Research & Development Activity of Irish Based Enterprise

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Executive Summary

The availability of a comprehensive profile of the research and development (R&D) activity, and associated economic activity of enterprise sectors in Ireland is key in order for the State to be in a position to decide on R&D policies and make investment decisions that maximise the potential for future economic and employment growth.

This report presents such a national profile, covering the period 1999 to 2007, using the Forfás/Central Statistics Office (CSO) survey of Business Expenditure on R&D (BERD), which is one component of a firm's overall innovation performance[1]. The output of this study is an evidence base for use by stakeholders to undertake subsequent analysis that can be used to inform enterprise development and funding agency strategies. This report is a complement to the joint HEA/Forfás report, 'Profile of Public Research Activity in Ireland, 1998-2006'.

For the purposes of this report and based on international classifications, R&D active enterprise sectors were categorised within the Manufacturing, Services and Primary Categories. National databases were used as a source of information to build economic and enterprise R&D profiles for each of ten sectors defined. OECD data was used to carry out an international comparison of enterprise R&D activity and contribution to GDP for each of the R&D active sectors.

The report presents a series of detailed R&D, economic profiles for each of ten R&D active enterprise sectors identified in this study as follows:

- Primary Sectors:
  - Agriculture, Hunting, Forestry, Fishing (Primary Category)
- Manufacturing Sectors
  - Food, Beverage & Tobacco
  - Wood, Paper & Publishing
  - Chemicals & Pharmaceuticals
  - Materials, Basic & Fabricated Metals
  - Machinery & Equipment
  - Computers, Electrical & Electronics
  - Manufacture of Medical Devices, Precision and Optical Instruments, Watches and Clocks
- Services
  - Software & Other Computer Services
  - Other Services (R&D Active)[2]

[1] The Forfás/CSO Community Innovation Survey takes a broader definition of innovation including product, process and organisation innovation in addition to actual expenditure on R&D.

[2] The 'other services' sector is based on the NACE codes between 50 and 99 for which data could be secured, and for which there were associated R&D activities. This sector covers a wide gamut of companies, including those in Motor vehicle repair, and wholesale and retail trade: NACE 50 -

Enterprise R&D Performance

In overall terms, R&D expenditure showed strong growth over the period 1999 – 2007, specifically in the modern high productivity and internationally trading sectors of the economy that contribute significantly to employment and value-added in the economy. R&D intensity within sectors also improved, but continues to lag behind international benchmarks.

The largest share of business expenditure on R&D in Ireland is accounted for by the manufacturing sector and predominantly in modern sectors of the economy, including medical devices, computers and engineering and chemicals and pharmaceuticals. The key findings from the sectors and subsectors profiled include:

- in the food and beverage sector which accounted for an estimated 5.6 % of GDP in 2007, 23% of firms were R&D active and business expenditure on R&D doubled between 1999 and 2007 to account for 5.5% of national BERD in 2007.
- in the wood, paper & publishing sector which accounted for an estimated 8.4 % of GDP in 2007, 3.7 % of firms were R&D active. While business expenditure on R&D increased between 1999 and 2007 the national share of BERD by this sector decreased during this time period and accounted for 0.7% of national BERD in 2007.
- in the chemical & pharmaceuticals sector which accounted for an estimated 13.1 % of GDP in 2007, 43% of firms were R&D active and business expenditure on R&D tripled between 1999 and 2007 to account for 19.8% of national BERD in 2007.
- in the materials and basic & fabricated metals sector which accounted for an estimated 1.6 % of GDP in 2007, 6% of firms were R&D active and business expenditure on R&D more than doubled between 1999 and 2007 to account for 4% of national BERD in 2007.
- in the machinery & equipment sector which accounted for an estimated 0.6 % of GDP in 2007, 26% of firms were R&D active and business expenditure on R&D more than doubled between 1999 and 2007 to account for 3.1% of national BERD in 2007.
- in the computers, electrical & electronics sector which accounted for an estimated 5.8 % of GDP in 2007, 59% of firms were R&D active and business expenditure on R&D increased between 1999 and 2007, but the share of national BERD decreased during this period from 36.8% to 21.8%.
- in the medical devices, precision and optical instruments, watches and clocks sector which accounted for an estimated 2.1% of GDP in 2007, 63% of firms were R&D active and business expenditure on R&D quadrupled between 1999 and 2007 to account for 9.5% of national BERD in 2007.
- in the software & other computer services sector which accounted for an estimated 1.7% of GDP in 2007, 6% of firms were R&D active and business expenditure on R&D more than doubled between 1999 and 2007 to account for 25.2% of national BERD in 2007.

52;Transport and other communications services: NACE 60-64 less 64.2; Telecommunications services: NACE 64.2; Financial Intermediation, NACE 65-67; Research and development services: NACE 73; All other business activities: NACE 74

- in the primary subsector which accounted for an estimated 2.0% of GDP in 2007, business expenditure on R&D declined to zero by 2007.
- in the 'other manufacturing' subsector which accounted for an estimated 1.7% of GDP in 2007, the business expenditure on R&D remained reasonably constant between 1999 and 2007 and accounted for 1.4% of total BERD in 2007.
- in the 'other services' sector (excluding the financial intermediation subsector) which accounted for an estimated 18% of GDP in 2007, 0.15% of firms were R&D active and business expenditure on R&D tripled between 2005 and 2007 to account for 7.4% of national BERD in 2007.
- in the financial intermediation subsector which accounted for an estimated 9.7% of GDP in 2007, business expenditure on R&D increased albeit in a somewhat fluctuating manner between 1999 and 2007 to account for 1.4% of national BERD in 2007.

Issues for Further Research

The analysis presented in this report is a complement to the Forfás/HEA report 'Profile of Public Research Activity in Ireland 1998-2006' and the Forfás/CSO Community Innovation Survey. Further analysis of the links between the data in these reports will be of benefit to understanding the overall dynamics within the innovation system, more broadly than an analysis of business expenditure on R&D on its own allows. In addition, some specific sectoral topics for further stakeholder consideration were identified based on a review of the data. These include:

- within the Manufacturing Category, the wood, paper & publishing sector stood out as having particularly low levels of BERD and FTE R&D personnel employed (at 0.7% and 0.5% respectively). Given that of the ten R&D active sectors reviewed, this sector had the third highest impact on GDP in 2007. There may be a basis for increased focus on tapping potential R&D and innovation opportunities to ensure sustainability/evolution and growth of this sector over time.
- the 'primary subsector' showed evidence of a declining R&D activity level which reached zero in 2007. Considering that this subsector ranked second in terms of employment impact in 2007 there is a need to better understand the BERD performance and potential within this sector.
- the 'other services' sector (excluding the financial intermediation subsector) was associated with 18% of GDP in 2007 and 28.4% employment. Following a step change in BERD between 2005 and 2007, the BERD in this sector was recorded at 7.4% (up from 2.5% in 2005), which brought Ireland into line with the 2005 investment level of a number of other countries, including Japan, France and Germany who recorded BERD of between 5-8% in 2005. However, there are a number of countries, including Spain, Norway, Poland, and Portugal, that invested in the range of 25-30 % of national BERD in this sector in 2005 and further analysis would be of benefit to identify the potential to further services related R&D growth in Ireland.

1. Introduction

Critical to the success of the Strategy for Science, Technology and Innovation (SSTI) is the utilisation of the outputs (people with world-class education, ideas, and knowledge) by enterprise, in order to deliver economic and employment impact. For the State to maintain appropriate targeted policies and investment in research and development (R&D) with a view to maximising the potential for economic and employment growth, it is essential that a clear picture of the R&D activities and the corresponding economic and employment impact of the enterprise sectors in Ireland is available so as to help inform policy decisions and State investments.

The purpose of this study was to collect and present a comprehensive profile of the economic contribution and employment impact of the R&D active enterprise sectors in Ireland, alongside a review of their engagement in R&D activities. For completeness, the R&D inactive enterprise sectors are also included. The output of this study is an evidence base of data for use by stakeholders to undertake subsequent analysis that can be used to inform enterprise and development agency strategies. The information and data will assist stakeholders in subsequent phases of national policy development and implementation to consider, *interalia*:

- the profile of enterprise R&D activity in Ireland, and mechanisms to exploit and highlight strengths so as to promote Ireland internationally as a base for research, development and innovation.
- how best to optimise State investment in enterprise R&D based on a focus of increasing Gross Domestic Product (GDP), employment and exports.

In addition, the output of this study will complement and fit within a broader programme of work on the effectiveness of the STI "ecosystem" in Ireland and complement other initiatives in the sector, such as the 'National Research Prioritisation Exercise', and the current project ongoing in Forfás to measure the economic impacts of public investment in research.

In Chapter 2, the enterprise categories and R&D active and inactive enterprise sectors as defined for this study are presented. The content provided in the sector profiles and the sources of data used for developing the profiles are also discussed. Finally the approach used for carrying out international comparisons of the R&D active sectors in terms of Value Added and Business Expenditure on R&D (BERD) for each R&D active sector is presented.

A summary outlining the salient data based messages from a review of: the enterprise categories; each of the R&D active sectors (and subsectors) profiled; and the R&D inactive sectors, is provided in Chapter 3. More detailed accounts are provided in Chapters 4, 5 and 6.

Key messages were developed based on a comparison of performance of enterprise categories and sectors and are presented in Chapter 7.

2. Definition of R&D Active and Inactive Enterprise Sectors and Categories

In this part of the report an explanatory note is provided by way of background as to how the sectors were identified and selected for profiling. The enterprise category to which each sector is associated is also documented. An outline of the content that is provided in each sector profile is discussed briefly, as is the methodology used for positioning each sector in an international context.

The data sources used in developing the sector profiles are discussed in this chapter and any deviation from these sources are referenced within the specific sector profile.

2.1 Defining the Key Research & Development Intensive Enterprise Sectors and Categories in Ireland

NACE codes (rev 1.1) are used to classify the economic activities that collectively contribute to make up a country's total economy. There are a series of key categories defined in the NACE classification system, within which a series of NACE codes are assigned.[3]

For the purposes of this exercise ten enterprise sectors were defined and selected as follows:

- The BERD by Irish based companies were reviewed according to NACE code.[4]
- Sectors were defined based on grouping specific NACE codes (in which enterprise was R&D active) that could be collectively defined under a super heading: in some cases, a single NACE code defined a sector, in other cases multiple NACE codes were used to define a sector.

The sectors defined for this analysis are listed below with their associated NACE codes. The sectors are listed under the NACE Category to which the NACE codes are associated in the NACE classification system.

NACE Manufacturing Category

- **Sector 1:** Food, Beverage & Tobacco[5]: NACE 15-16
- **Sector 2:** Wood, Paper & Publishing: NACE 20-22
- **Sector 3:** Chemicals & Pharmaceuticals: NACE 24
- **Sector 4:** Materials, Basic & Fabricated Metals: NACE 25-28
- **Sector 5:** Machinery & Equipment n.e.c.: NACE 29
- **Sector 6:** Computers, Electrical & Electronics: NACE 30-32

[3] The key Categories are : Primary; Manufacturing; Electricity, Gas and Water supply, Construction; Services
[4] See section 1 in Volume 2 of this report for a full list of NACE codes
[5] Whilst there is no real R&D investment in tobacco, BERD data is collected in a manner that food and beverage and tobacco are grouped together.

- **Sector 7:** Manufacture of Medical Devices, Precision and Optical Instruments, Watches and Clocks: NACE 33

NACE Real Estate & Renting & Business Activities Category

- **Sector 8:** Software & Other Computer Services: NACE 72

NACE Agricultural, Hunting & Forestry, Fishing and Manufacturing Categories

- **Sector 9:** Other Primary and Manufacturing Sectors:
  - Agriculture, Hunting, Forestry, Fishing NACE 1-10:
  - Other Manufacturing NACE : 16, 17, 18,19, 23, 34, 35, 36.1-36.6, 37[6]

NACE Wholesale and Retail Trade (repair of motor vehicles, motor cycles and personnel and household goods), Transport, Storage and Communication, Business Activities[7], Financial Intermediation, Categories

- **Sector 10:**Other Services (R&D Active)[8] :
  - Motor vehicle repair, and wholesale and retail trade: NACE 50 -52
  - Transport and other communications services: NACE 60-64 less 64.2
  - Telecommunications services[9]: NACE 64.2
  - **Financial Intermediation,[10] NACE 65-67**
  - Research and development services: NACE 73
  - All other business activities: NACE 74

The investment in R&D by enterprise in Ireland is predominantly by companies in the NACE classified Manufacturing Category. In this analysis, seven of the ten sectors and part of another sector (sector 9) were associated with the Manufacturing Category (NACE 15 – 37). Two of the sectors (sector 8 & 10) were associated with Services activities (NACE 50-99), and so the NACE Categories for sector 8 &10 can be considered to be sub headings of a broad Services Category. Part of Sector 9 (other primary) was associated with the Primary Category (NACE 1-10).

Based on a GDP of €190.6 bn in 2007, then companies that are associated with the ten sectors profiled accounted for of the order of 69% of the total GDP in 2007 (38 % in the Manufacturing

[6] NACE 1,2 are in the NACE agriculture, hunting and forestry category; NACE 5 is in the NACE fishing category; NACE 15-37 are in the NACE manufacturing category.
[7] The NACE code 72 is not included as this NACE code defines a full R&D intensive enterprise sector for Ireland, and is dealt with separately.
[8] The 'other services' sector is based on the NACE codes between 50 and 99 for which data could be secured, and for which there were associated R&D activities. This sector covers a wide gamut of companies.
[9] Zero BERD was reported by the telecommunications subsector in 2007, however, it is included as it sits within the economic data reported for transport and communication services (NACE 60-64).
[10] NACE 65-67 (financial intermediation) is a strong subsector in the 'other services' sector.

Category[11], 29 % in the Services Category[12] and 2% in the Primary Category[13]). In 2007, the ten sectors defined accounted for ~ 50% of employment in that year. However, these figures need to be modified to reflect that the primary subsector was R&D inactive in 2007, and so it is estimated that of the order of 67 % of GDP and 45% of employment were associated with the sectors that were R&D active in 2007.

In addition, the companies associated with the ten sectors defined accounted for 100% of the total BERD in 2007.

Companies associated with the following NACE codes were not included for detailed[14] profiling as there was minimal indication of BERD within these areas:

- Construction: NACE 45
- Electricity, Gas, & Water Supply: NACE 40-41
- Hotels & Restaurants: NACE 55
- Real Estate & Renting of Machinery and Equipment Without Operator and of Personal and Household Goods: NACE 70-71
- Public Administration/Defence: NACE 75
- Education: NACE 80
- Health & Social Work: NACE 85
- Other Activities: NACE 90
- Recreational, Cultural & Sporting Activities: NACE 92
- Sewage & Refuse Disposal/Membership of Organisations: NACE 90,91, 94-99

Together companies associated with these NACE codes accounted for in the region of 27 % of GDP in 2007 and in the region of 43% of employment.[15]

These R&D inactive sectors fit within the Construction Category (NACE 45), the Electricity, Gas & Water Supply Category (NACE 40-41), and within the broad Services Category (NACE 50-99).[16]

Including the contribution of the primary subsector in 2007, this leads to an estimated 29% of GDP and 49% of employment that was linked to enterprise that had no R&D activity in 2007.

[11] Calculated based on the ratio of the total Net Output of Sectors 1-7 & the manufacturing activities in Sector 9 to the value of GDP.
[12] Calculated based on the ratio of, the total Gross Value Added for Sectors 8 & 10, to the value of GDP.
[13] Calculated based on the ratio of the Gross Value Added of the Primary category within Sector 9, to the value of GDP.
[14] A brief economic profile and for each of these areas is included in Section 2 of Volume 2 of this report.
[15] The total of the profiled and non profiled sectors accounted for 96.2% of GDP in 2007 and 93.5% of employment. The discrepancy from 100% values can be accounted for by the fact that; a variety of data sources were used for profiling the employment; Net Output and GVA were intermixed, and 2005 (or 2006) figures were used in some instances when 2007 figures were not available.
[16] Data for the Construction Category was taken from the Quarterly National House Survey and National Accounts, data for the Services Category was taken from the CSO Annual Services Enquiry Data and the Quarterly National Household Survey and National Accounts, and data for the Electricity, Gas and Water Supply Category was taken from CSO Census of Industrial Production

The R&D inactivity of these sectors in Ireland is positioned in an international context in Chapter 6.

2.2 Information Provided in the R&D Active Sector Profiles

The following information is provided in Chapter 5 within the profile of each R&D active sector:[17]

1. A high level economic profile is presented for the time frame 1999-2007, and further pertinent points related to the role of indigenous and foreign owned companies within the sector are provided.[18]

   Unless otherwise specified within the text, economic profiles of sectors 1-7 were developed using data in Table 8 of The Central Statistics Office (CSO) databases on 'Census of Industrial Production'.

   The economic profiles of sector 8 and sector 10 were developed using the data available in the CSO Published Annual Services Inquiry Reports. Based on the information available, Turnover and Gross Value Added measures are reported in place of the Gross Output and Net Output data reported for the other sectors. The exception was the financial intermediation subsector in sector 10, for which employment figures were sourced from the Quarterly National Household Survey, and GVA figures from the National Accounts.

   For sector 9, the economic profile for the 'other manufacturing' subsector was developed using data in Table 8 of The Central Statistics Office (CSO) databases on 'Census of Industrial Production. The economic profile for the 'other primary' subsector was developed from data in Table 9.3 of the CSO 2007 Annual Report. Gross Value Added is reported in place of Net Output Data.

   The figures quoted for GDP and total national employment were based on data available in the CSOs report 'The *Statistical Yearbook of Ireland 2008*'.

2. A high level overview of the R&D activity level of each sector is provided over the time period 1999 -2007.[19] This concentrated primarily on € spend in each sector and the number of full time equivalent (FTE) R&D employees in each sector. Further pertinent points in relation to the activities of Irish owned and foreign owned companies within the sector are also provided. Unless otherwise specified within the text, data used for generating the R&D profiles of all sectors was developed using data from the Business Expenditure on R&D (BERD) reports[20].

   It is noted that there was a change in the manner in which the 2007 BERD data was classified relative to the classification of BERD data from previous years. However, for the purpose of this exercise the 2007 data was re-coded according to the previous classification scheme, and so direct time series comparisons can be made.

[17] A Glossary of Terms is provided in Annex 1.

[18] A full list of economic facts and figures is available for each sector in Section 2 of Volume 2 of this report.

[19] A full list of facts and figures for BERD for each sector is available in Section 3 of Volume 2 of this report.

[20] The 2007/2008 Business Expenditure Report was published by The CSO in 2009. Previous to this Business Expenditure Reports were published by Forfás.

It is noted that the number of active R&D firms (as estimated using the BERD data) is not an absolutely definitive number of R&D active firms in the country. However, the BERD figures have been used so as to provide a guiding estimate of the proportion of R&D active firms in each sector.

The R&D Government Grants reported for each sector are based on the values reported by the companies.[21]

3. An international comparison of Ireland's position based on the measures of BERD and Value Added is presented. For this purpose, specialisation indices were calculated for BERD and Value Added for eight countries, including Ireland. The indices are calculated according to the formula:

$$\text{Specialisation Index 'i'} = (X_{i,\ \text{Ireland}} / \Sigma X_{\text{Ireland}}) / (X_{i,\ \text{reference}} / \Sigma X_{\text{reference}})$$

Where

Specialisation Index 'i' = specialisation index for BERD in sector i

$X_{i,\ \text{Ireland}}$ = BERD spend in sector i for Ireland

$\Sigma X_{\text{Ireland}}$ = Total BERD spend in Ireland

$X_{i,\ \text{reference}}$ = BERD spend in sector i, by all reference countries

$\Sigma X_{\text{reference}}$ = Total BERD spend by all references countries

Ideally the reference countries would include all industrial countries, however, the required data was available for eight countries[22] in total (in 2005) for all the sectors of interest, and so these eight countries formed the base for the reference variables.

On the basis of the index, a country is defined as being specialised in BERD if its share of BERD is higher than the average of the reference countries.

If the specialisation index > 1, then Ireland is specialised in BERD in this sector.

If the specialisation index < 1 then Ireland is not specialised in BERD in this sector.

Specialisation indices for Value Added were also developed for each sector. The data for Value Added and BERD for each country have been taken from OECD databases for 2005.[23]

[21] A comparison between the Government funding reported by companies (per sector) and the Government funding by enterprise agencies showed that 5 of the top 6 sectors achieved the same relative ranking in terms of funding, regardless of the mechanism for developing the funding ranking list (as can be seen in Section 4 of Volume 2 of this report). It is noted that the criteria for classification of company activities to specific NACE sectors may vary somewhat between the CSO and enterprise agencies.

[22] The eight countries used were: Greece, Germany, France, Belgium, The Netherlands, Spain, Italy, Ireland.

[23] Value Added data was taken from the OECD STAN Database for Structural Analysis and the BERD data was taken from the OECD Business enterprise R&D expenditure by industry and by source of funds Database. Both databases were available through the OECD.stat website.

3. Key Messages: Enterprise Categories and Sector Profiles

3.1 Key Messages from Enterprise Categories Data

- Two thirds of the BERD spend was in the Manufacturing Category and this underpinned 10.5% of employment and close to 40% of GDP, in 2007.
- Taking into consideration the whole of the Services Category, then two thirds of national employment, and half of GDP was underpinned by one third of the total BERD. However, a more detailed view of the activity of sectors within the Services Category revealed that 75% of the BERD investment associated with this category was in the software and other computer services, for which the contribution to GDP and employment was only 1.7% and 1.8% respectively.
- The number of FTE R&D personnel employed in the Services and Manufacturing Category was similar despite the lower investment in the Services Category. This is likely a consequence of the higher capital investment required in the Manufacturing Category.
- When all of the R&D inactive Industry Categories (or sectors within categories) were also taken into consideration, then of the order of 29% of GDP and 49% of employment in 2007 was associated with R&D inactive industries.[24]

3.2 Key Messages from R&D Active Enterprise Sectors Data

It is noted that in some cases 2007 data was not available for Net Output/ GVA, and in this case the 2005 figure was used as the latest available data point.

