to be raised that the most recent wave of high-tech foreign direct investment into Ireland may not be sufficiently embedded in the Irish economy, to prevent their movement to lower wage economies so as to avoid a profits squeeze. The other concern is whether or not indigenous industry has developed sufficient capabilities to compete internationally now that the buoyant domestic market appears to be slowing down. These concerns are not new, and have been aired before in times of economic slowdown. That these questions are being raised again indicates that the long-term sustainability of the type of industrial development that has taken place in Ireland in the recent past, is questionable (O'Sullivan 2000).

Networking Policy

There have been two policy-inspired attempts to encourage networking in Ireland. The first, the National Linkage Programme (NLP), was launched in 1985. The aim of this initiative was to optimise the domestic sourcing of manufacturing industry, and in particular to develop trade links between overseas companies in Ireland and other Irish-based firms. The longer-term objective was to encourage the domestic suppliers to progress to export trade (Kennedy 1991, 96). The policy met with some success. Local sourcing of materials by foreign-owned industry and the electronics sector in particular, increased until 1990-91, perhaps as a result of the NLP, but

have levelled off since then (O'Sullivan 2000).

The second networking initiative arose in 1996, when Forbairt (the development agency responsible for indigenous industry) introduced a Pilot Network Programme (PNP). The PNP – involving 17 networks and a total of 31 SMEs (small and medium enterprises) – aimed to encourage small firms to co-operate in activities they were unable to undertake individually due to their small scale. The objective of the PNP was to put in place some of the resources needed to facilitate and establish formal networks of the “Danish” type (Rosenfeld 1996), to help the networks devise joint solutions to common problems and to evaluate the results. The final evaluation report on the PNP was not published, although there is evidence that one network of furniture companies that developed under this initiative was successful (Heanue and Jacobson 2002). To date, however, a more extensive Network Programme has not been instituted by any of the Irish industrial development agencies.

Regional Policy

Promoting balanced regional development in Ireland has been a long-term public policy objective since the beginning of the 19th Century. Fitzgerald et al (1999, 109) argue, however, that there has not always been a clearly articulated strategy. Instead, measures such as regionally differentiated industrial grants (to influence the location of mobile investment), special

compensatory payments to farmers in disadvantaged areas, and various government decentralisation initiatives, have been relied upon. In addition, in the more recent past, regionally differentiated industrial grants have been augmented by EU regional policy instruments such as structural funds (p. 109).

In 1999, Ireland was formally divided into two regions, principally for EU Structural funding purposes – the less prosperous Border, Midlands and Western region (BMW) that retains Objective 1 status – and the Southern and Eastern region (S&E), which is now classified as an Objective 1 region in transition. On foot of this classification, two regional assemblies were established, which have responsibility for implementing among other initiatives, industrial and development policies. It is not clear, however, to what extent these regional industrial and development policies will help to promote localised learning and knowledge creation/exchange in the regions. There are two main reasons for this. First, contrary to the thrust of the localised learning and regional development literature, these policies are designed at national, and not regional level, and the assemblies have no devolved political power or wide-ranging locally representative structures. Second, the recently published National Spatial Strategy, which provides the overall framework for regional development for the next twenty years, is focused primarily on

the provision of hard infrastructure and promoting economies of scale in industry.

Innovation Policy

The most significant development in Irish innovation policy in the recent past, was the adoption and new national focus on innovation systems and learning (STIAC 1995). However, the interpretation of this concept as expressed in policy instruments, seems to focus solely on high-tech industries. For example, the policy framework for the Productive Sector Operational Programme as set out in the National Development Plan (NDP) 2000-2006 states that "the challenge ahead is to facilitate the conditions which allow for the further development of an indigenous enterprise culture which recognises the importance of high-tech, high value-added business which has at its heart a deep commitment to the role of research and innovation ..." (p. 121). There is, however, for the first time a commitment to developing Regional Innovation Systems. Lets focus on the implications of this initiative for the BMW region, which is dependent to a greater extent on traditional and natural resource-based industries than the rest of the country.

The amount of funding allocated to Research, Technological Development & Innovation (RTDI) for the BMW region is 32 percent of the total Productive Sector Operational Programme. Approximately 0.9 percent of the RTDI budget for the BMW region is allocated

to developing Regional Innovation Systems: in absolute terms a budget of €6 million for a six-year period.

It is envisaged that this funding will focus on "encouraging regions to bring together elements of the innovation system into the region (industry, colleges, institutes, agencies, financial institutions) in order to build strategies related to local industrial or research strengths". The NDP goes on to state that "funding will be available for both the preparation and the implementation of regional innovation plans and it is envisaged that proposals would incorporate regional technology parks or other forms of networks" (p. 131). Both the absolute level of finance available, and the activities that are envisaged by this initiative are some distance from the concept of a regional system of innovation as conventionally understood.

Reorganisation of support institutions

Since 1958, Ireland has pursued a strategy of export-led growth based on encouraging foreign direct investment, gradually removing protectionism, and providing incentives for firms to export. The export-led growth policies – particularly low corporate profit tax rates and capital grants – were generally successful, in that they attracted foreign direct investment (FDI), reduced unemployment, and arrested the deterioration in the balance of payments. Concern began to be expressed because while FDI-

created employment grew, jobs in indigenous industry declined. Although the decade of the 1970s was marked globally by oil crises, these were not identified as the cause of this poor employment performance. Both international consultants (Telesis 1982) and some local experts (e.g. O'Malley 1985) were convinced that what was required was a shift in industrial policy, to favour subsidiaries of multinational corporations less and indigenous firms more.

A White Paper on Industrial Policy in 1984 did indeed lead to change, though not as substantial a change as had been suggested. A National Linkage Programme – which had mixed results – and a Company Development Programme were introduced. Sector specific policies began to be adopted, aimed at identifying already successful firms in each sector and assisting them, rather than providing blanket assistance at lower levels, for larger numbers of firms. These new policies were applied both to traditional sectors like furniture, and to advanced technology industries like electronics.

A second consultancy exercise to examine Irish industry and industrial policy was published in 1992. The Culliton Report's major recommendations included the reorganisation of the industrial development organisations into two main agencies, one of which (Enterprise Ireland) should specifically address the development needs of indigenous, Irish-managed industry (Culliton 1992, 371).

The report also contained an innovative proposal, informed by the work of Porter (1990), to change the focus of industrial policy towards promoting the growth of industrial clusters around niches of national competitive advantage. These recommendations have to varying extents been adopted.

The policy changes since the mid-1980s have had some impact. O'Malley (1998) argues that since 1987 the performance of Irish-owned firms has improved considerably, relative not only to Ireland's own historical experience but also compared to that of industrial countries in general. (Others, including O'Hearn, 1998, remain doubtful about whether there has been a fundamental change in the strength of the indigenous sector.)

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