3.2.1 Food & Beverage

- With a Net Output of 5.6% of GDP, the relative contribution to the total economy was smaller in 2007 than in 1999, but Net Output as a proportion of the Manufacturing Category had remained constant at ~ 15.5%.
- 93% of the 696 firms in this sector were Irish owned in 2007 and these companies accounted for 26% of the Net Output.
- This sector has a high intensity of export sales (63% of Gross Output in 2005).
- Employment was 2 % of national employment (42,875 people) in 2007 - lower than in 1999. However, total employment impacts are far reaching from this sector- estimated in the region of 230,000 people.
- An estimated 23% of firms in this sector were R&D active in 2007.
- BERD in the food & beverage sector doubled between 1999 and 2007 and accounted for 5.5% of national BERD in 2007.

[24] It is noted that while the Primary Category/ subsector was defined as an R&D active sector, there was zero R&D activity measured in 2007 in this sector, and so economic contribution of this sector is included in the 2007 economic contribution of the R&D inactive sectors.

- Indigenous companies accounted for 58% of BERD in the food and beverage sector in 2007 and 11.5% of total indigenous BERD.
- 657 full time equivalent (FTE) R&D personnel were employed in this sector in 2007 – accounting for 6% of total national FTE R&D personnel.
- In 2005 Ireland demonstrated a specialisation in the food & beverage sector[25], based on BERD and Value Added measures.
- To maximise the potential for Ireland in this sector, further efforts must be made to increase the return on investment in the indigenous sector towards improving Value Added, and foreign owned companies should be encouraged to continue increasing their levels of BERD so as to continue to drive the high levels of Value Added being achieved.

3.2.2 Wood, Paper & Publishing

- With a Net Output of 8.4% of GDP in 2007, the relative contribution of this sector increased from 8.0% of GDP in 1999.
- 94 % of the 1087 firms in 2007 were Irish owned, and indigenous companies accounted for 13% of Net Output in 2007.
- The publishing subsector dominates the Value Added (86% of total in 2005), exports (79% of total in 2005), and employment (60 % of total in 2005) – primarily publishing of software products.
- Employment decreased to 26,248 in 2007, which was 1.2 % of the total national employment (a decrease from the 1.9% level in 1999).
- An estimated 3.7% of firms in this sector were R&D active in 2007.
- Indigenous companies accounted for 100% of BERD in 2007.
- The absolute BERD € value increased between 1999 and 2007, but the share of national BERD decreased from 1.2% in 1999, to 0.7 % in 2007.
- The number of FTE R&D personnel decreased from 113 in 1999 to 59 in 2007, representing a share of 0.5% of the total national FTE R&D personnel in 2007 (a decrease from 1.4% in 1999).
- In 2005 Ireland demonstrated a specialisation in the wood, paper & publishing sector, based on BERD and Value Added measures - the publishing sub sector dominated Value Added, but the wood subsector dominated BERD.

3.2.3 Chemical & Pharmaceuticals

- With a Net Output of 13.1 % of GDP, the relative contribution to the total economy was smaller in 2007 than in 1999 (16.6%), but Net Output as a proportion of the Manufacturing Category remained at ~ 38 ± 3 % between 1999 and 2007.
- Net Output was dominated by foreign owned firms in 2007.

[25] Relative to the eight countries used for the reference base: Greece, Germany, France, Belgium, The Netherlands, Spain, Italy, Ireland.

- Employment has been reasonably static at ~ 24,000 since 2001, and this sector accounted for 1.1 % of national employment in 2007 (a decrease from the 1.4% share in 1999).
- An estimated 43% of firms in this sector were R&D active in 2007.
- BERD in the chemical & pharmaceutical sector tripled in € terms between 1999 and 2007, and accounted for 19.8% of national BERD in 2007 (an increase from the 13.8% share of BERD in 1999).
- 90% of BERD was by foreign owned companies in 2007.
- The number of FTE R&D personnel increased by 50% between 1999 and 2007 to reach 999 FTE in this sector– accounting for 9.1% of total national FTE R&D personnel (an increase from the 7.9% share in 1999).
- In 2005 Ireland demonstrated a specialisation in the chemical & pharmaceutical sector, based on BERD and Value Added measures.

3.2.4 Materials and Basic & Fabricated Metals

- With a Net Output of 1.6 % of GDP, the relative contribution to the total economy was smaller in 2007 than in 1999 (2.2%). The Net Output as a proportion of the Manufacturing Category decreased slightly from 4.7% to 4.3% between 1999 and 2007.
- 90% of firms were Irish owned in 2007 and these companies accounted for 78% of Net Output in 2007.
- The total number of people employed in this sector grew by 6% between 1999 and 2007, although the share of national employment fell from 2.3% in 1999 to 1.9% in 2007.
- An estimated 6% of firms in this sector were R&D active in 2007.
- BERD in this sector more than doubled in € terms between 1999 and 2007, and accounted for 4% of national BERD in 2007 (an increase from the 3.6% share in 1999).
- 64% of BERD was by foreign owned companies in 2007.
- The number of FTE R&D personnel increased by 50% between 1999 and 2007, to reach 525 FTE in this sector – accounting for 4.8% of total national FTE R&D personnel (an increase from the 4.1% share in 1999).
- In 2005 Ireland was not specialised in this sector based on BERD and Value Added measures.

3.2.5. Machinery & Equipment

- With a Net Output of 0.6% of GDP, the relative contribution to the total economy was smaller in 2007 than in 1999, but Net Output as a proportion of the Manufacturing Category fluctuated in the range 1.3%-1.8% during this time frame.
- 85% of the 362 firms in this sector were Irish owned in 2007 and accounted for 40% of the Net Output.
- Exports as a % of Gross Output grew from 72% to 77% between 1999 and 2007.

- Employment was 0.6 % of national employment (12,383) people in 2007 (lower than the 0.9 % share in 1999).
- An estimated 26% of firms in this sector were R&D active in 2007.
- BERD in the machinery & equipment more than doubled between 1999 and 2007 and accounted for 3.1% of national BERD in 2007.
- Indigenous companies accounted for 63% of BERD in this sector in 2007.
- The number of FTE R&D personnel fluctuated between 1999 and 2007, with 396 FTE in 2007 representing 3.6% of the total national FTE R&D personnel.
- In 2005 Ireland did not demonstrate specialisation in the machinery & equipment sector relative to other countries considered, based on BERD and Value Added measures.

3.2.6 Computers, Electrical & Electronics

- With a Net Output of 5.8 % of GDP, the relative contribution to the total economy was smaller in 2005 than in 1999 (8.8%), and Net Output as a proportion of the Manufacturing Category decreased from 18.7% in 1999 to 14.7% in 2005.
- 95.4% of Net Output was accounted for by foreign owned companies in 2003.
- Employment in this sector decreased by 42% (to 27,500) between 1999 and 2007. In 2007, this accounted for 1.3% of total national employment (a drop from the 3% share in 1999).
- An estimated 59% of firms in this sector were R&D active in 2007.
- BERD in the computers, electrical & electronics has shown an overall increase in comparing the € investment in 1999 and 2007. However, the share of national BERD by this sector has decreased from 36.8% in 1999 to 21.8 % in 2007.
- 87% of BERD was by foreign owned companies in 2007.
- The number of FTE R&D personnel employed in this sector in 2007 was less than the number in 1999. In 2007, 2086 FTE R&D personnel were employed representing 19% of the total national FTE R&D personnel (a decrease from the 29% share in 1999).
- In 2005 Ireland demonstrated a specialisation in the computers, electrical & electronics sector, based on BERD and Value Added measures.

3.2.7 Medical Devices, Precision and Optical Instruments, Watches and Clocks

- With a Net Output of 2.1 % of GDP, the relative contribution to the total economy was higher in 2005 than in 1999 (1.6%), and Net Output as a proportion of the Manufacturing Category increased from 3.4 % in 1999 to 5.4% in 2005.
- There was a 56% increase in employment between 1999 and 2007. This sector accounted for 1.2 % of national employment in 2007 (an increase from the 1% share in 1999).
- An estimated 63% of firms in this sector were R&D active in 2007.
- BERD in medical devices, optical and other instruments sector has quadrupled in € terms between 1999 and 2007, and accounted for 9.5% of national BERD in 2007.
- 84% of BERD was by foreign owned companies in 2007.

- The number of FTE R&D personnel increased by over 90% between 1999 and 2007. This sector accounted for 7.8% of total national FTE R&D personnel in 2007(an increase from the 5.4% share in 1999).
- In 2005 Ireland demonstrated a specialisation in this sector, based on BERD and Value Added measures.

3.2.8 Software & Other Computer Services

- With a Gross Value Added of 1.7 % of GDP, the relative contribution to the total economy was greater in 2007 than in 1999 (1.3%). The Gross Value Added as a proportion of the total Services Category increased from 6.6% in 1999 to 7.0% in 2007.
- Employment doubled in this sector between 1999 and 2007. In 2007, employment in this sector accounted for 1.8 % of national employment in 2007 (an increase from the 1.2% share in 1999).
- An estimated 6% of firms in this sector were R&D active in 2007.
- BERD in the software and other computer services sector has more than doubled in € terms between 1999 and 2007, and accounted for 25.2% of national BERD in 2007.
- 65% of BERD was by foreign owned companies in 2007.
- The number of FTE R&D personnel increased by close to 50% between 1999 and 2007 to reach 3,807 FTE in this sector in 2007– accounting for 34.8% of total national FTE R&D personnel.
- In 2005 Ireland demonstrated a specialisation in this sector, based on BERD and Value Added measures.

3.2.9 Other Primary & Manufacturing

3.2.9.1 Other Primary

- With the Gross Value Added of 2.0 % of GDP, the relative contribution to the total economy was smaller in 2007 than in 1999 (3.2%).
- Employment declined by 16.3% over the period between 1999 and 2007. Employment in this sector accounted for 5.4 % of national employment in 2007 (a decrease from the 8.6% share in 1999).
- BERD in the primary manufacturing sector decreased to almost zero in 2007.
- The number of FTE R&D personnel decreased to zero in 2007.

3.2.9.2 Other Manufacturing

- The Net Output this sector accounted for 1.7% of GDP in 1999 and this share decreased to 0.8% in 2005.
- Employment declined by 26% over the period between 1999 and 2007. Employment in this sector accounted for 1.2 % of national employment in 2007 (a decrease from the 2.1% share in 1999).

- BERD in the 'other manufacturing' subsector accounted for 2.8% of total BERD in 1999, and this decreased to 1.4% in 2007.
- The number of FTE R&D personnel decreased between 1999 and 2007, and this sector accounted for 2.1% of the total share of FTE R&D personnel in 2007 (a decrease from the 4.3% share in 1999).

3.2.10 Other Services

3.2.10.1 Other Services (excluding Financial intermediation)

- With a Gross Value Added of 18% of GDP, the relative contribution to the total economy was greater in 2007 than in 1999 (16.1%).
- Employment in this sector increased by 70% between 1999 and 2007. In 2007, employment in this sector accounted for 28.4 % of national employment (an increase from the 22.1% share in 1999).
- An estimated 0.15% of firms in this sector (61,583) were R&D active in 2007.
- BERD in this sector tripled between 2005 and 2007 and accounted for 7.4% of national BERD in 2007 (an increase from 3.4% in 1999).
- BERD was evenly split between indigenous and foreign owned companies in 2007.
- The number of FTE R&D personnel increased three fold between 2005 and 2007. The sector accounted for 9.8% of total national FTE R&D personnel in 2007 (an increase from the 3.9% share in 1999).
- Indigenous companies accounted for 66% of R&D employment in this sector in 2007.
- In 2005 Ireland did not demonstrate a specialisation in this sector, based on BERD and Value Added measures.

3.2.10.2 Financial intermediation

- With a Gross Value Added of 9.7 % of GDP, the relative contribution to the total economy was greater in 2007 than in 1999 (6.2%).
- Employment in this sector increased by 38% between 1999 and 2007. In 2007, employment in this sector accounted for 4.2 % of national employment (an increase from the 3.8% share in 1999).
- BERD has increased in a fluctuating manner between 1999 and 2007. Overall BERD in 2007 was almost a factor of 6 times its level in 1999. BERD in this sector accounted for 1.4% of national BERD in 2007 (an increase from 0.5% in 1999).
- The number of FTE R&D personnel increased almost three fold between 1999 and 2007. The sector accounted for 1.9% of total national FTE R&D personnel in 2007 (an increase from the 0.9% share in 1999).

- In 2005 Ireland demonstrated a specialisation in this sector, based on BERD and Value Added measures.

3.3 Key Messages from R&D Inactive Industry Categories and Sector Profile Data

- Of the five categories used to describe the enterprise activity in Ireland: Construction, Electricity, Gas & Water Supply, Primary, Manufacturing, and Services; two of these – Construction and Electricity, Gas & Water Supply - are classified as R&D inactive categories. These R&D inactive categories accounted for 10% of GDP and 12.6% of employment in 2007.The primary category was classified as R&D active based on R&D activity recorded prior to 2007, however in 2007 the R&D activity level was reduced to zero.
- The lack of R&D activity in the Construction, and Electricity, Gas & Water Supply and Primary Categories are not internationally unique, with most of the countries reviewed indicating less than 2% of BERD activity in these categories.
- Within the Services Category, the R&D inactive sectors for which data was available (NACE 55, 75-79) indicated that Ireland's lack of BERD spend in these areas is not internationally unique, with most of the countries reviewed indicating less than 2% of BERD spend on these sectors.
- In total, in 2007, R&D inactive sectors/categories accounted for in the region of 29 % of GDP and in the region of 49% of employment (this includes the economic and employment contribution of the primary subsector).[26]

[26] The total of the profiled and non profiled sectors accounted for 96.2% of GDP in 2007 and 93.5% of employment. The discrepancy from 100% values can be accounted for by the fact that; a variety of data sources were used for profiling the employment; Net Output and GVA were intermixed, and 2005 (or 2006) figures were used in some instances when 2007 figures were not available.

4. Enterprise Category Profiles

The five Categories that collectively make up the majority of the Irish economy are defined as:

- Primary (agriculture, fishing and forestry):NACE 1-10
- Manufacturing Category: NACE 15 -37
- Electricity, Gas & Water Supply: NACE 40-41
- Construction Category: NACE 45
- Services Category: NACE 50-99

The contribution to GDP and to national employment by the enterprise sectors within the five categories is shown in Fig 1 (it is noted that in some cases a category and sector are defined as one and the same). Based on the R&D activity of the various enterprise sectors a proportion of the economy is deemed as R&D active and a proportion is deemed as R&D inactive The 'other primary' sector appears as an anomaly in the representation in Fig. 1 as it is deemed R&D active, but there is zero percent of national BERD or R&D personnel associated with it. This anomaly is a consequence of the 'other primary' sector being classified as an R&D active sector in the years previous to 2007.

The Manufacturing Category accounted for 38% of GDP in 2007 and 10.5% of national employment. All of the sectors within this category were engaged in some level of R&D activity, and overall this category accounted for 65.8% of BERD and 46.5% of FTE R&D personnel.

Overall the Services Category accounted for 46.2% of GDP and 65% of employment in 2007. The R&D active sectors within this category accounted for 29.4% of GDP and 34.4% of employment and were associated with 34% of BERD and 46.5 % of FTE R&D personnel. Based on the data presented in Fig. 1 there is also a series of enterprise sectors within the Services Category that are not R&D active and these industries were associated with 16.8 % of GDP and 30.6% of employment in 2007.

The Primary Category was classified as R&D active in 2007. It accounted for 2.0% of GDP and 5.4% on employment. However, there was zero BERD and FTE R&D personnel recorded for this category in 2007 (although some level of R&D activity was recorded in years previous to this).

The Electricity, Gas & Water Supply Category and the Construction Category were R&D inactive in 2007 and collectively accounted for 10% of GDP and 12.6% of employment.

In the region of 29% of GDP and 49% of employment was associated with R&D inactive sectors in total in 2007 (including the contribution from the Primary Category).

In the region of 67% of GDP and 45% of employment was associated with R&D active sectors in total in 2007 (excluding the contribution from the Primary Category).

It is noted that based on the figures used, the total contribution to GDP accounted for in 2007, was 96.2% and for employment was 93.5%.

Figure 1: Representation of the contribution to the economy and subsequent associated level of R&D activity in 2007 according to enterprise category and enterprise sector for 2007.

Categories	Sector 2007	% of GDP	% of national employment
Services: 46.2% of GDP and 65.0% of National empolyment	Other Services	27.70%	32.60%
	Software & Other Computer Services	1.70%	1.80%
	Hotels & Restaurants	1.90%	7.20%
	Public administration/ Defence	3.80%	5.10%
	Education	3.80%	6.60%
	Health & Social work	4.70%	7.60%
	Recreational, Cultural & Sporting	0.70%	1.40%
	Other Community, Social & Personal	0.30%	1.10%
	Sewage & Refuse Disposal/ Membership Organisations	1.60%	1.60%
Manufacturing: 38.0% of GDP and 10.5% of National employment	Chemical & Pharmaceuticals	13.10%	1.10%
	Wood, Paper & Publishing	8.40%	1.20%
	Computers, Electrical & Electronics	5.80%	1.30%
	Food & Beverage	5.60%	2.00%
	Other Manufacturing	0.80%	1.20%
	Medical Devices, Precision and Optical	2.10%	1.20%
	Materials and Basic & Fabricated Metals	1.60%	1.90%
	Machinery & Equipment	0.60%	0.60%
Primary: 2% of GDP and 5.4% of National Employment	Other Primary	2.00%	5.40%
Electricity,Gas and Water Supply: 1.5% of GDP and 0.5% of National employment	Electricity, Gas & Water Supply	1.50%	0.50%
Construction: 8.5% of GDP and 12.1% of National employment	Construction	8.50%	12.10%

R&D Active Services Sectors: 29.4% of GDP and 34.4% of National employment

R&D Inactive Services Sectors: 16.8% of GDP and 30.6% of National employment

R&D Active Manufacturing Sectors: 38.0% of GDP and 10.5% of National employment

R&D Active Primary Sectors: 2.0 % of GDP and 5.4 % of National employment

R&D Inactive: 1.5% of GDP and 0.5% of National employment

R&D Inactive: 8.5% of GDP and 12.1% of National employment

R&D Active Services Sectors 2007	% of national BERD	% of national FTE R&D personnel
Other Services	8.80%	11.70%
Software & Other Computer Services	25.20%	34.80%

R&D Active Manufacturing Sectors 2007	% of national BERD	% of national FTE R&D personnel
Chemical & Pharmaceuticals	19.80%	9.10%
Wood, Paper & Publishing	0.70%	0.50%
Computers, Electrical & Electronics	21.80%	19.00%
Food & Beverage	5.50%	6.00%
Other Manufacturing	1.40%	2.10%
Medical Devices, Precision and Optical	9.50%	7.80%
Materials and Basic & Fabricated Metals	4.00%	4.80%
Machinery & Equipment	3.10%	3.60%

R&D Active Primary Sector 2007	% of national BERD	% of national FTE R&D personnel
Other Primary	0.00%	0.00%

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[27] Sources of Data for the figures represented in Fig. 1 are provided in Section 2 of Volume 2 of this report.

5. R&D Active Enterprise Sector Profiles

This section presents an economic and R&D profiled for each of the enterprise sectors defined in B1. It is noted at the onset, that in some cases 2007 data was not available for Net Output/GVA and so the latest available data (typically 2005) is subsequently used as the comparison point when 2007 data from all enterprise sectors are being compared.

5.1 Food & Beverage Sector: NACE 15-16

5.1.1 Economic Profile

Table 1: Key economic facts and figures for the food & beverage sector: NACE 15-16. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	806	810	781	637	696
Total Employment	47,513	50,079	49,030	43,239	42,875
Total Employment/Total National Employment	3.0%	2.9%	2.7%	2.2%	2.0%
Gross Output	14,233,611	16,773,329	17,803,268	18,046,566	19,855,174
Net Output	6,592,657	8,091,952	9,393,901	10,057,551	10,763,132
Net Output/GDP	7.3%	6.9%	6.7%	6.2%	5.6%

Activities of companies in this sector include the production, processing and preserving of food and dairy products and the manufacture of beverages and tobacco.

In 1999, the food & beverage sector in Ireland was represented by 806 firms, of which 730 (90%) were Irish owned. During the period 1999 to 2007 there was an overall fall in the number of firms in this sector to 696. The drop in proportionate terms was more dramatic in the foreign company category, which, by 2007, showed a 43% decline in the number of firms based in Ireland, relative to the 1999 figure. The corresponding decline for Irish owned firms was approximately 11 % over this time frame.

The Net Output of the food & beverage sector accounted for 7.3% of the GDP in 1999 and this share shrank over the years so that by 2007 it accounted for 5.6 % of GDP. However, as a proportion of the manufacturing industries, the Net Output of the food & beverage sector remained reasonably constant between 1999 and 2007 maintaining a share of the total Manufacturing Category[28] Net Output of 15.5 ± 0.6 % each year during this time period.

[28] Manufacturing Category includes NACE codes 15-37

Gross and Net Output continued to grow on a yearly basis in this sector. In 2007, Gross Output was split nearly evenly in terms of contribution from foreign and Irish owned firms. However, the indigenous companies accounted for only 26% of the Net Output for this sector, whilst the foreign companies account for 74%.

Exports as a % of Gross Output also continued to grow in the food and beverage sector from 1999 levels and in 2005 accounted for more than 60% of Gross Output. Whilst this ratio was higher for foreign owned companies than Irish owned companies, the indigenous companies also export at a significant level of gross output (40% in 2003[29]), indicating the importance of this sector in terms of export sales. However, in more recent times the export performance has been weakened due primarily to adverse movements of Sterling and difficult demand conditions.[30]

Total employment in the food & beverage sector over the period 1999-2007 peaked in 2001, and subsequently declined, so that the total employment levels in 2007 were below that of 1999. The overall drop in the employment figure was primarily driven by the reduction in employment by foreign owned firms. In 2007, indigenous companies accounted for 80% of employment in this sector and foreign owned companies accounted for 20% of the employment (despite the fact that foreign owned companies accounted for only 6% of the total number of firms in 2007).

The contribution of the food & beverage sector in relation to its share of national employment has shown a decline on a yearly basis, both in the indigenous and foreign owned company categories, over the time period 1999-2007. In 2007, the food & beverage sector was estimated to provide 2% of the total national employment, a 1% point reduction relative to its share in 1999. It is noted that this significant reduction was primarily due to growth in employment in other sectors rather than the decline in absolute numbers of employees in the food & beverage sector.

The food & beverage sector is estimated to generate indirect employment of approximately 60,000 associated with transport, distribution, warehousing, engineering supplies and other services). The food and beverage sector also supports some 120, 000 farmers, thus the total employment impact that can be attributed to this sector is in the region of 230,000,[31] and as such is a very important sector in the economy.

Further importance is attached to the food & beverage sector because it is regionally spread. It is also the sector with the greatest degree of integration on an all-island basis which offers opportunity for collaboration.[32] Furthermore the sector is dominated by indigenous companies and thus does not have a significant repatriation of profits abroad and as a sector it has a high utilisation of domestically sourced raw materials and inputs.

[29] Latest figure available
[30] Driving Export Growth, Statement of Sectoral Competitiveness, National Competitiveness Council, Dec 2009
[31] Future Skills Requirements of the Food and Beverage Sector, Expert Group on Future Skills Needs, Nov 2009
[32] Driving Export Growth, Statement of Sectoral Competitiveness, National Competitiveness Council, Dec 2009

5.1.2 Research and Development Activity

An estimated 23% of companies in the food & beverage sector had some R&D activity in 2007. The food and beverage sector accounted for 5.7 % of the BERD in 1999. This share of national BERD dropped slightly over time, but by 2007 the share of BERD in this sector had been restored to its 1999 levels. In absolute terms, the investment in BERD in 2007 was more than double that of the 1999 levels. Both indigenous and foreign owned companies showed similar trends in terms of absolute € investment in R&D with little growth in R&D investment from 1999 to 2003, followed by a doubling of investment from 2003 to 2007.

In absolute € terms the indigenous companies invested more per year over the time frame 1999 -2007 than their foreign counterparts, with 58% of total BERD in the food & beverage sector in 2007 coming from the Irish companies.

Table 2: Key R&D facts and figures for the food & beverage sector. NACE 15-16. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	44,086	46,300	41,379	61,641	88,186
Share of National BERD	5.7%	5.6%	3.8%	4.6%	5.5%
Total FTE R&D Personnel	531	511	305	573	657
Share of National FTE R&D Personnel	6.5%	5.9%	3.3%	5.6%	6.0%
Total R&D Spend/Net Output	0.7%	0.6%	0.4%	0.6%	0.8%

The food & beverage sector accounted for between 8-10% of the BERD by Irish companies between 1999 and 2005, with this increasing slightly to 11.5 % in 2007. In 1999 the BERD spend by foreign owned companies in the food & beverage sector accounted for 3.5% of BERD from foreign companies. This share of BERD fell off in the following years but share was regained in 2007 to a level of 3.2%.

Large[33] companies were the dominant size category for investment in R&D in the food and beverage sector, and accounted for 57.3% of BERD in 2005. This was true in both the indigenous and foreign owned companies, with large firms accounting for 48% and 72.4 % of the respective indigenous and foreign owned portions of BERD in the food & beverage sector.[34]

[33] See the Glossary of Terms in Annex 1 for definition of small, medium and large enterprises.
[34] No data was available for the breakdown of firm size for indigenous and foreign owned firms in 2007.

Medium companies also accounted for a sizeable portion of the BERD spend in 2005: 29.5 % in total, 25.4% in the foreign owned category and 32% in the indigenous category. Small Irish companies also invested in R&D, with 20% of the indigenous BERD in 2005 coming from this class of firm size.

The number of full time equivalent (FTE) R&D personnel decreased between 1999 and 2003 and then the numbers of FTE R&D personnel grew from 2003 to 2007, at which point the 1999 levels were surpassed. The data indicated some level of reduction in the proportion of technical staff and some increase in the proportion of non-PhD researchers over the time period.

In 2007, companies in the food & beverage sector received €7.4 million in support for R&D through Government grants[35]. This was estimated as 8.4% of total spend on in-house R&D in this sector. In absolute € terms, the food & beverage sector received the 5th largest sum of money for R&D by way of Government grants in 2007.

Experimental development is the dominant research type that companies in the food and beverage sector have engaged in.

5.1.3 Importance of the Food & Beverage Sector for Ireland in an International Context

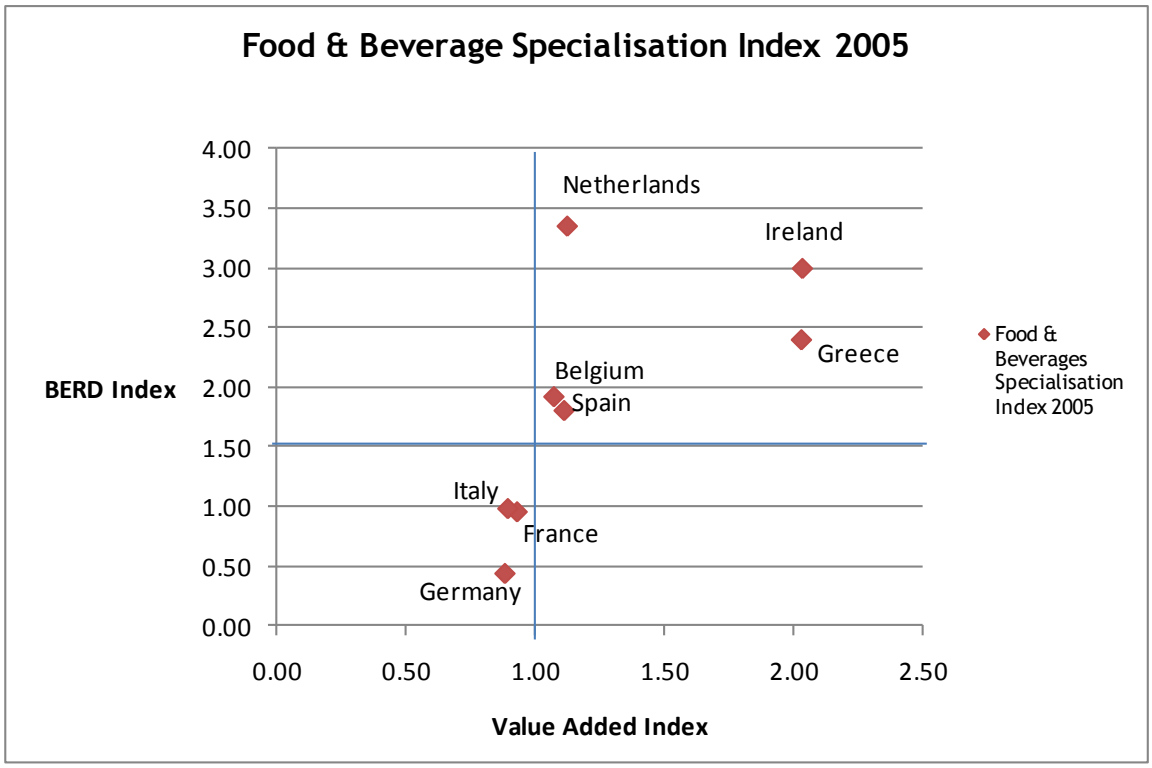
In Fig. 2 the indices for BERD and Value Added, based on 2005 values for the food & beverage sector, are plotted for a number of countries. Of the eight countries considered, three countries were shown not to be specialised in the food & beverage sector, either in BERD or Value Added, and all other countries showed some level of specialisation in both fields. Based on an interpretation of these two sets of specialisation indices, the data suggests that Ireland is well positioned in this sector; in 2005 it had one of the highest specialisations in Value Added and coupled with a specialisation in BERD, the Value Added would have been expected to be sustained in the following years at a minimum or grow[36] (as was seen to happen in 2007). The Netherlands had the highest indices for BERD in 2005, however did not show a corresponding high indices for Value Added.

Whilst not included in the data shown in Fig. 2, other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[37] Ireland still appeared as a strong performer when other countries were considered, in particular relevant to Finland, who spent nearly 8% of national BERD activities in this sector but who held less than 2% of the share of national Value Added through this sector.

However, despite the appearance of specialisation in this sector for Ireland in 2005, (based on the two measures considered) when the characteristics of the indigenous and foreign owned companies in this sector were decoupled, further insights were gained. It was the foreign owned enterprise that drove the high levels of Value Added recorded, and it was the indigenous sector that drove the comparatively high investment in BERD in the food & beverage sector.

[35] Based on data reported by enterprise in the BERD survey.
[36] Investment in BERD would be expected to help maintain or grow the Value Added.
[37] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Portugal, Finland, Czech Republic, Austria.

Figure 2: BERD and Value Added Indices for the food & beverage sector in 2005, for a range of European countries.



5.2 Wood, Paper & Publishing Sector: NACE 20-22

5.2.1 Economic Profile

Table 3: Key economic facts and figures for the wood, paper & publishing sector: NACE 20-22. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	839	936	1014	882	1087
Total Employment	29,785	30,230	27,890	25,779	26,248
Total Employment/Total National Employment	1.9%	1.8%	1.6%	1.3%	1.2%
Gross Output	9,092,688	10,820,559	12,131,022	14,722,465	18,302,148
Net Output	7,275,983	8,813,000	9,709,855	12,636,595	15,937,508
Net Output/GDP	8.0%	7.5%	7.0%	7.8%	8.4%

Activities of companies in this sector includes manufacture of wooden products, manufacture of pulp, paper and paper products and publishing works in formats including traditional print form, audio tape, CD-ROM or on-line. As will be discussed in the subsequent text, it is the high level of activities associated with publishing of software that make this overall sector a particularly strong contributor to GDP.

In 1999, the wood, paper & publishing sector in Ireland was represented by 839 firms, of which 786 (94%) were Irish owned. During the period 1999 to 2007 there was an overall growth in the number of firms in this sector to 1,087. This growth was driven primarily by an increase in the number of Irish owned firms in this sector. The proportion of Irish owned firms remained at 94% in 2007.

In comparison to other manufacturing industries, the wood and paper & publishing sector is notable for having a large number of firms, with many of these classified as 'small' in size.

Gross and Net Output continued to grow on a yearly basis in this sector with both measures doubling in value between 1999 and 2007. In 2007, indigenous companies accounted for 18% of Gross output and 13% of Net Output, whilst foreign companies accounted for 82% of Gross Output and 87% of Net Output.

The Net Output of the wood, paper & publishing sector accounted for 8.0% of the GDP in 1999. The sector lost share of GDP over the following years, but regained share by 2007 to show an overall increase to 8.4 %. Both Irish owned companies and foreign owned companies showed a decrease in the Net Output share of GDP between 1999 and 2003. The decline in share from 1.5% in 1999 continued until 2005 for Irish owned companies, reaching 0.8 %, after which the Net Output share of GDP increased to 1.1 %. For foreign owned companies, the Net Output share of GDP showed a recovery after 2003, and by 2007 a Net Output per GDP of 7.3% was recorded, despite the fact that only 6% of the total number of firms in this sector were foreign owned in 2007.

As a proportion of the Manufacturing Category, the Net Output of the wood, paper & publishing sector increased its share by nearly 6 percentage points during the period 1999 to 2007 to reach 23%. This increase in share was driven by the activity of the foreign owned companies who accounted for 20.1% of the Net Output of the Manufacturing Category in 2007.

High levels of Gross Outputs exported were recorded in the wood, paper & publishing sector in 1999, and the level of Gross Outputs exported as a % of Gross Output was seen to climb from 73.5% in 1999 to 82% in 2005[38]. However, this measure is dominated by the activity of the foreign companies with 95% of Gross Output associated with these companies exported in 2003[39]. In contrast only 17.7% of Gross Output was exported by the indigenous companies in this year (albeit this was an increase from the 12.4% level in 1999). The exports were dominated by activity in the print & publishing subsector.

The print & publishing subsector of the wood, paper & publishing sector contributed by and far the largest portion of Value Added[40] (at 86% of the sector value in 2005), followed by the wood and then paper & pulp subsectors. Exports were also dominated by the print & publishing subsector (at 79% of exports in the sector in 2005) as was employment (at 60% of employment in the sector in 2005).

[38] Latest figure available.

[39] Latest figure available.

[40] Figures for Net Output were not available for these subsectors though the CSO, so Value Added data available through the OECD were used in this instance.

It is clear from the data presented that this subsector is a very significant contributor to the Irish economy, with the activities associated with the print & publishing subsector having the largest impact. Indeed probing this further, it is the activities of companies associated with the publishing of software products that is the key element in realising such a high contribution to the economy in this sector.

Total employment in the wood, paper & publishing sector over the period 1999-2007 peaked in 2001, and subsequently declined, so that the total employment levels in 2007 were below that of 1999. The overall drop in the employment figure was driven by a reduction in employment by both Irish and foreign owned firms. In 2007, indigenous companies accounted for 75% of employment in this sector and foreign owned companies accounted for 25% of the employment (despite the fact that foreign owned companies accounted for only 6% of the total number of firms in 2007).

The contribution of the wood, paper & publishing sector in relation to its share of national employment has shown a decline on a yearly basis, both in the indigenous and foreign owned company categories, over the time period 1999-2007. In 2007, the wood, paper & publishing sector was estimated to provide 1.2% of the total national employment, a 0.7 percentage point reduction relative to its share in 1999. It is noted that this reduction was primarily due to growth in employment in other sectors rather than the decline in absolute numbers of employees in the wood, paper & publishing sector.

5.2.2 Research and Development Activity

Table 4: Key R&D facts and figures in the wood, paper & publishing sector. NACE 20-22. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	9,463	13,334	9,364	10,782	11,340
Share of National BERD	1.2%	1.6%	0.9%	0.8%	0.7%
Total FTE R&D Personnel	113	104	72	69	59
Share of National FTE R&D Personnel	1.4%	1.2%	0.8%	0.7%	0.5%
Total R&D Spend/Net Output	0.13%	0.15%	0.09%	0.09%	0.07%

An estimated 3.7% of companies in the wood, paper & publishing sector had some R&D activity in 2007. The wood, paper & publishing sector accounted for 1.2% of the BERD in 1999. There was little growth in the investment in R&D by companies in this sector in the following years and so the share of national BERD dropped over time reaching 0.7% by 2007. Indigenous companies accounted for 79% of the investment in BERD in 1999, and this rose to 100% by 2007.

The indigenous companies in this sector represented 2.6 % of the indigenous spend on BERD in 1999, and levels of BERD fluctuated slightly around this value in the following years, reaching a value of 2.6% again in 2007. The foreign owned companies represented 0.4 % of foreign spend on BERD in 1999, however, by 2007 the level of investment had dropped to 0%.

Small companies are the dominant size category for indigenous company investment in R&D in the wood, paper & publishing sector accounting for 60% of the investment in 2005, followed by 40% of investment by medium sized companies.

The number of FTE R&D personnel decreased by close to 50% between 1999 and 2007. Whilst a complete set of data is not available separately for indigenous and foreign companies, the decrease is suspected to have been driven to some extent by the decrease in R&D activity displayed by the foreign companies. The data indicates that a similar proportion of staff type - support, technical and non PhD - was maintained in the sector from year to year, with an indication of some PhD researchers being employed in this sector in 2007. The R&D personnel employed in this sector in 2007 represents 0.5% of the total R&D personnel employed nationally.

Experimental development is the dominant research type that companies in the wood, paper & publishing sector engages in.

The wood subsector of the wood, paper & publishing sector contributed by and far the largest portion of BERD (at 88% of the sector value in 2007[41]), followed by the print & publish and then the paper & pulp subsectors. Employment of R&D personnel for this sector was also dominated by the wood sector (78% of the sector value in 2007).

In 2007, support received through Government grants was estimated as 14.7% of total spend on in-house R&D in the wood, paper & publishing sector. In absolute € terms, the wood, paper & publishing sector received €1.66 million through Government grants - the 10th largest sum of money for R&D by way of Government grants in 2007.

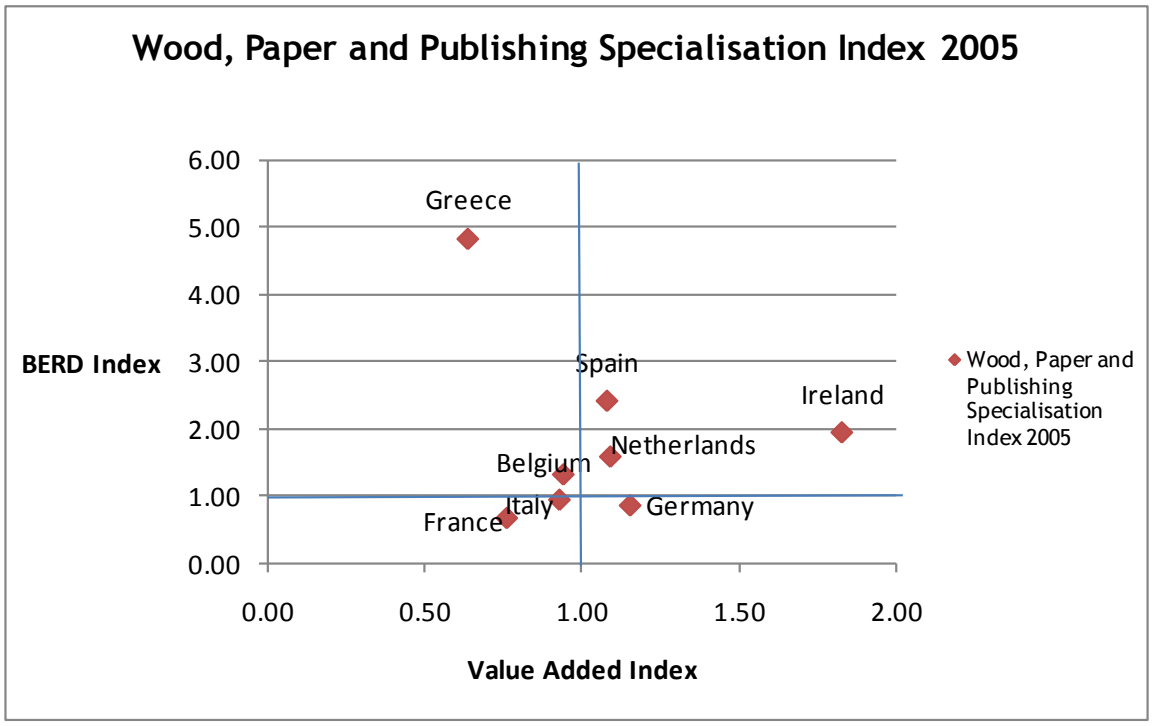
5.2.3 Importance of the Wood, Paper & Publishing Sector for Ireland in an International Context

In Fig. 3 the indices for BERD and Value Added, based on 2005 values for the wood, paper & publishing sector, are plotted for a number of countries. Of the eight countries considered, two countries were shown not to be specialised in the wood, paper & publishing sector, either in BERD or Value Added. Two countries showed a level of specialisation in BERD but not in Value Added. One country showed a level of specialisation in Value Added but not in BERD. Three countries showed a level of specialisation in both BERD and Value Added, including Ireland. Based on an interpretation of these two sets of indices, the data suggests that Ireland is well positioned in this sector; in 2005 it was specialised in Value Added (based on the countries considered) and coupled with a specialisation in BERD, the Value Added would have been expected to be sustained in the following years at a minimum or grow[42] (as was seen to happen in 2007).

[41] Based on data provided through OECD.

[42] Investment in BERD would be expected to help maintain or grow the Value Added.

Figure 3: BERD and Value Added Indices for the wood, paper & publishing sector in 2005, for a range of European countries.



Whilst not included in the data shown in Fig. 3[43], other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[44] Ireland still appeared as a strong performer when other countries were considered, although Finland was seen to spend a greater share of its BERD, and reap a greater share of its national Value Added from this sector, than Ireland.

When the characteristics of the subsectors are considered, it is clear that the investment in BERD in the wood, paper & publishing sector is dominated by one subsector (wood), and by the Irish owned companies, whilst the Value Added is dominated by a different subsector (print & publishing) and by foreign owned companies.

[43] As stated in the introduction, specialisation indices were developed based on an eight country reference. Data for all of the sectors of interest was available only for these eight countries. Data for other countries was used for further comparison within each sector.

[44] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Portugal, Finland, Czech Republic, Austria, Denmark, Japan.

5.3 Chemical & Pharmaceutical Sector: NACE 24

5.3.1 Economic Profile

Table 5: Key economic facts and figures for the chemical & pharmaceutical sector: NACE 24. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	242	242	235	213	225
Total Employment	22,969	24,589	23,669	24,513	24,027
Total Employment/Total National Employment	1.4 %	1.4%	1.3%	1.3%	1.1%
Gross Output	18,578,875	25,543,093	28,534,235	28,942,883	32,750,674
Net Output	15,057,014	20,108,933	23,879,143	23,913,912	25,052,299
Net output/GDP	16.6%	17.2%	17.1%	14.7%	13.1%

Activities of companies included in this sector include manufacture of chemicals, chemical products and pharmaceutical products.

In 1999, the chemical & pharmaceutical sector in Ireland was represented by 242 firms, of which 124 (51%) were Irish owned. During the period 1999 to 2007 the number of firms active in this sector in Ireland declined slightly; there was a small increase in the number of Irish owned firms and a decrease in the number of foreign owned firms.

The Net Output of the chemical & pharmaceutical sector accounted for 16.6% of the GDP in 1999 and this share shrank over the years so that by 2007 it accounted for 13.1 % of GDP. However, as a proportion of the Manufacturing Category, the Net Output of the chemical and pharmaceutical sector fluctuated slightly between 1999 and 2007 maintaining a share of the total Manufacturing Category Net Output of 38 ± 3 % each year during this time period.

Over the 1999 -2007 time period, Gross and Net Output grew substantially in this sector by 75% and 66% respectively. In 2007, 96 % of Gross Output was associated with foreign owned companies, and 98% of Net Output was associated with foreign companies.

Exports as a % of Gross Output also continued to grow in the chemical & pharmaceutical sector from 1999 levels and in 2005 accounted for more than 97% of Gross Output. Whilst this ratio was higher for foreign owned companies (at 98.7% in 2003) than Irish owned companies, the indigenous companies also export at a significant level of gross output (41.2% in 2003[45]), indicating the importance of this sector in terms of export sales.

[45] Latest figure available

Total employment in the chemical & pharmaceutical sector grew by 4 % over the period 1999-2007, and this was a consequence of increases in employment by both Irish and foreign owned companies.

The contribution of the chemical and pharmaceutical sector in relation to its share of national employment has shown a decline on a yearly basis, both in the indigenous and foreign owned company categories, over the time period 1999-2007. In 2007, the sector was estimated to provide 1.1% of the total national employment, a 0.3 percentage point reduction relative to its share in 1999. It is noted that this reduction was primarily due to growth in employment in other sectors rather than the decline in absolute number of employees in the chemical & pharmaceutical sector.

5.3.2 Research and Development Activity

Table 6: Key R&D facts and figures in the chemical & pharmaceutical sector. NACE 24. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	106,559	95,795	208,295	300,407	317,827
Share of National BERD	13.8%	11.6%	18.9%	22.6%	19.8%
Total FTE R&D Personnel	653	714	735	1,159	999
Share of National FTE R&D Personnel	7.9%	8.2%	7.9%	11.2%	9.1%
Total R&D Spend/Net Output	0.7%	0.5%	0.9%	1.3%	1.3%

An estimated 43% of companies in the chemical & pharmaceutical sector had some R&D activity in 2007. The chemical and pharmaceutical sector accounted for 13.8% of the national BERD in 1999 and increased over the following years, showing a 19.8 % share in 2007. In absolute terms, the investment in BERD in 2007 was triple that of the 1999 levels. Both indigenous and foreign owned companies showed similar trends in terms of absolute € investment in R&D with little growth in R&D investment from 1999 to 2001, followed by subsequent rapid growth. The € investment in BERD was dominated by the foreign owned companies who have consistently accounted for close to 90% of the national investment in this sector.

Large companies are the dominant size category for investment in R&D in the chemical & pharmaceutical sector, and accounted for 78.4% of national BERD in 2005. This was true for the foreign owned companies, with large firms accounting for 83% of the respective foreign

company proportion of BERD. In contrast the medium size companies were the dominant investors in BERD at 56% of indigenous company investment.[46]

Overall the proportion of BERD as a % of the Net Output has shown a modest increase over the 1999 to 2007 time frame.

The number of full time equivalent R&D personnel increased significantly between 1999 and 2007. The data indicates some level of reduction in the proportion of non-PhD staff and some increase in the level of PhD qualified researchers over the time period.

In 2007, this sector received €6.5 million in support through Government grants and this was estimated as 2.1% of the total spend on in-house R&D in this sector. In absolute € terms, the chemical and pharmaceutical received the 6th largest sum of money for R&D by way of Government grants in 2007.

Experimental development was found to be the dominant research type that small and medium companies in the sector engaged in. In comparison, in large companies, research activities were split more evenly between experimental and applied (+ basic) research.

5.3.3 Importance of the Chemical & Pharmaceuticals Sector for Ireland in an International Context

In Fig. 4 the indices for BERD and Value Added, based on 2005 values for the chemical & pharmaceuticals sector, are plotted for a number of countries. Of the eight countries considered, three countries were shown not to be specialised in this sector, either in BERD or Value Added, and all other countries showed some level of specialisation in both fields.

Whilst not included in the data shown in Fig. 4 other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[47] In 2005, Hungary, Belgium, The Netherlands and Denmark were all found to spend a greater proportion of their national BERD investment than Ireland in the chemical & pharmaceuticals sector (ranging from 45% to 24%) However, Ireland still appeared as a strong performer with its share of national BERD at 22.6% being comparable to that of Denmark and The Netherlands, and its share of Value Added, at 7.5%, far exceeding the share of Value Added reported by other countries; Belgium showed the second highest share of Value Added after Ireland - at less than 4% despite its 35% investment in BERD.

When the contributions by the chemical & pharmaceuticals subsectors were decoupled, it was found that the Value Added measure in the chemicals subsector was approximately three times greater than for the pharmaceuticals subsector, in 2005. However, the investment in BERD by the pharmaceutical subsector dominated the share of BERD with close to an order of magnitude higher spend than in the chemical subsector in 2005, with this ratio being similar in 2007. It was also noted that the number of full time equivalent R&D personnel employed in the chemical subsector was approximately a quarter of the number employed in the pharmaceuticals subsector in 2007. [48]

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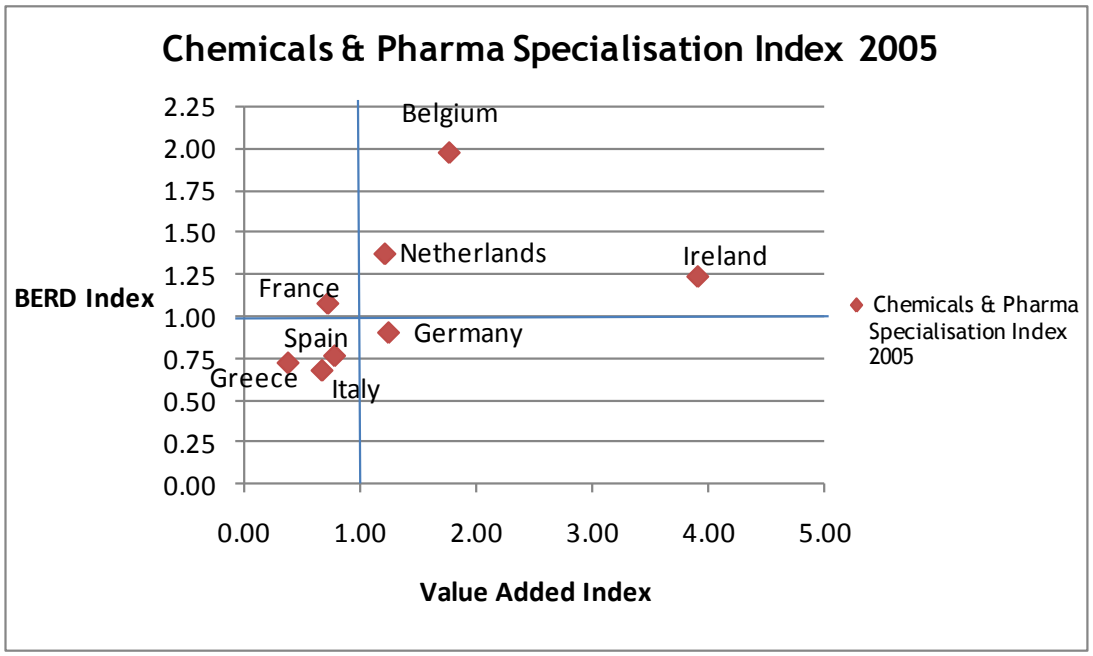
[46] No data was available for the breakdown of firm size for indigenous and foreign owned firms in 2007.

[47] Countries included Hungary, Korea, Czech Republic, Poland, Austria, Finland, Japan, Denmark.

[48] Caution must be used in interpreting this data as the criteria for allocating companies to specific NACE codes can vary between surveys, and thus it is conceivable that activities associated with 'chemicals' companies and 'pharmaceuticals' companies could be intermixed between NACE codes.

Figure 4: BERD and Value Added Indices for the chemicals & pharmaceuticals sector in 2005, for a range of European countries.



5.4 Materials and Basic & Fabricated Metals Sector: NACE 25-28

5.4.1 Economic Profile

Table 7: Key economic facts and figures for the materials and basic & fabricated metals sector: NACE 25-28. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	1173	1247	1352	1277	1619
Total Employment	36,660	35,572	33,662	35,954	38,955
Total Employment/Total National Employment	2.3%	2.1%	1.9%	1.9%	1.9%
Gross Output	4,186,861	4,477,525	4,460,789	5,433,398	6,910,390
Net Output	2,013,726	2,194,240	2,169,456	2,519,061	3,017,455
Net output/GDP	2.2%	1.9%	1.6%	1.6%	1.6%

This sector is made up of a series of subsectors including:

- Manufacture of rubber and plastic products: NACE 25
- Manufacture of other non-metallic mineral products: NACE 26
- Basic metals, iron and steel. NACE: 27.1 - 27.3 + 27.51 +27.52
- Basic metals, non-ferrous. NACE: 27.4 + 27.53 + 27.54
- Manufacture of fabricated metal products except machinery and equipment: NACE 28

Activities of companies in this sector includes manufacture of rubber and plastics products as well as glass and glass products, ceramic tiles and flags, bricks, and construction products such (eg. cement, lime and plaster). It also includes activities of smelting or refining ferrous and nonferrous metals from ore, pig or scrap and manufacture of "pure" metal products usually with a static, immovable function.

In 1999, the materials and basic & fabricated metals sector in Ireland was represented by 1173 firms, of which 1,059 (90%) were Irish owned. During the period 1999 to 2007 the number of firms active in this sector in Ireland increased by 38%; this was accounted for by an increase of 449 indigenous firms and a reduction by three of the number of foreign owned firms .

The Net Output of the materials and basic & fabricated metals sector accounted for 2.2% of the GDP in 1999 and this share shrank over the years so that by 2007 it accounted for 1.6 % of GDP. As a proportion of the Net Output of the total Manufacturing Category, the Net Output of the materials and basic & fabricated metals sector was 4.3% in 2007 in comparison to 4.7 % in 1999.

Over the 1999 -2007 time period, Gross and Net Output grew in this sector, with the largest growth recorded between 2005 and 2007. In 2007, 76% of Gross Output was associated with Irish owned companies, and 78% of Net Output was associated with Irish owned companies.

Exports as a % of Gross Output in the materials and basic & fabricated metal sector showed rapid decline from 40.2% in 1999 to 15.9% in 2005. Gross outputs exported as a % of the total manufacturing Gross Outputs exported also showed decline and decreased from 2.9% to 1.0% between 1999 and 2005.

Total employment in the materials and basic & fabricated metals sector showed some fluctuations over the period between 1999 and 2007, with an overall growth by 6 % when the 1999 and 2007 figures were compared. During the 1999 to 2007 period, employment in foreign owned companies showed a steady decline, and so the overall increase in employment in 2007 relative to the 1999 levels was solely a result of increased employment of 18% by the indigenous companies.

The contribution of the materials, basic & fabricated metals sector in relation to its share of national employment has shown a decline, both in the indigenous and foreign owned company categories, over the time period 1999-2007. In 2007, the sector was estimated to provide 1.9% of the total national employment, a 0.4 percentage point reduction relative to its share in 1999. It is noted that this reduction was due to growth in employment in other sectors rather than the decline in absolute numbers of employees in the materials and basic & fabricated metals sector.

5.4.2 Research and Development Activity

Table 8: Key R&D facts and figures for the materials and basic & fabricated metals sector. NACE 25-28. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	27,693	28,204	28,782	39,252	64,211
Share of National BERD	3.6%	3.4%	2.6%	3.0%	4.0%
Total FTE R&D Personnel	340	382	384	388	525
Share of National FTE R&D Personnel	4.1%	4.4%	4.1%	3.8%	4.8%
Total R&D Spend/Net Output	1.4%	1.3%	1.3%	1.6%	2.1%

An estimated 6% of companies in the materials and basic & fabricated metals sector had some R&D activity in 2007. The materials and basic & fabricated metals sector accounted for 3.6% of the national BERD in 1999 and this share declined in the following years, until 2007 when it showed an increase relative to the 1999 level. In absolute terms, the investment in BERD in 2007 was more than double that of the 1999 levels. The significant increase in BERD recorded in 2007 was due to a significant increase in R&D investment by foreign owned companies in this year. In 1999 the € investment in BERD was dominated by the Irish owned companies who accounted for 73% of the expenditure. However, in 2007 the balance had shifted and the majority of the € investment in BERD came from the foreign owned companies who accounted for 64% of the expenditure.

Large companies made the biggest investment in R&D in the materials and basic & fabricated metals sector and accounted for 45% of national BERD in 2005. Small companies and medium companies also invested in R&D at levels of 33% and 22% respectively of the total BERD in this sector in 2005. The contribution of large, medium and small companies to the total BERD was similar for both foreign and Irish owned companies.

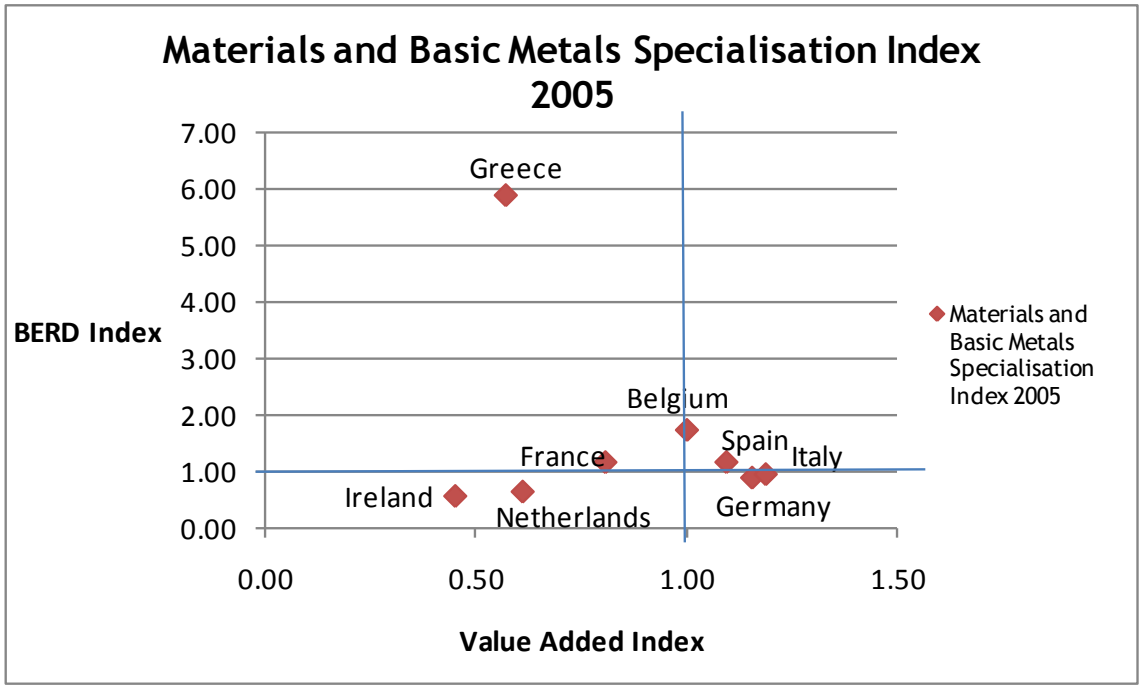
There was little change in the number of full time equivalent R&D personnel up to 2005. In the period between 2005 and 2007 there was a 35% increase in full time equivalent R&D personnel in this sector. The data indicates an increase in the proportion of PhD staff and some increase in the level of non-PhD qualified researchers between 2005 and 2007.

In 2007, this sector received €4.3 million in support received through Government grants, which was estimated at 6.8% of total spend on in-house R&D in this sector. The basic metals and non-ferrous metals subsector received the highest proportion of Government grants relative to their in-house R&D spend, at 20.9 %. In absolute € terms, the materials and basic metals sector received the 7th largest sum of money for R&D by way of Government grants in 2007.

Experimental development was found to be the dominant research type for large companies. However, in small and medium companies, research activities were split more evenly between experimental and applied (+basic) research.

5.4.3 Importance of the Materials and Basic & Fabricated Metals Sector for Ireland in an International Context

Figure 5: BERD and Value Added Indices for the materials and basic & fabricated metals sector in 2005, for a range of European countries.



In Fig. 5 the indices for BERD and Value Added, based on 2005 values for the materials and basic & fabricated metals sector, are plotted for a number of countries. Of the eight countries considered, two countries were shown not to be specialised in this sector, either in BERD or Value Added, and all other countries showed some level of specialisation in one or both fields. Ireland actually shows no specialisation in either BERD or Value Added. In fact there is no particularly strong country in terms of having specialisation in both BERD and Value Added. Greece is by far the greatest specialist in terms of BERD, however, it does not have a corresponding specialisation in Value Added.

Whilst not included in the data shown in Fig. 5 other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[49] In 2005, the Czech Republic showed the highest share of national Value Added for this sector (at close to 8%) and a corresponding share of BERD of 8%. Ireland demonstrated the lowest share of national Value Added relative to all of the other countries, and the 4th lowest share of national investment in BERD (after Denmark, Portugal and Hungary).

[49] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Portugal, Finland, Japan, Denmark.

5.5 Machinery & Equipment N.E.C. Sector: NACE 29

5.5.1 Economic Profile

Table 9: Key economic facts and figures for the machinery & equipment sector: NACE 29. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	371	367	325	279	362
Total Employment	14,494	14,074	11,699	10,938	12,383
Total Employment/Total National Employment	0.9%	0.8%	0.7%	0.6%	0.6%
Gross output	1,557,376	1,738,883	1,608,319	1,784,222	2,412,206
Net output	777,232	774,127	753,361	871,073	1,184,849
Net output/GDP	0.9%	0.7%	0.5%	0.5%	0.6%

Activities of companies in this sector include manufacture of machinery and equipment which independently act on materials either mechanically or thermally or perform operations on materials. In 1999, the machinery & equipment sector in Ireland was represented by 371 firms, of which 314 (85%) were Irish owned. Between 1999 and 2007 the number of firms active in this sector decreased reaching a minimum in 2003, and then increased again so that by 2007 levels were similar to those in 1999.

The Net Output of the machinery and equipment sector accounted for 0.9% of the GDP in 1999 and this share shrank over the years so that by 2007 it accounted for 0.6 % of GDP. As a proportion of the Net Output of the total Manufacturing Category, the Net Output of the machinery and equipment sector was 1.7% in 2007 in comparison to 1.8 % in 1999, although a minimum of 1.3 % was reached in 2003.

Over the 1999 -2007 time period, Gross and Net Output in this sector grew. In 2007, 41% of Gross Output was associated with Irish owned companies, and 39% of Net Output was associated with Irish owned companies.

Exports as a % of Gross Output in the machinery & equipment sector showed a 5% increase between 1999 and 2005 (from 72% – 77%). Gross outputs exported as a % of the total manufacturing sector also showed a modest decline over this time period.

Total employment in the machinery and equipment sector dropped by 25% between 1999 and 2005, although there was significant recovery in employment between 2005 and 2007. This recovery in employment was driven by increases of employment in Irish owned companies.

The contribution of the machinery and equipment sector in relation to its share of national employment has shown a decline, both in the indigenous and foreign owned company categories, over the time period 1999-2007. In 2007, the sector was estimated to provide 0.6%

of the total national employment, a 0.3 percentage point reduction relative to its share in 1999. It is noted that this reduction is due to both growth in employment in other sectors as well as the decline in absolute numbers of employees in the machinery & equipment sector.

5.5.2 Research and Development Activity

Table 10: Key R&D facts and figures for the machinery & equipment sector. NACE 29. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	22,529	15,085	43,237	48,214	48,930
Share of National BERD	2.9%	1.8%	3.9%	3.6%	3.1%
Total FTE R&D Personnel	316	247	442	502	396
Share of National FTE R&D Personnel	3.8%	2.9%	4.8%	4.9%	3.6%
Total R&D Spend/Net Output	2.9%	1.9%	5.7%	5.5%	4.1%

An estimated 26% of companies in the machinery & equipment sector had some R&D activity in 2007. The machinery & equipment sector accounted for 3.1% of the national BERD in 2007. The share of BERD peaked in 2003 at 3.9% and has been declining since then. In absolute terms, the investment in BERD in 2007 was more than double that of the 1999 levels. The significant increase in BERD recorded in 2003 was due to a significant increase in R&D investment by Irish owned companies in that year, and further increase in BERD in 2005 and 2007 were due to increases in BERD by foreign owned companies. In 2007 the € investment in BERD was dominated by the Irish owned companies who accounted for 63% of the expenditure.

Large companies made the biggest investment in R&D in the machinery & equipment sector and accounted for 38% of national BERD in 2005. Small and medium companies also invested in R&D at levels of 31% and 30% respectively of the total BERD in this sector in 2005. Large companies dominated the R&D expenditure in the foreign owned enterprise, investing 84% of the BERD. In comparison, more than half of the BERD for Irish owned companies came from medium companies, in 2005.

The number of full time equivalent R&D personnel appeared to fluctuate quite significantly over the period 1999 to 2007.

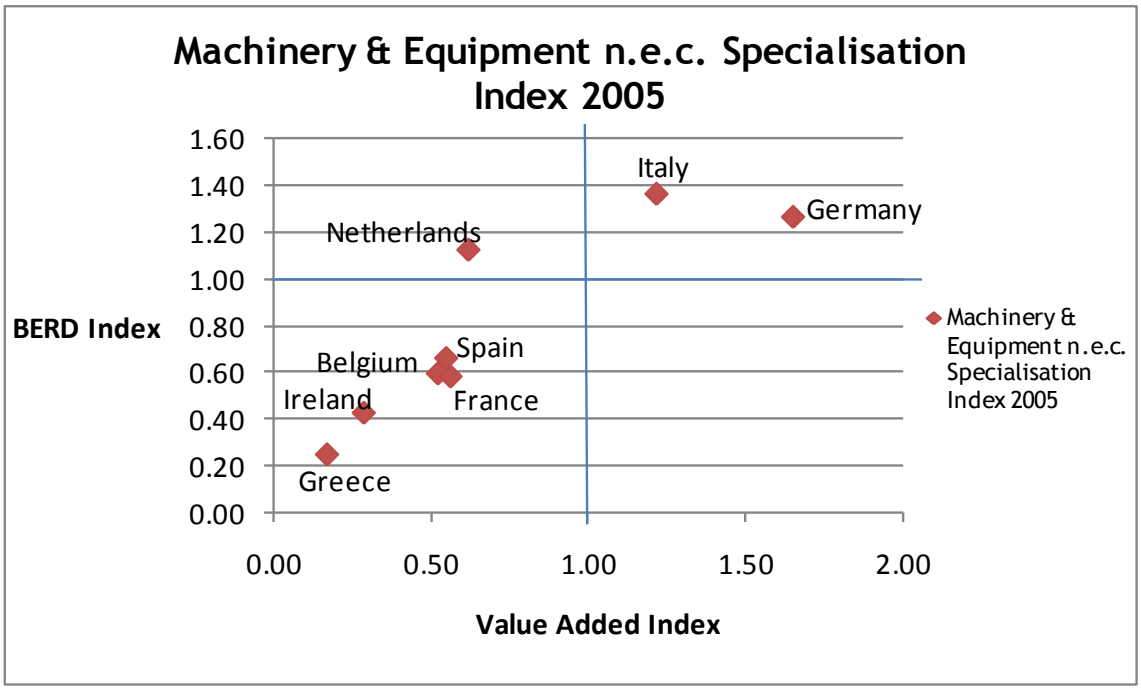
In 2007, this sector received €2.2 million in support through Government grants, which was estimated at 4.7% of the total spend on in-house R&D in this sector. The basic metals and non-ferrous metals subsector received the highest proportion of Government grants relative to their in-house R&D spend, at 20.9 %. In absolute € terms, the machinery and equipment sector received the 8th largest sum of money for R&D by way of Government grants in 2007.

Experimental development was found to be the dominant research type for small and medium companies. However, in large companies, research activities were split more evenly between experimental and applied (+basic) research.

5.5.3 Importance of the Machinery & Equipment Sector for Ireland in an International Context

In Fig. 6 the indices for BERD and Value Added, based on 2005 values for the machinery & equipment sector, are plotted for a number of countries. Of the eight countries considered, five countries, including Ireland, were shown not to be specialised in this sector, either in BERD or Value Added. Of the remaining countries, The Netherlands is specialised in BERD but not Value Added. Germany and Italy are both shown to be specialised in both BERD and Value Added in this sector. Whilst not included in the data shown in Fig.6 other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[50] In 2005, Greece showed the lowest share of national Value Added for this sector, followed by Ireland. Greece also showed the lowest share of national BERD for this sector, followed by Portugal and then Ireland.

Figure 6: BERD and Value Added Indices for the machinery & equipment sector in 2005, for a range of European countries.



[50] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Portugal, Finland, Japan, Denmark.

5.6 Computers, Electrical and Electronics: NACE 30-32

5.6.1 Economic Profile

The computers, electrical & electronics sector is made up by a series of subsectors including:

- Office, accounting and computing machinery: NACE 30
- Electrical motors, generators and transformers: NACE 31.1
- Electricity distribution and control apparatus: NACE 31.2
- Insulated wire and cable (includes optic fibre cables): NACE 31.3
- Accumulators, primary cells and primary batteries: NACE 31.4
- Electric lamps and lighting equipment: NACE 31.5
- Other electrical equipment: NACE 31.6
- Electronic valves, tubes and components: NACE 32.1
- TV, radio transmitters and line apparatus: NACE 32.2
- TV and radio receivers, sound and video goods: 32.3

Activities of companies in this sector include the manufacture of office machinery and computer equipment as well as the manufacture of electrical machinery and apparatus. It also includes the manufacture of equipment for broadcasting and transmission, receivers, recorders and reproduction equipment.

In 1999, the computers, electrical and electronics sector in Ireland was represented by 326 firms, of which 201 (62%) were Irish owned. By 2007 the number of firms active in this sector was lower than the 1999 levels, at 265.

The Net Output of the computers, electrical & electronics sector accounted for 8.8% of the GDP in 1999 and this share shrank over the years so that by 2005 it accounted for 5.8 % of GDP. As a proportion of the Net Output of the total Manufacturing Category, the Net Output of the computers, electrical and electronics sector was 14.7% in 2005, which was a drop by 4 percentage points from the 1999 levels of 18.7%.

Over the 1999 -2005 time period, Gross and Net Output in this sector fluctuated somewhat, but showed overall modest growth. In 2003, 4.7% of Gross Output was associated with Irish owned companies and 4.6% of Net Output was associated with Irish owned companies.

A drop in total employment in the computers, electrical & electronics sector of 42% was measured between 1999 and 2007. Whilst a full set of data was not available for the foreign and Irish owned companies, figures did indicate that the significant drop in employment was driven by decreases in employment in the foreign owned companies.

In 2007, the sector was estimated to provide 1.3% of the total national employment, a 1.7 percentage point reduction relative to its share in 1999. It is noted that this reduction was due to growth in employment in other sectors as well as the decline in absolute numbers of employees in the computers, electrical & electronics sector.

Table 11: Key economic facts and figures for the computers, electrical & electronics sector: NACE 30-32. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	326	331	305	221	265
Total Employment	47,844	45,197	33,376	29,212	27,850
Total Employment/Total National Employment	3.0%	2.6%	1.9%	1.5%	1.3%
Gross output	21,154,009	26,964,855	21,455,254	23,621,728[51]	24,878,000[52]
Net output	7,972,236	10,039,236	8,023,719	9,442,948	-
Net output/GDP	8.8%	8.6%	5.8%	5.8%	-

5.6.2 Research and Development Activity

Table 12: Key R&D facts and figures for the computers, electrical & electronics sector: NACE 30-32. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	284,869	110,780	186,908	278,165	350,230
Share of National BERD	36.8%	13.5%	17.0%	21.0%	21.8%
Total FTE R&D Personnel	2,418	1,143	1,797	2,229	2,086
Share of National FTE R&D	29.4%	13.2%	19.4%	21.6%	19.0%
Total R&D Spend/Net Output	3.6%	1.1%	2.3%	2.9%	-

[51] The Gross Output data for 2005 for the computer, electrical & electronics sector (NACE code 30-32) and medical, precision and optical instruments, sector (NACE code 33) is taken from the CSO database Publications on Census of Industrial Production data Table 1 as the Gross Output data split for these two sectors was unavailable in Table 8.

[52] The Gross Output data for 2007 was not available separately for the computer, electrical & electronics sector (NACE code 30-32) and medical, precision and optical instruments sector (NACE code 33), as the CSO report the Gross Output data from NACE code 30-33 as one section. Instead the Turnover data which is a close comparison to Gross Output is shown in the tables for these two NACE code sectors 30-32 and NACE code 33 in order to analyse the trend over the period 1999 to 2007.

An estimated 59% of companies in the computer, electrical & electronics sector had some R&D activity in 2007. The computers, electrical & electronics sector accounted for 36.8% of BERD in 1999, but dropped rapidly to 13.5% by 2001. Share of BERD for this sector subsequently increased yearly reaching 21.8% by 2007. In absolute terms, the investment in BERD in 2007 was a factor of 1.2 times that of the 1999 levels. The significant decrease in BERD recorded in 2001 was due to a significant decrease in R&D investment by foreign owned companies in this year, and subsequent increases in BERD between 2003 and 2007 were driven by increases in BERD by foreign owned companies. In 2007 the € investment in BERD was dominated by the foreign owned companies who accounted for 87% of the total expenditure on R&D in this sector. In 2007, BERD by foreign companies in this sector accounted for 26.2% of BERD by foreign owned companies. In 2007, BERD by Irish companies accounted for 10.6% of BERD by Irish owned companies.

Overall in this sector the large firm size category invested most significantly in BERD at 49% of the total sector BERD. For indigenous enterprise, small companies made the biggest investment in R&D in the computers, electrical and electronics sector and accounted for 64% of indigenous BERD in 2005. Large companies were the largest spenders on R&D in the foreign owned enterprise category, investing 57% of the BERD associated with foreign owned companies.

The number of full time equivalent R&D personnel dropped by over 50% in going from 1999 to 2001. However, over the following years the numbers increased rapidly so that by 2007, the number of full time equivalent R&D personnel was at 86% of the 1999 level. The lower number of personnel between 1999 and 2007 was primarily due to a reduction in 'technical' personnel.

In 2007, companies in this sector received €17.2 million in support through Government grants, which was estimated at 4.9% of total spend on in-house R&D in this sector. In absolute € terms, the computers, electrical & electronics sector received the 2nd largest sum of money for R&D by way of Government grants in 2007.

Experimental development was found to be the dominant research type for medium and large companies. However, in small companies, research activities were dominated by applied research (+basic).

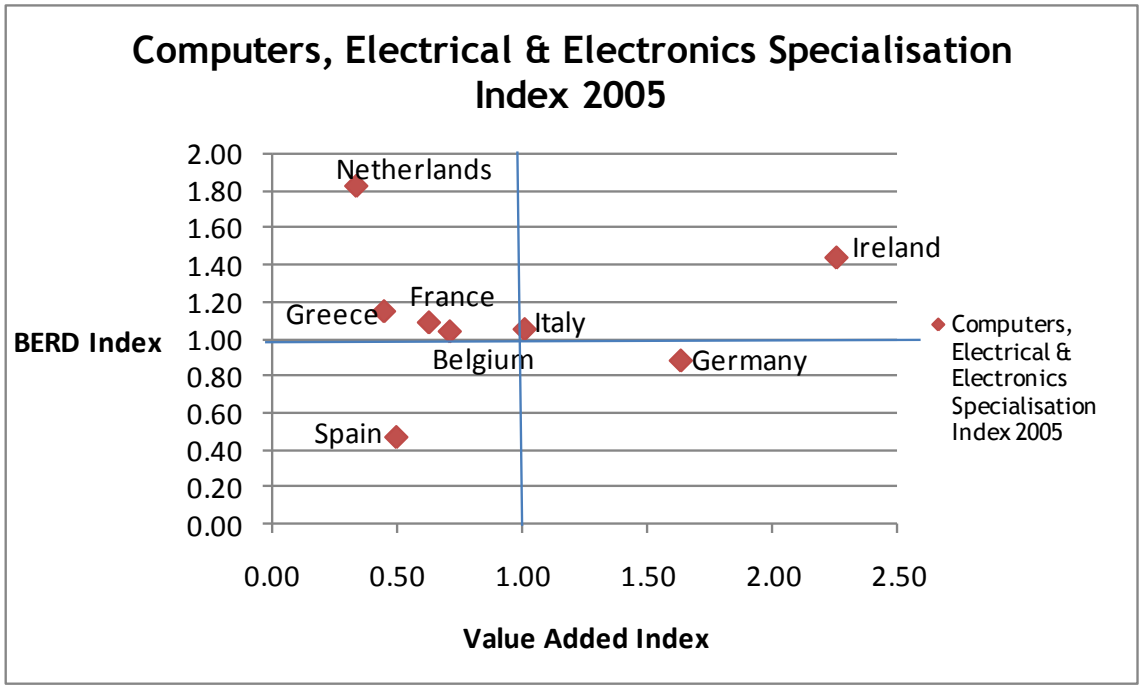
5.6.3. Importance of the Computer, Electrical & Electronics Sector for Ireland in an International Context

In Fig. 7 the indices for BERD and Value Added, based on 2005 values for the computers, electrical & electronics sector, are plotted for a number of countries. Of the eight countries considered, one country was not specialised in either BERD or Value Added, four countries were found to be specialised in BERD but not Value Added, and one country was specialised in Value Added but not BERD. Italy was found to be just on the border of specialisation for both BERD and Value Added. Ireland stands out as having the highest levels of specialisation in BERD and Value Added of the countries considered. Whilst not included in the data shown in Fig. 7 other countries were reviewed with respect to their national share of Value Added and Share of BERD for this sector.[53] In 2005, Finland and Korea both showed the greatest national share of Value Added and BERD for this sector. Hungary showed a greater share of national Value Added than Ireland's share but a lower share of national BERD than Ireland. Japan showed a greater share of national BERD than Ireland but a lower share of national Value Added. All

[53] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Finland, Japan.

other countries considered had both lower shares of national BERD and Value Added than Ireland.

Figure 7: BERD and Value Added Indices for the computers, electrical & electronics sector in 2005, for a range of European countries.



5.7 Medical Devices, Precision and Optical instruments, Watches and Clocks: NACE 33

5.7.1 Economic Profile

This sector represents manufacture of medical devices, scientific and technical instruments (e.g. electro-diagnostic apparatus, avionic equipment, etc.), photographic and cinematographic equipment, industrial process control equipment, and personal goods. However, the economic and R&D profiles are dominated by the activities of the medical devices subsector.

In 1999, the medical, optical and other instruments sector in Ireland was represented by 141 firms, of which 75 (53%) were Irish owned. By 2007 the number of firms active in this sector was slightly higher than the 1999 levels, at 167.

Table 13: Key economic facts and figures for the medical, optical and other instruments sector: NACE 33. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	141	139	131	130	167
Total Employment	16,618	19,792	19,627	24,306	25,874
Total Employment/Total National Employment	1.0%	1.1%	1.1%	1.3%	1.2%
Gross output	2,410,537	4,659,102	5,113,299	5,749,185[54]	7,005,000[55]
Net output	1,438,796	2,534,015	2,848,187	3,467,249	-
Net output/GDP	1.6%	2.2%	2.0%	2.1%	-

The Net Output of the sector accounted for 1.6% of the GDP in 1999 and this share grew over the years so that in 2005 it accounted for 2.1 % of GDP. As a proportion of the Net Output of the total Manufacturing Category, the Net Output of the medical, optical and other instruments sector was 5.4% in 2005, which was an increase of 2% from the 1999 levels of 3.4%.

Over the 1999 -2005 time period, Gross and Net Output in this sector grew rapidly by factors of 2.9 and 2.4 respectively between 1999 and 2007. In 2003, 5.6% of Gross Output was associated with Irish owned companies, and 5.3% of Net Output was associated with Irish owned companies.

There was a 56% increase in total employment in the sector between 1999 and 2007. Whilst a full set of data was not available for the foreign and indigenous companies, figures did indicate that the significant increase in employment was driven by increases in employment in the foreign owned companies.

In 2007, the sector was estimated to provide 1.2% of the total national employment, a 0.2 percentage point increase relative to its share in 1999. It is noted that this increase in the national share of employment was despite the growth of employment in other sectors also.

[54] The Gross Output data for 2005 for the computer, electrical & electronics sector (NACE code 30-32) and medical, precision and optical instruments, sector (NACE code 33) is taken from the CSO database Publications on Census of Industrial Production data Table 1 as the Gross Output data split for these two sectors was unavailable in Table 8.

[55] The Gross Output data for 2007 was not available separately for the computer, electrical & electronics sector (NACE code 30-32) and medical, precision and optical instruments sector (NACE code 33), as the CSO report the Gross Output data from NACE code 30-33 as one section. Instead the Turnover data which is a close comparison to Gross Output is shown in the tables for these two NACE code sectors 30-32 and NACE code 33 in order to analyse the trend over the period 1999 to 2007.

5.7.2 Research and Development Activity

Table 14: Key R&D facts and figures for the medical, optical and other instruments sector: NACE 33. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	38,606	57,030	113,876	124,298	151,874
Share of National BERD	5.0%	6.9%	10.3%	9.4%	9.5%
Total FTE R&D Personnel	447	582	752	849	854
Share of National FTE R&D Personnel	5.4%	6.7%	8.1%	8.2%	7.8%
Total R&D Spend/Net Output	2.7%	2.3%	4.0%	3.6%	-

An estimated 63% of companies in the medical, optical and other instruments sector had some R&D activity in 2007. The medical, optical and other instruments sector accounted for 5.0 % of BERD in 1999, and this increased to 9.5% by 2007. In absolute terms, the investment in BERD in 2007 was a factor of nearly 4 times that of the 1999 levels. The significant increase in BERD recorded in 2003 was due to a significant increase in R&D investment by foreign owned companies in this year, and subsequent increases in BERD between 2003 and 2005 were due to increases in BERD by Irish owned companies. In 2007 the € investment in BERD was dominated by the foreign owned companies which accounted for 84% of the total expenditure on R&D in this sector. In 2007, BERD by foreign companies in this sector accounted for 11% of BERD by foreign owned companies. In 2007, BERD by Irish companies accounted for 5.6% of BERD by Irish owned companies.

Over all in this sector the large firm size category invested most significantly in BERD at 68% of the total sector BERD. For indigenous enterprise, small companies made the biggest investment in R&D in the medical, optical and other instruments sector and accounted for 56% of indigenous BERD in this sector in 2005. Large companies were the biggest spenders on R&D in the foreign owned enterprise category, investing 91% of the BERD associated with foreign owned companies.

The number of full time equivalent R&D personnel in the medical, optical and other instruments sector grew by over 90% in going from 1999 to 2007.

In 2007, this sector received €13.6 million in support through Government grants, which was estimated at 9% of the total spend on in-house R&D in this sector. In absolute € terms, the medical, optical and other instruments sector received the 3rd largest sum of money for R&D by way of Government grants in 2007.

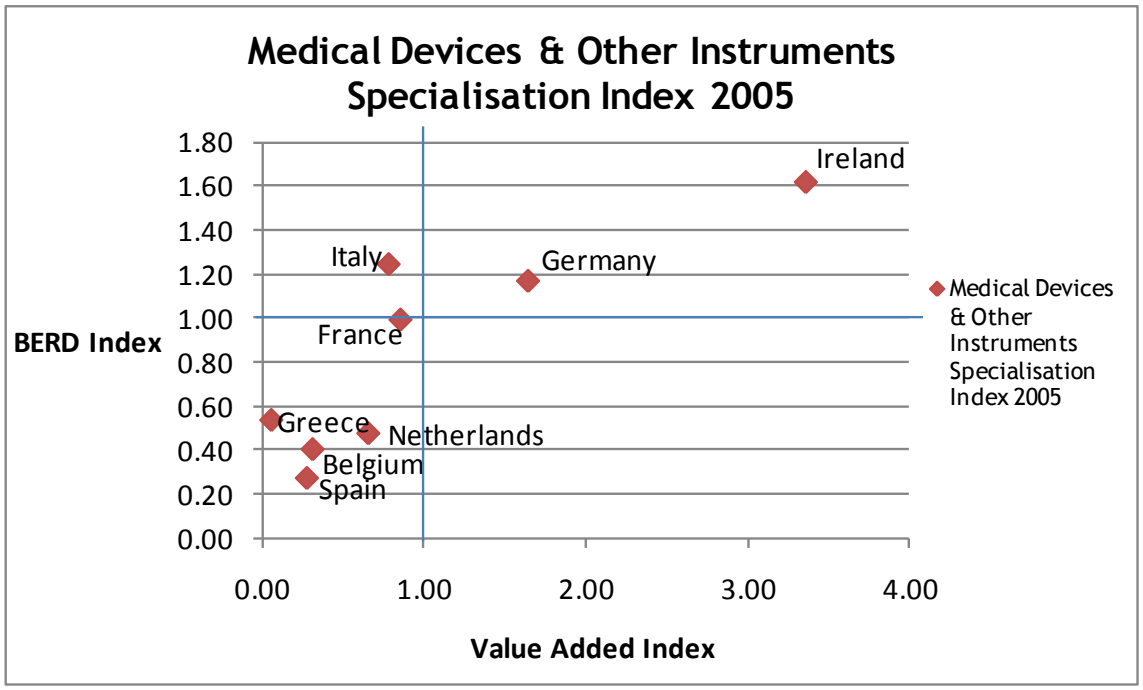
Applied research was found to be the dominant research type all firm sizes with an approximate estimate of a 1:2 investment in experimental development to applied research in this sector by enterprise.

5.7.3 Importance of the Medical, Optical and Other Instruments Sector for Ireland in an International Context

In Fig. 8 the indices for BERD and Value Added, based on 2005 values for the medical, optical and other instruments sector, are plotted for a number of countries. Of the eight countries considered, five countries were not specialised in either BERD or Value Added, and one country was found to be specialised in BERD but not Value Added. Germany and Ireland were both found to be specialised in BERD and Value Added.

A series of countries were reviewed with respect to their national share of Value Added and share of BERD for this sector.[56] In 2005, Ireland showed the largest share of national BERD and Value Added for this sector relative to all of the other countries considered. Germany and Denmark were the closest countries to Ireland in terms of a high share of national Value Added and national share of BERD.

Figure 8: BERD and Value Added Indices for the medical, optical and other instruments sector in 2005, for a range of European countries.



[56] Countries included Norway, Hungary, Korea, Czech Republic, Poland, Austria, Portugal, Finland, Japan, Denmark.

5.8 Software and Other Computer Services: NACE 72

5.8.1 Economic Profile

Activities of companies in this sector include software consultancy, data processing, database activities, Maintenance and repair and other computer related activities.

In 1999, the software and other computer services sector in Ireland was represented by 1,627 firms. By 2007 the number of firms active in this sector had tripled.

The Gross Value Added of the software & other computer services sector accounted for 1.3% of the GDP in 1999 and this share fluctuated somewhat over the following years, and by 2007 it was 1.7%.

Turnover and Gross Value Added in this sector grew rapidly between 1999 and 2007.

Total employment in this sector doubled between 1999 and 2007 and this translated to a change in the share of total national employment from 1.2% in 1999 to 1.8% in 2007.

Table 15: Key economic facts and figures for the software & other computer services sector: NACE 72. Monetary data is in €'000.[57]

	1999	2001	2003	2005	2007
Number of Firms	1,627	3,184	3,434	4,242	4,924
Total Employment	18,612	22,259	24,030	29,938	36,917
Total Employment/Total National Employment	1.2%	1.3%	1.3%	1.5%	1.8%
Turnover	2,976,965	6,137,853	6,210,522	10,604,785	17,146,771
Gross Value Added	1,221,628	2,377,457	2,360,610	3,110,796	3,252,293
Gross Value Added/GDP	1.3%	2.0%	1.7%	1.9%	1.7%

[57] Gross and Net Output figures were not available for this sector, and so these measures have been replaced with figures for Turnover and Gross Value Added.

5.8.2 Research and Development Activity

Table 16: Key R&D facts and figures for the software & other computer services sector: NACE 72. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	184,972	360,355	399,023	390,858	403,893
Share of National BERD	23.9%	43.8%	36.2%	29.5%	25.2%
Total FTE R&D Personnel	2,606	3,823	3,956	3,819	3,807
Share of National FTE R&D Personnel	31.7%	44.1%	42.7%	37.0%	34.8%
Total R&D Spend/Net Output	15.1%	15.2%	16.9%	12.6%	12.4%

An estimated 6% of companies in the software & other computer services sector had some R&D activity in 2007. The software and other computer services sector accounted for 23.9 % of BERD in 1999, and this increased to 43.8% by 2001. Subsequently the share of BERD for this sector has been declining, and a value of 25.2 % was recorded in 2007. In absolute terms, the yearly investment in BERD has been essentially static between 2003 and 2007. The 2007 BERD from this sector was more than double the BERD in 1999. The step change in BERD recorded in 2001 was due to a significant increase in R&D investment by foreign owned companies in this year. In 2007 the € investment in BERD by the foreign owned companies was 65.5% and 34.5% by the indigenous companies. In 2007, BERD by foreign companies in this sector accounted for 22.8% of BERD by foreign owned companies, whilst BERD by Irish companies accounted for 31.5% of BERD by Irish owned companies.

Over all in this sector the large firm size category invested most significantly in BERD at 53% of the total sector BERD. For indigenous enterprise, small companies made the biggest investment in R&D in the software & other computer services sector and accounted for 56% of indigenous BERD in 2005. Large companies were the biggest spenders on R&D in the foreign owned enterprise category, investing 78% of the BERD associated with foreign owned companies.

The number of full time equivalent R&D personnel in the software & other computer services sector grew by close to 50% between 1999 and 2001, after which the employment levels remained relatively unchanged. The Irish owned companies accounted for employment of 40 % of FTE R&D personnel this sector in 2007, in comparison to 60% by foreign owned companies.

In 2007, this sector received €19.35 million in support through Government grants, which was estimated at 4.8% of the total spend on in-house R&D in this sector. In absolute € terms, the software & other computer services sector received the largest sum of money for R&D by way of Government grants in 2007.

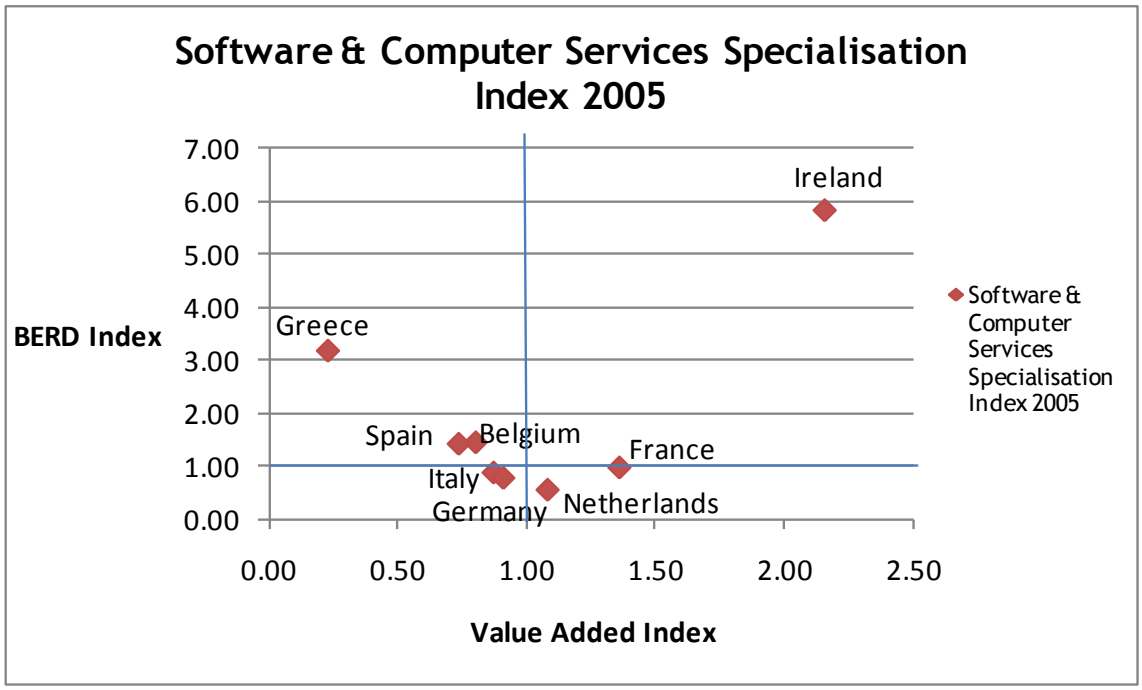
Experimental development was found to be the dominant research type in large companies. BERD on experimental and applied (+basic) research was nearly evenly split for small companies, and BERD for applied research was greater than the spend on experimental development in the medium size companies.

5.8.3 Importance of the Software & Other Computer Services Sector for Ireland in an International Context

In Fig. 9 the indices for BERD and Value Added, based on 2005 values for the software and other computer services sector, are plotted for a number of countries. Of the eight countries considered, two countries were not specialised in either BERD or Value Added, three countries were found to be specialised in BERD but not Value Added, and two countries were found to be specialised in Value Added but not BERD. Ireland was the one country (of the eight considered) that was found to be specialised in BERD and Value Added

A series of countries were also reviewed with respect to their national share of Value Added and share of BERD for this sector.[58] In 2005, Ireland showed by far the largest share of national BERD and national share of Value Added for this sector relative to all of the other countries considered.

Figure 9: BERD and Value Added Indices for the software & other computer services sector in 2005, for a range of European countries.



[58] Countries included Norway, Hungary, Czech Republic, Poland, Austria, Portugal, Finland, Japan, Denmark.

5.9 Other Primary & Manufacturing (NACE: 1-10 & NACE: 16,17,18,19,23,34, 35, 36.1-36.6,37)

Due to the broad range of activities associated with this sector, reporting of the economic and R&D profiles has been split out into two subsectors. Agriculture, Hunting, Forestry and Fishing activities are captured under the 'other primary' subsector. Manufacture of tobacco, textiles, wearing apparel, leather product, coke & refined petroleum products, motor vehicles, other transport equipment, furniture and finally recycling, are captured under the 'other manufacturing' subsector.

5.9.1 Economic Profile of 'Other Primary'

Table 17: Key economic facts and figures for the 'Other Primary' subsector: NACE 1-10. Monetary data is in €'000.[59]

	1999	2001	2003	2005	2007
Number of Firms	-	-	-	-	-
Total Employment	135,900	122,500	115,900	113,700	113,800
Total Employment/Total National Employment	8.6%	7.1%	6.5%	5.9%	5.4%
Gross Output	-	-	-	-	-
Gross Value Added	2,931,000	3,579,000	3,648,000	4,097,000	3,863,000
Gross Value Added/GDP	3.2%	3.1%	2.6%	2.5%	2.0%

Activities of companies in this sector includes agricultural production and Mining which covers not only extraction from a quarry, but also dredging of alluvial deposits, rock crushing and the use of salt marshes. The products are used most notably in construction, manufacture of materials, manufacture of chemicals, etc.

Over the 1999 -2007 time period, Gross Value Added showed overall positive growth.

The Gross Value Added of the other primary subsector accounted for 3.2% of the GDP in 1999 and this share decreased over the following years, and by 2007 it was 2.0%.

Employment figures associated with this subsector remain high, but there was a decrease in total employment by 16.3% between 1999 and 2007 and this translated to a change in the share of total national employment from 8.6% in 1999 to 5.4% in 2007.

[59] Net Output figures were not available for this sector, and so these measures have been replaced with Gross Value Added.

5.9.2 Research and Development Activity of 'Other Primary'

The 'other primary' subsector accounted for 0.11 % of BERD in 1999, and this decreased to close to 0% by 2007. In absolute terms, the yearly investment in BERD fluctuated during the years between 1999 and 2007 but declined to near zero activity levels by 2007.

The number of full time equivalent R&D personnel in the 'other primary' sector dropped to zero in 2007. In 2007, the 'other primary' sector did not receive support for R&D through Government grants.

Table 18: Key R&D facts and figures for the 'Other Primary' subsector: NACE:1-10. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	859	2,928	2,800	1,318	14
Share of National BERD	0.11%	0.33%	0.25%	.01%	0.00%
Total FTE R&D Personnel	13	35	17	14	0
Share of National FTE R&D Personnel	0.15%	0.39%	0.18%	0.13%	0.00%
Total R&D Spend/Net Output	0.03%	0.08%	0.08%	0.03%	0.00%

5.9.3 Economic Profile of 'Other Manufacturing'

Activities of companies included in this sector include manufacture of coke, refined petroleum products and nuclear fuel. Manufacture of furniture; Recycling: processing of waste and scrap and other articles into secondary raw materials.

In 1999, the 'other manufacturing' subsector in Ireland was represented by 896 firms. By 2007 the number of firms active in this sector had increased to 1,114. In 2003 [60] 92% of firms in this subsector were Irish owned.

The Net Output of this subsector accounted for 1.7% of the GDP in 1999 and this share decreased over the following years, and by 2005 it was 0.8%. The Net Output of the subsector as a proportion of the Net Output of the total Manufacturing Category was 2.1% in 2005, which was a decrease of 1.4% from the 1999 levels of 3.5%.

[60] Latest available data for the breakdown between indigenous and foreign owned companies.

Over the 1999 -2007 time period, Gross and Net Output in this sector remained reasonably static.

Total employment in this subsector decreased by 26% between 1999 and 2007 and this translated to a change in the share of total national employment from 2.1% in 1999 to 1.2% in 2007.

Table 19: Key economic facts and figures for the 'Other Manufacturing' subsector: NACE 16,17,18,19, 23, 34, 35, 36.1-36.6, 37. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	896	984	1,051	855	1,114
Total Employment	33,088	30,876	28,349	23,862	24,529
Total Employment/Total National Employment	2.10%	1.80%	1.60%	1.20%	1.20%
Gross Output	3,439,003	3,436,800	3,698,067	4,414,769	3,045,408
Net Output	1,499,357	1,498,531	1,470,680	1,355,611	-
Net Output/GDP	1.70%	1.30%	1.10%	0.80%	-

5.9.4 Research and Development Activity of 'Other Manufacturing'

Table 20: Key R&D facts and figures for the 'Other Manufacturing' subsector: 16,17,18,19, 23, 34, 35, 36.1-36.6, 37. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	21,806	19,391	23,484	17,984	22,154
Share of National BERD	2.7%	2.2%	2.2%	1.3%	1.3%
Total FTE R&D Personnel	353	245	299	172	231
Share of National FTE R&D Personnel	4.30%	2.7%	3.2%	1.7%	2.1%
Total R&D Spend/Net Output	1.45%	1.29%	1.60%	1.33%	-

An estimate of 7.3% of companies in the 'other manufacturing' subsector were R&D active in 2007.

The 'other manufacturing' subsector accounted for 2.7 % of BERD in 1999, and this decreased to 1.3% by 2007. In absolute terms, the yearly investment in BERD fluctuated during the years between 1999 and 2007. In 2007, BERD by foreign companies in this sector accounted for 50% of the sector BERD and 1 % of total BERD by foreign owned companies. BERD by Irish companies accounted for 50 % of BERD in this sector and 2.5% of the total BERD by Irish owned companies.

The number of FTE R&D personnel in the 'other manufacturing' subsector dropped by 35% between 1999 and 2007. The Irish owned companies accounted for 58 % of R&D employment in 2007 in this sector, in comparison to 42% by foreign owned companies. In 2007, this subsector employed 2.1 % of the national FTE R&D personnel.

In 2007, the 'other manufacturing' subsector received €1.7 million in support through Government grants, which was estimated at 11% of total spend on in-house R&D in this sector. In absolute € terms, the 'other manufacturing' subsector received the 9th largest sum of money for R&D by way of Government grants in 2007.

This subsector comprises a diverse range of activities and covers the NACE codes of manufacturing of; tobacco(NACE 16), textiles (NACE 17), wearing apparel(NACE18), leather goods (NACE 19);coke and refined petroleum products (NACE 23); motor vehicles (NACE 34), other transport equipment (NACE 35); of furniture (NACE 36); Recycling (NACE 37).

Approximately 50% of the BERD was by companies that fall under the motor vehicle and other transport equipment NACE codes (NACE 34,35). A further 30% of BERD was accounted for by the companies falling under the Recycling and manufacturing of furniture NACE codes (NACE 36,37). R&D employment in 2007 was dominated by companies associated with these four NACE codes, with nearly equal numbers of FTE R&D personnel being employed by companies associated with each of these four NACE codes.

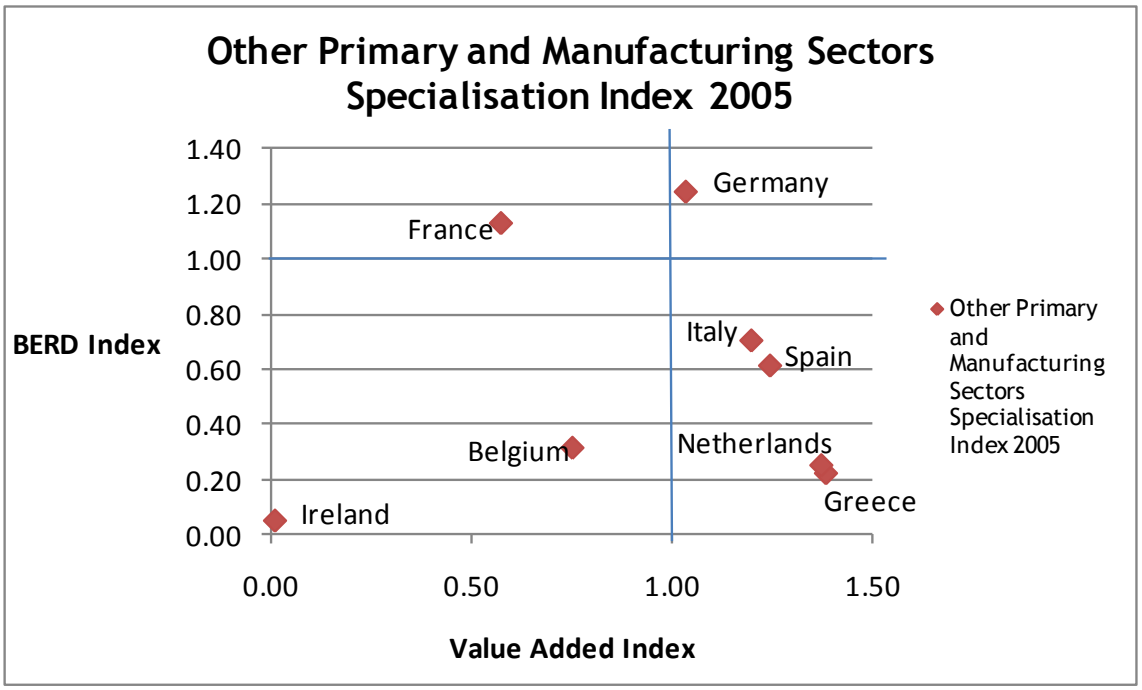
5.9.5 Importance of the Other Primary and Manufacturing Sector, to Ireland, in an International Context

In Fig. 10 the indices for BERD and Value Added, based on 2005 values of the total 'other primary and manufacturing sector' are plotted for a number of countries. Of the eight countries considered, two countries were not specialised in either BERD or Value Added, one country was found to be specialised in BERD but not Value Added, and four countries were found to be specialised in Value Added but not BERD. One country was found to be specialised in both BERD and Value Added. Ireland was one of the countries that was found to be neither specialised in BERD nor Value Added.

A series of countries were also reviewed with respect to their national share of Value Added and share of BERD for this sector.[61] In 2005, Ireland showed by the lowest share of national BERD and Value Added for this sector relative to all of the other countries considered.

[61] Countries included Norway, Hungary, Czech Republic, Poland, Finland, Korea.

Figure 10: BERD and Value Added Indices for the Other Primary and Manufacturing Sector in 2005, for a range of European countries.



5.10 Other Services: NACE 50-52, 60-64, 73-74 & NACE 65-67

In the 'other services' sector, the subsector 'financial intermediation' has been profiled separately due to the significant economic impact associated with this subsector. Elsewhere in the report where 'other services' is referenced, it is implied that financial intermediation is included in the respective data.

5.10.1 Economic Profile – 'other services' (excluding financial intermediation)

The 'other services' sector is based on the NACE codes between 50 and 99 for which data could be secured, and for which there was also BERD associated with the NACE codes. This sector (minus the financial intermediation subsector) covers a wide gamut of companies, and the series of subsectors that add to make the whole sector are as follows:

- Motor vehicle repair, and wholesale and retail trade: NACE 50 -52
- Transport and other communications services: NACE 60-64 less 64.2
- Telecommunications services: NACE 64.2
- Research and development services: NACE 73
- All other business activities: NACE 74

NACE codes, 50-52, 60-64, 73-74 were represented by 32,000 companies in 1999. The number of firms active in this sector has risen rapidly between 1999 and 2007, and has nearly doubled during this time period.

The Gross Value Added of this 'other services' sector accounted for 16.1% of the GDP in 1999 and this share increased over the following years, and by 2007 it was 18%.

Total employment in this sector increased by 70% between 1999 and 2007 and this translated to a change in the share of total national employment from 22.1% in 1999 to 28.4% in 2007.

Table 21: Key economic facts and figures for the other services sectors: NACE 50-52,60-64,73-74. Monetary data is in €'000.

	1999	2001	2003	2005	2007
Number of Firms	32,005	43,665	54,647	54,554	61,583
Total Employment	351,408	410,011	486,214	505,480	596,268
Total Employment/Total National Employment	22.1%	23.8%	27.2%	26.2%	28.4%
Turnover	61,774,315	83,472,287	105,228,012	138,095,183	160,678,971
Gross Value Added	14,547,455	17,625,927	25,335,401	33,446,676	34,281,111
GVA/GDP	16.1%	15.1%	18.2%	20.6%	18%

5.10.2 Research and Development Activity- 'other services' (excluding financial intermediation

0.15% of companies in the 'other services' sector were estimated to have some R&D activity in 2007. This sector accounted for 3.4 % of BERD in 1999, and this increased to 7.4% by 2007. In absolute terms, the yearly investment in BERD increased between 1999 and 2007 – albeit in a fluctuating manner, with a step change in BERD being measured in 2007. In 2007 BERD in this sector was evenly split between indigenous and foreign owned companies. In 2007, BERD by foreign companies in this sector accounted for 4.8% of total BERD by foreign owned companies. BERD by Irish companies in this sector accounted for 14.3% of BERD by Irish owned companies.

The number of FTE R&D personnel in the 'other services' sector fluctuated during the years between 1999 and 2007, reaching a high of over 1,000 FTE R&D personnel in 2007. The Irish owned companies accounted for 66 % of R&D employment in 2007 in this sector, in comparison to 34% by foreign owned companies. In 2007, this sector employed 9.8 % of the national FTE R&D personnel.

In 2007, this sector received €9.9 million in support through Government grants, which was estimated at 11.5% of the total spend on in-house R&D in this sector. In absolute € terms, the

'other services' sector received the 4th largest sum of money for R&D by way of Government grants in 2007.

Table 22: Key R&D facts and figures for the 'other services' sector: NACE 50-52,60-64,73-74. Monetary data is in €'000.[62]

	1999	2001	2003	2005	2007
BERD (€'000)	25,940	55,667	43,715	32,774	118,578
Share of National BERD	3.4%	6.8%	4.0%	2.5%	7.4%
Total FTE R&D Personnel	323	670	506	348	1,075
Share of National FTE R&D Personnel	3.9%	7.7%	5.5%	3.4%	9.8%
Total R&D Spend/Net Output	-	-	-	-	-

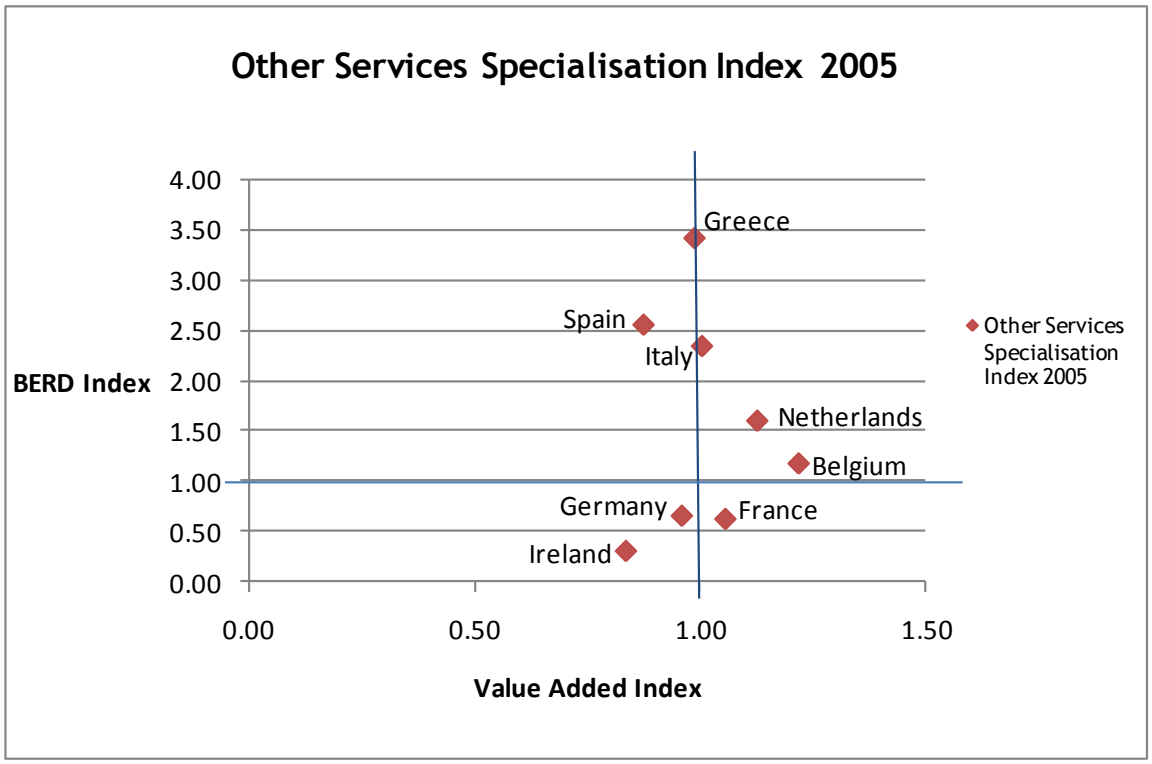
5.10.3 Importance of the 'Other Services' Sector (excluding financial intermediation) for Ireland in an International Context

In Fig. 11 the indices for BERD and Value Added, based on 2005 values for the 'other services' sector, are plotted for a number of countries. Of the eight countries considered, Ireland and Germany were the only country not specialised in either BERD or Value Added. Belgium and The Netherlands both showed a degree of specialisation in both BERD and Value Added. The remaining countries were found to be specialised in either BERD or Value Added.

A series of countries were also reviewed with respect to their national share of Value Added and Share of BERD for this sector.[63] In 2005, Ireland showed the lowest share of national BERD for this sector relative to all of the other countries considered. In some of the countries considered (Norway, Poland, Portugal and Spain), over 25% of the share of national BERD was invested in this sector. Other countries such as France, Germany and Japan showed a more modest 5-8% share of their BERD investment in this sector, however, Ireland was still significantly below this at a 2.5 % share of national BERD in 2005. This sector constitutes a considerable portion of the Value Added share for many countries (between 20% and 30%).

[62] Gross and Net Output figures were not available for this sector, and so these measures have been replaced with figures for Turnover and Gross Value Added.
[63] Countries included Austria, Czech Republic, Denmark, Finland, Hungary, Japan, Norway, Poland, Portugal.

Figure 11: BERD and Value Added Indices for the other services sector (excluding financial intermediation) in 2005, for a range of European countries.



5.10.4 Economic Profile of the Financial Intermediation Subsector (additional sub sector of 'other services')

Table 23: Key economic facts and figures of the financial intermediation subsector: NACE 65-67. Monetary data is in €'000.[64]

	1999	2001	2003	2005	2006
Number of Firms	-	87	80	79	-
Total Employment	61,000	68,400	72,600	83,700	83,900
Total Employment/Total National Employment	3.8%	4.0%	4.1%	4.3%	4.2%
Gross output	-	-	-	-	-
Gross Value Added	5,631,820	7,721,576	11,443,464	14,711,271	17,174,890
GVA/GDP	6.2%	6.6%	8.2%	9.1%	9.7%

[64] Gross and Net Output figures were not available for this sector, and so these measures have been replaced with figures for Turnover and Gross Value Added.

This subsector was represented by 79 companies in 2005. The Gross Value Added of the financial intermediation subsector accounted for 6.2% of the GDP in 1999 and this share increased over the following years, and by 2007 it was 9.7%.

Total employment in this sector increased by 38% between 1999 and 2007 and this translated to a change in the share of total national employment from 3.8% in 1999 to 4.2% in 2007.

5.10.5 Research and Development Activity of the Financial Intermediation Subsector (additional sub sector of 'other services')

This sector accounted for 0.5 % of BERD in 1999, and this increased to 1.4% by 2007.[65] [66] In absolute terms, the yearly investment in BERD increased between 1999 and 2007 albeit in a fluctuating manner, with a step change in BERD being measured between '03 and '05.

The number of FTE R&D personnel in the financial intermediation sector fluctuated during the years between 1999 and 2007, reaching a high of 210 FTE R&D personnel in 2007.

In 2007, this sector received approximately €1 million in support through Government grants, which was estimated at 5% of the total spend on in-house R&D in this sector.

Table 24: Key R&D facts and figures of the financial intermediation subsector: NACE 65-67. Monetary data is in €'000.

	1999	2001	2003	2005	2007
BERD (€'000)	3,658	10,527	13	19,326	21,704
Share of National BERD	0.5%	1.3%	0.0%	1.5%	1.4%
Total FTE R&D Personnel	72	117	1	168	210
Share of National FTE R&D Personnel	0.9%	1.4%	0.0%	1.6%	1.9%
Total R&D Spend/Net Output	0.1%	0.1%	0.0%	0.1%	0.1%

[65] There is an unusual drop to near zero in 2003, which cannot be explained.

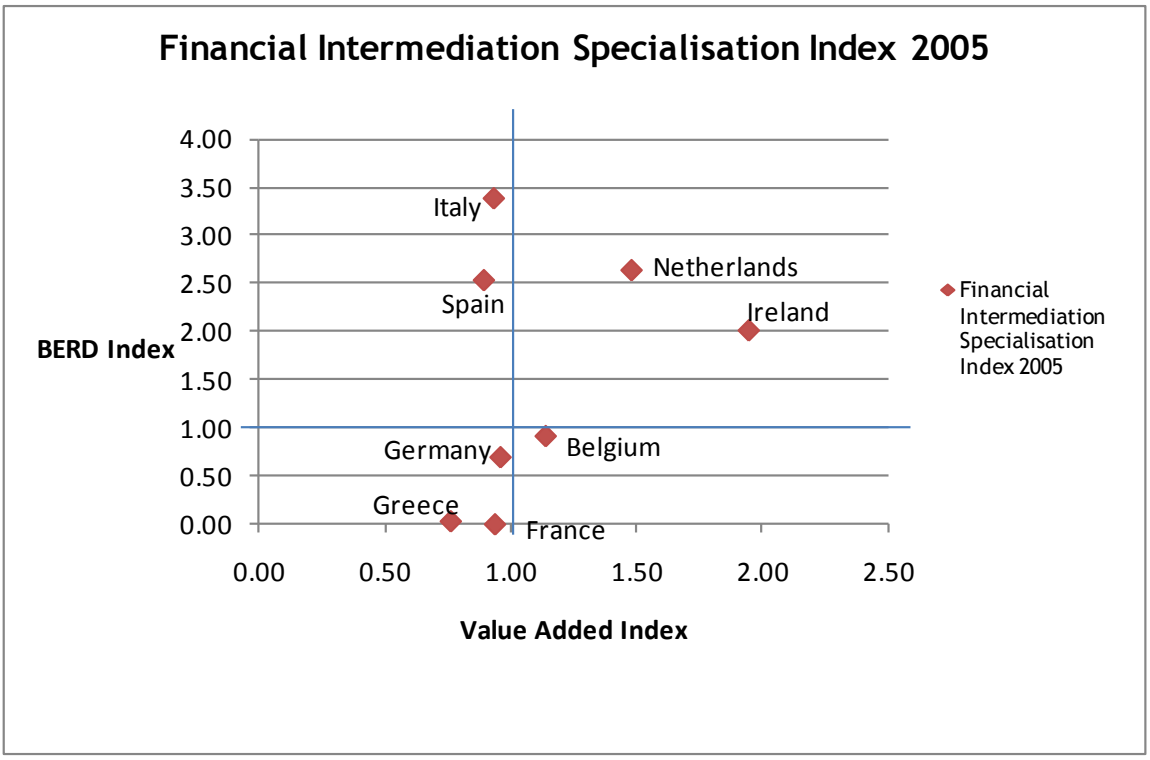
[66] In 2005, Financial Intermediation accounted for 37% of BERD in 'other services', and telecommunications accounted for 26% of BERD in the 'other services' industry. Financial Intermediation accounted for 31.5% of total Value added in 'other services', and telecommunications accounted for 16% of Value Added in the other services enterprise sector.

5.10.6 Importance of the Financial Intermediation Subsector for Ireland in an International Context

In Fig. 12 the indices for BERD and Value Added, based on 2005 values for the 'other services' sector, are plotted for a number of countries. Of the seven countries considered, Ireland and The Netherlands were the only countries specialised in both BERD and Value Added.

A series of countries were also reviewed with respect to their national share of Value Added and Share of BERD for this sector.[67] In 2005,Ireland showed the highest share of national GVA (at ~ 10%) in comparison to all of the other countries considered.

Figure 12: BERD and Value Added Indices for the financial intermediation subsector in 2005, for a range of European countries.



[67] Countries included Australia, Austria, Czech Republic, Denmark, Finland, Hungary, Japan, Norway, Poland, Portugal, Spain.

6. R&D Inactive Enterprise Categories and Sector Profiles

Companies associated with the following NACE codes were not included for detailed[68] profiling as there was minimal indication of BERD within these areas:

- Construction: NACE 45
- Electricity, Gas, & Water Supply: NACE 40-41
- Hotels & Restaurants: NACE 55
- Real Estate & Renting of Machinery and Equipment Without Operator and of Personal and Household Goods: NACE 70-71
- Public Administration/Defence: NACE 75
- Education: NACE 80
- Health & Social Work: NACE 85
- Other Activities: NACE 90
- Recreational, Cultural & Sporting Activities: NACE 92
- Sewage & Refuse Disposal/Membership of Organisations: NACE 90,91, 94-99

Together companies associated with these NACE codes accounted for in the region of 27 % of GDP in 2007 and in the region of 43% of employment.[69,70] When the contribution from the Primary Category is included (there was no R&D recorded in 2007 in this Category), then it is estimated that 29% of GDP and 49% of employment were associated with R&D inactive enterprise.

There was minimal BERD from Irish based enterprise tied to the companies associated with these NACE codes. In comparison, companies in some countries show some small level of activities in these areas, but in general these account for a small share of the BERD by the countries considered[71].

For example in the Construction Category (NACE 45);Austria, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Poland, and Spain reported BERD of 0-1% of total BERD in 2005. Belgium, Czech Republic, Japan, Netherlands, and Norway reported BERD of 1-

[68] A brief economic profile of each of these areas is included in Section 2 of Volume 2 of this report.
[69] The total of the profiled and non profiled sectors accounted for 96.2% of GDP in 2007 and 93.5% of employment. The discrepancy from 100% values can be accounted for by the fact that; a variety of data sources were used for profiling the employment; Net Output and GVA were intermixed, and 2005 (or 2006) figures were used in some instances when 2007 figures were not available.
[70] The contribution to GDP and employment by the Primary Category/sector is not included in calculating this figure. Although the BERD in the Primary Category/sector was zero in 2007, there was R&D recorded in years prior to this and so this sector was profiled.
[71] Countries considered were: Australia, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Netherlands, Norway, Poland, Portugal, Spain.

2% of total BERD in this area in 2005[72]. The exceptions were Australia who spent close to 4 % and Portugal who spent more than 9%.

In the Electricity, Gas and Water Supply Category (NACE 40-41); France, Iceland Poland and Spain spent 1-2% of national BERD in 2005. All other countries invested less than this.

Based on NACE codes 55 (Hotels & Restaurants), BERD was low in all countries considered, with Australia reporting the highest spend at 0.12% of total BERD in 2005. Based on NACE codes 75-79 (Community, Social & Personal Services),it was found that of the countries considered, Australia, Czech Republic, Greece, Portugal and Spain spent 1-2% on company R&D in these areas. All other countries invested less than 1% of their national BERD in this area. The NACE codes in the range 50-99 are all classified as sitting within the Service Category.

Thus, it would appear that Ireland is not unique in terms of the low level of R&D investment by companies associated with the NACE 1-10, NACE 40-41, 45, 55, 75-79 (Ireland registered less than 0.5% in each of these aforementioned areas in 2005).[73]

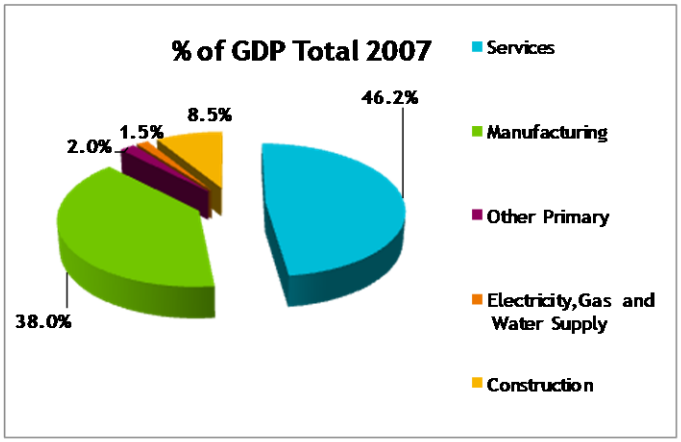
[72] BERD data was taken from the OECD Business enterprise R&D expenditure by industry and by source of funds Database, available through the OECD.stat website.
[73] It is noted that NACE codes between 50 and 99 are classified as sitting within the Services Category.

7. Enterprise Category and Sector Comparisons

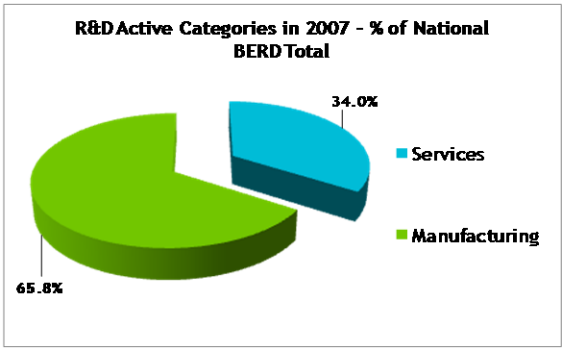
7.1 Enterprise Category Comparison

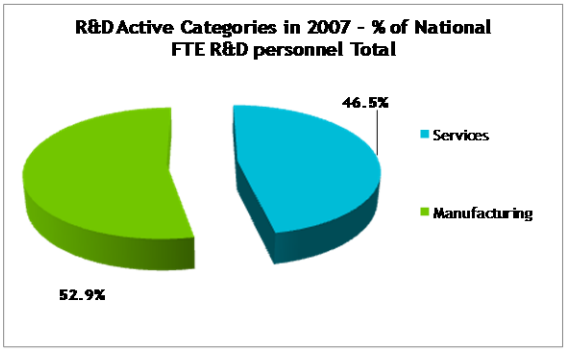
Pictorial views of the contribution to GDP and to employment by enterprise category, and their subsequent proportionate activity in terms of BERD and FTE R&D personnel are presented, based on 2007 data, in Fig. 13 (a) and (b) respectively.

Figure 13(a): Proportion of GDP associated with the industry categories and the BERD and employment of R&D personnel associated with each enterprise category in 2007.[74,75]



R&D Active Industry Sectors within the Manufacturing and Services Categories were associated with ~ 67% of GDP

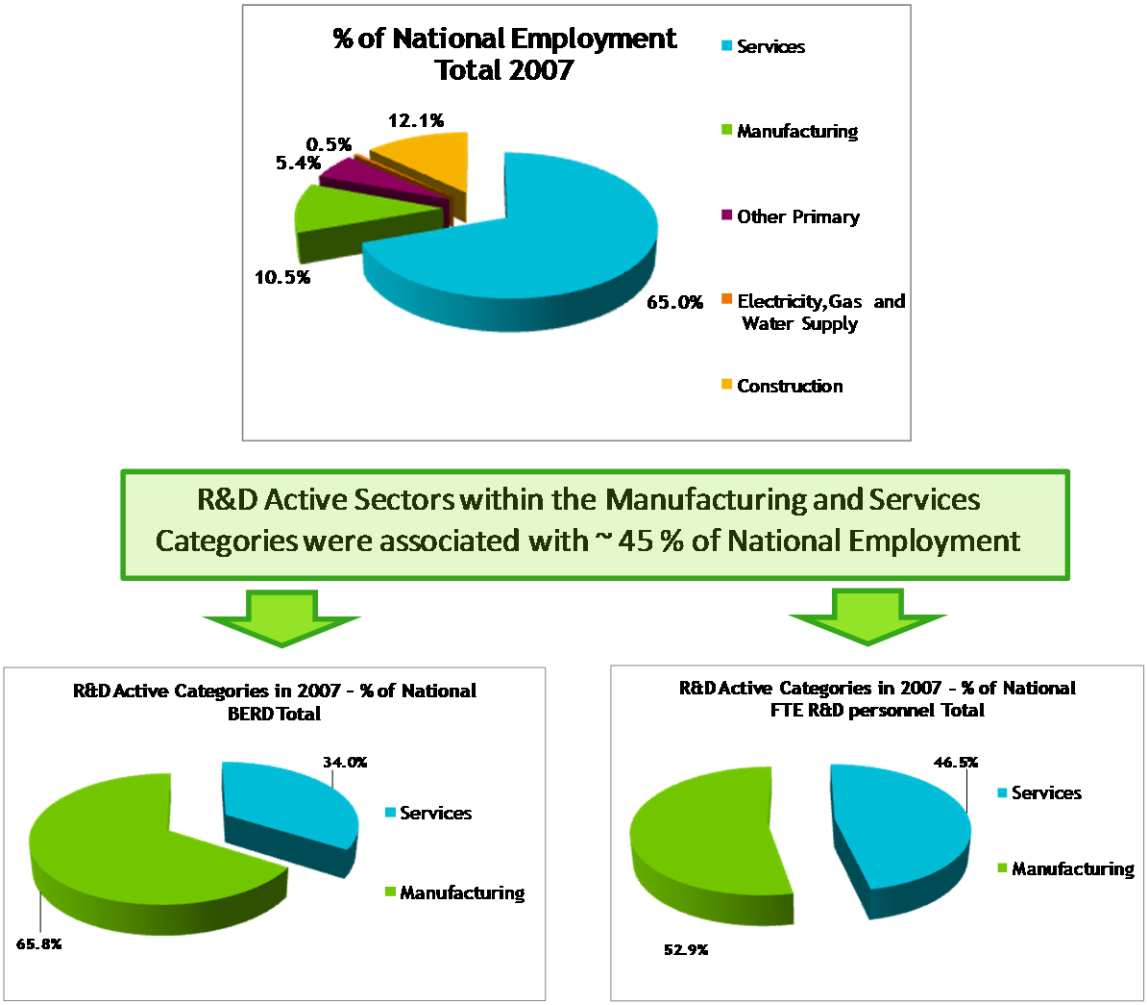




[74] It is noted that the Primary Category was classified as an R&D active category due to historical R&D engagement, but had no associated BERD in 2007.

[75] The total of the profiled and non profiled sectors accounted for 96.2% of GDP in 2007. The discrepancy from 100% values can be accounted for by the fact that a variety of data sources were used, Net Output and GVA were intermixed, and 2005 (or 2006) figures were used in some instances when 2007 figures were not available.

Figure 13(b): Proportion of employment associated with the industry categories and the BERD and employment of R&D personnel associated with each enterprise category, in 2007.[76]



Two of the five categories were classified as R&D inactive (Construction, and Electricity, Gas & Water Supply) and together accounted for 5.7% of GDP and 4.9% of employment in 2007.

The Primary Category was classified as an R&D active Category, based on R&D activities prior to 2007. However, there was no R&D activity recorded in 2007. This Category contributed 2% to GDP and 5.4% to employment in 2007.

The two categories that had R&D activity associated with them in 2007 were the Services and Manufacturing Categories, which together contributed to ~84% of GDP and ~76% of employment (including both R&D active and inactive sectors in the Services Category).

The Manufacturing and Services Categories both contributed significant proportions to GDP at 38% and 46.2% respectively. However, the Services Category had a significantly bigger impact on the level of employment at 65%, over the 10.5% impact of the Manufacturing Category.

[76] The total of the profiled and non profiled sectors accounted for 93.4% of employment. The discrepancy from 100% values can be accounted for by the fact that a variety of data sources were used for profiling the employment and 2005 (or 2006) figures were used in some instances when 2007 figures were not available.

As can be seen in Fig. 14(a) and 14(b), the R&D sectors within the Services Category that were R&D active (software & other computer services, 'other services', financial intermediation) accounted for 29.4 % of GDP and 34.4% of national employment. The R&D inactive sectors accounted for 16.8% of GDP and 30.6% of national employment.

Figure 14 (a): Contribution to GDP, by the various sectors within the Services Category.

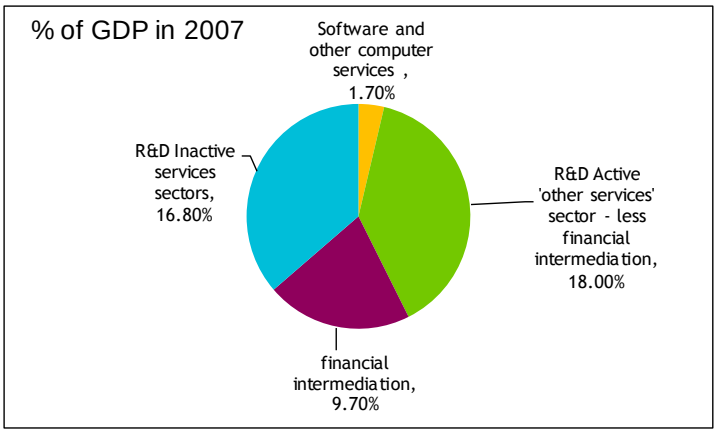
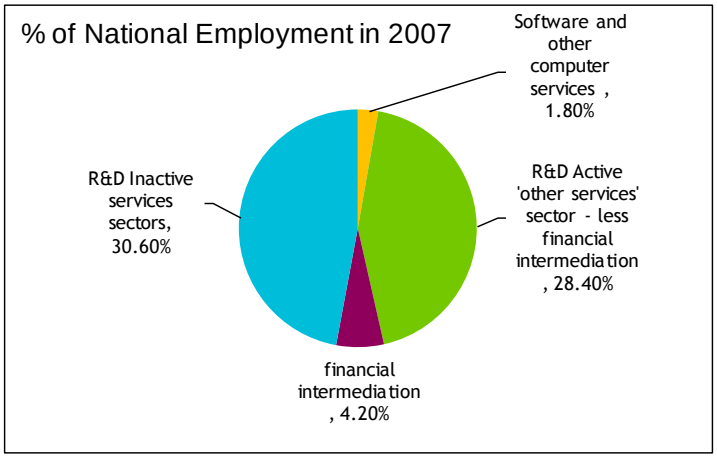


Figure 14 (b): Contribution to national employment, by the various sectors within the Services Category.



Top level economic and R&D engagement figures are provided for the Manufacturing and Services Categories in Table 25. The economic data is provided for both the total Services Category and the proportion of the Services Category that is R&D active. As can be seen in Table 25, 66 % of BERD was in the Manufacturing Category and 34% of BERD was invested in the Services Category in 2007. Whilst the Manufacturing Category also had a higher level of FTE R&D personnel associated with it at 52.5%, the Services Category was close behind in this case with 46.5% of FTE R&D personnel.

Table 25: Top level economic and enterprise R&D engagement data for the Manufacturing and Services Categories.

Category	% GDP	% National Employment	% BERD	% FTE R&D Personnel
Services - R&D active and inactive sectors	46.20%	65.00%	34%	52.50%
Services - R&D active sectors	29.40%	34.40%	34%	52.50%
Services - R&D inactive sectors	16.80%	30.60%	0%	0.00%
Manufacturing	38%	10.50%	66%	46.50%

7.1.1 Key Messages Based on Enterprise Category Comparison

A review of the BERD and R&D FTE Personnel with respect to the status of the economic impact of the enterprise categories highlights that in 2007:

- Two thirds of the BERD spend was in the Manufacturing Category and this underpinned 10.5% of employment and ~ 38% of GDP.
- Taking into consideration the whole of the Services Category, then two thirds of national employment, and half of GDP was underpinned by one third of the total BERD. However, a more detailed view of the activity of sectors within the Services Category revealed that 75% of the BERD investment associated with this category was in the software and other computer services, for which the contribution to GDP and employment was only 1.7% and 1.8% respectively.
- The number of FTE R&D personnel employed in the Services and Manufacturing Category was similar despite the lower investment in the Services Category. This is likely a consequence of the higher capital investment required in the Manufacturing Category.

7.2 Sector Comparison Data

7.2.1 Comparison of Individual Sectors

In this section, a series of charts and tables are presented to provide comparator views of the economic impact and BERD engagement of the different enterprise sectors profiled. The following information is presented:

- Figures 15,16 and 17 represent the contribution of each enterprise sector to GDP, the contribution of each enterprise sector to employment and the ratio of the proportion of GDP to the proportion of employment for each sector respectively.
- Figures 18 and 19 represent the proportion of national investment in BERD associated with each sector and the proportion of national FTE R&D personnel associated with each sector respectively.
- Figure 20 represents the BERD intensity for each sector.
- Table 26 summarises the performance of each of the enterprise sectors in terms of BERD and Value Added, as determined from a comparison of performance with other countries.
- Table 27 provides 2007 data on the key economic and BERD measures in tabular form. It also includes further information in terms of the proportion of the total Government R&D grants that were received by each industry and the proportion of the total BERD by each industry that is represented by the Government R&D grants to each industry. Finally, the proportion of employment in a given sector that is accounted for by FTE R&D personnel is also presented in Table 27. The 1999 data for each sector is also presented in this format in Section 5 of Volume 2 of this report.
- Table 28 represents the data from Table 27 in a ranking format. This clearly identifies a sector's relative performance in terms of impact/engagement for a given measure. The 1999 data for each sector is also presented in this format in Section 5 of Volume 2 of this report.
- Table 29 is a matrix which denotes whether economic and R&D measures have had positive or negative growth based on a comparison between 1999 and 2007 data. Comments are provided with this table for sectors where consistent growth of a factor under consideration was not the trend over the time period considered (1999 -2007).

Considering all of the information presented in Figures 15-20 and Tables 26 – 29, a series of key points of interest are noted and key messages are developed in terms of the economic impact and BERD performance based on the ten sectors profiled.

Figure 15: Net Output as a % of GDP for each of the ten Sectors in 1999 and 2005/2007.[77,78,79]

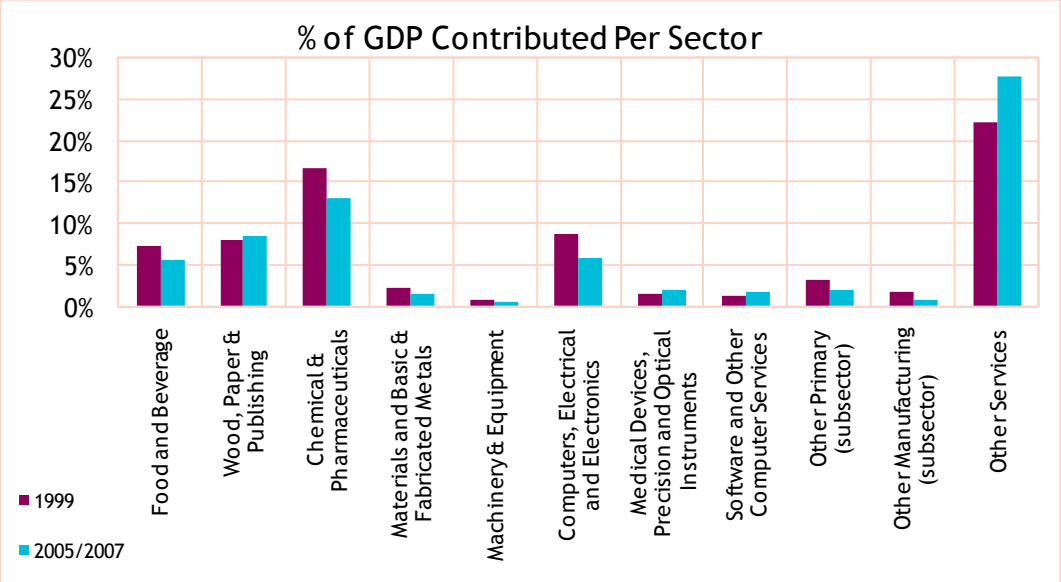
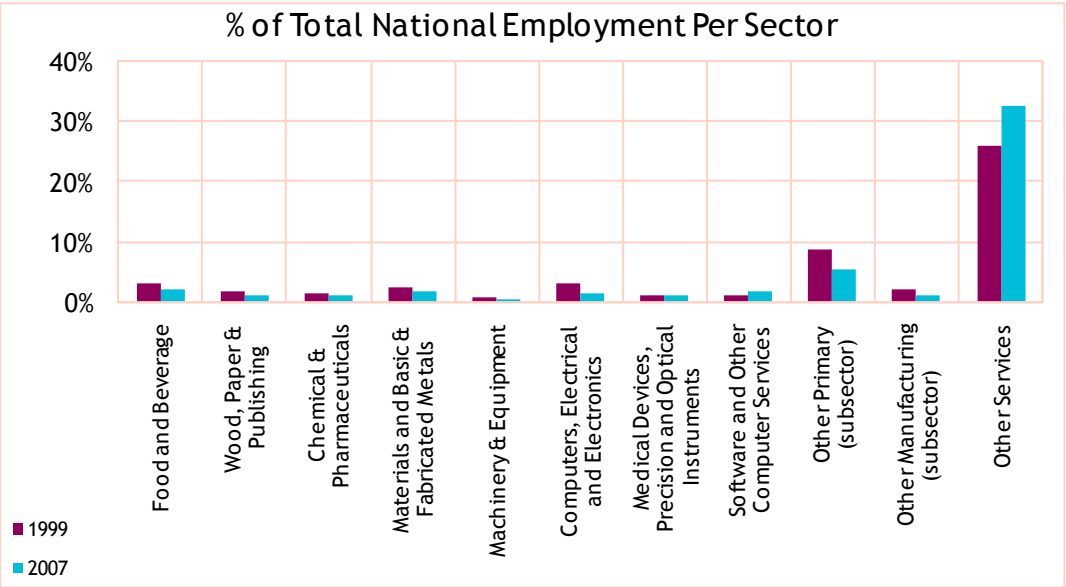


Figure 16: The proportion of the total national employment provided by each sector in 1999 and 2007.



[77] The 'other primary and manufacturing' sector is split in to two subsectors- primary and 'other manufacturing'.

[78] 2005 data was the latest available data for the medical devices, precision and optical instruments sector, the computer, electrical & electronics sector and the 'other manufacturing' subsector was for 2005. Data for the other sectors was based on 2007 figures.

[79] Gross Value Added figures were used in place of net output for the software & other computer services sector, the primary subsector, and the 'other services' sector.

Figure 17: The ratio of the proportion of GDP and proportion of national employment by each sector in 1999 and 2007.

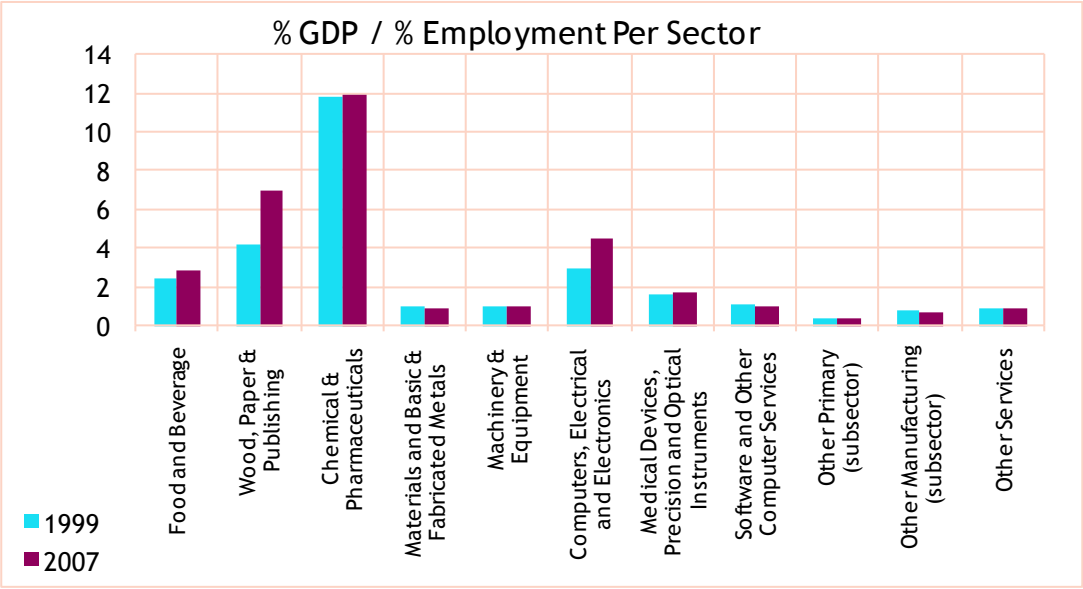


Figure 18: The proportion of the total national BERD by each sector in 1999 and 2007.

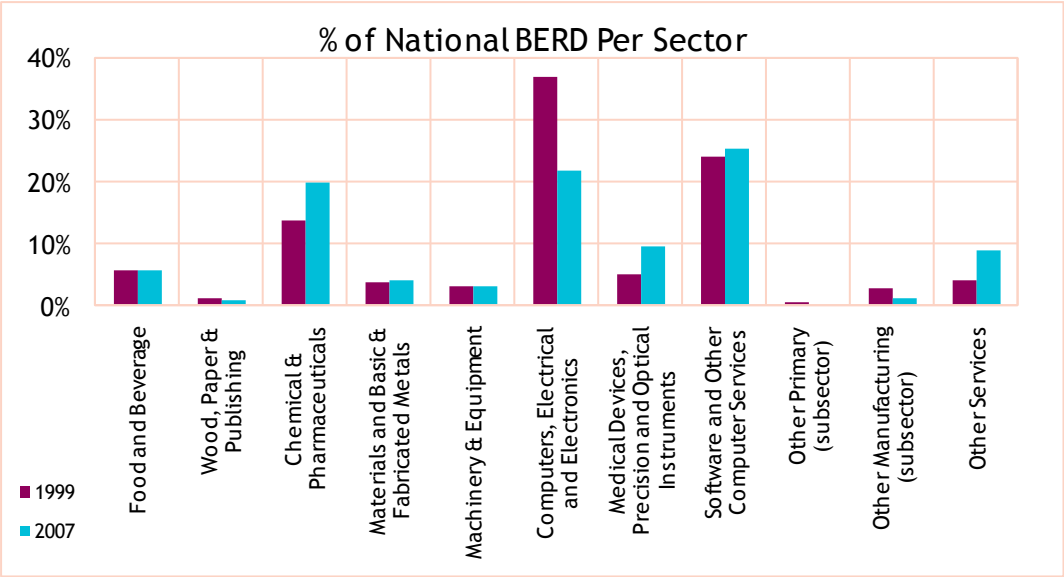


Figure 19: The proportion of the total national FTE R&D personnel employed by each sector in 1999 and 2007.

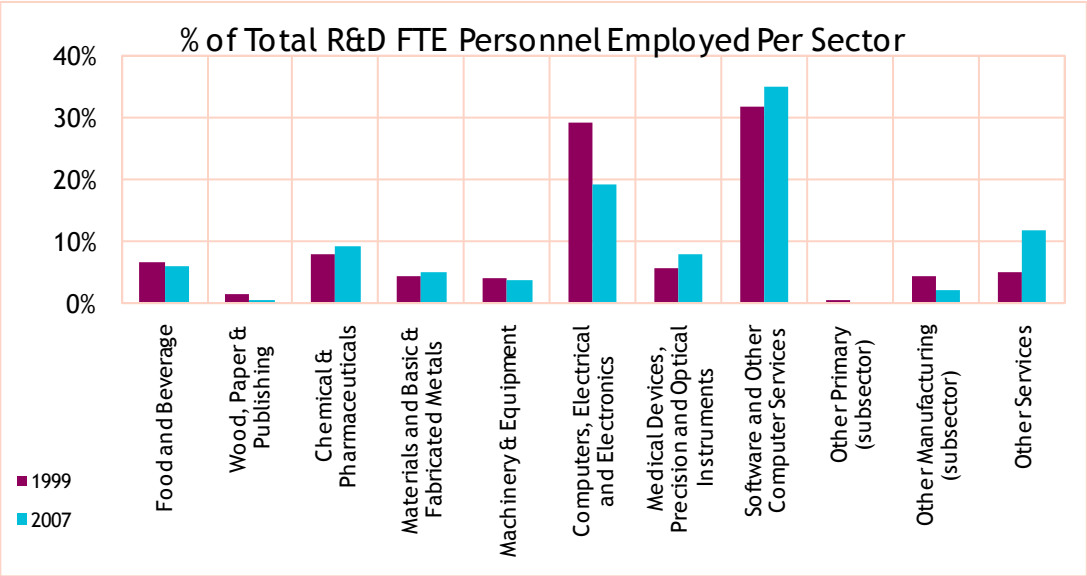
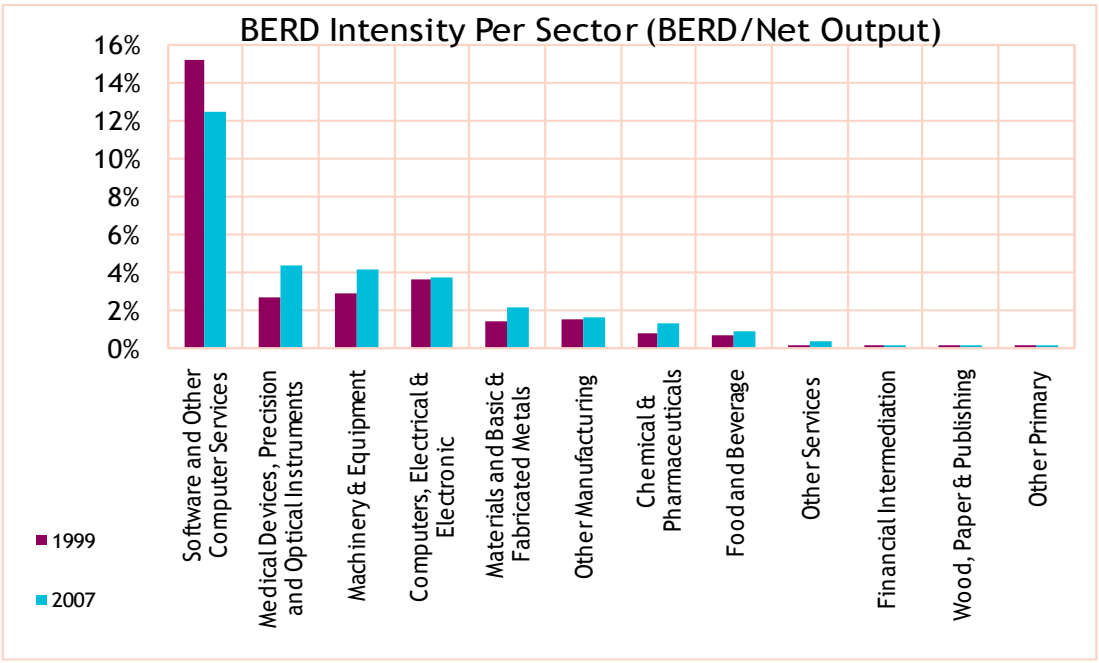


Figure 20: The BERD Intensity (BERD/Net Output or GVA) for each sector in 1999 and 2007.[80]



[80] The BERD Intensity is estimated based on GVA for the Software and other computer services sector, the 'other services' sector, the financial intermediation and 'other primary' subsectors. 2005 economic data was used for the medical devices, computers, electrical & electronics and 'other manufacturing' subsector.

Table 26: Specialisation performance of enterprise sectors as defined based on comparison of BERD and Value Added activities with other countries.

	Specialised in BERD	Specialised in Value Added
Other Services (excluding financial intermediation)	no	no
Financial Intermediation	yes	yes
Chemical & Pharmaceuticals	yes	yes
Wood, Paper & Publishing	yes	yes
Computers, Electrical & Electronics	yes	yes
Food & Beverage	yes	yes
Other Primary and Manufacturing	no	no
Medical Devices, Precision and Optical Instruments	yes	yes
Software & Other Computer Services	yes	yes
Materials and Basic & Fabricated Metals	no	no
Machinery & Equipment	no	no

Table 27: Top level economic and enterprise R&D figures in 2007[81],for the ten most R&D intensive enterprise sectors in Ireland.

	% GDP	% of national employ-ment	% of national BERD	% of national FTE R&D personnel	% of total Gov Grants to each Industry	% of Gov Grant to in house R&D spend	FTE R&D as a % of total employ ment	% of firms R&D active
Other Services (including financial intermediation)	27.70%	32.60%	8.80%	11.70%	12.80%	8.30%	0.16%	0.15%
Chemical & Pharmaceuticals	13.10%	1.10%	19.78%	9.10%	7.70%	2.1%	4.16%	43.00%
Wood, Paper & Publishing	8.40%	1.20%	0.70%	0.50%	1.96%	14.7%	0.22%	3.70%
Computers, Electrical &Electronics	5.80%	1.30%	21.80%	19.00%	20.40%	4.9%	7.49%	59.00%
Food &Beverage	5.60%	2.00%	5.50%	6.00%	8.78%	8.4%	1.53%	23.00%
Other Primary and Manufacturing	2.80%	6.60%	1.40%	2.10%	2.27%	4.8%	0.17%	7.30%
Medical Devices, Precision and Optical Instruments	2.10%	1.20%	9.50%	7.80%	16.09%	9.0%	3.30%	63.00%
Software & Other Computer Services	1.70%	1.80%	25.20%	34.80%	22.85%	10.1%	10.31%	6.00%
Materials and Basic & Fabricated Metals	1.60%	1.90%	4.00%	4.80%	5.16%	6.8%	1.35%	6.00%
Machinery & Equipment	0.60%	0.60%	3.10%	3.60%	2.63%	4.6%	3.20%	26.00%

[81] In the case of in the case of the computers, electrical & electronics sector, the 'other manufacturing' subsector, and the medical devices, precision and optical instruments sector 2005 data was used for the comparison of GDP and %GDP, as it was the latest data available.

Table 28: Relative ranking of the key economic and BERD measures based on 2007[82] data, for the ten most R&D intensive enterprise sectors in Ireland.

	Ranking - impact on GDP	Ranking - impact on employment	Ranking - investment in BERD	Ranking - relative numbers of R&D personnel employed	Ranking of size of Gov grants to each enterprise sector	% of Gov Grant to in house R&D spend	FTE R&D as a % of total employment	% of firms R&D active
Other Services	1	1	5	3	4	6.90%	9	0.15%
Chemical & Pharmaceuticals	2	9	3	4	6	2.10%	3	43.00%
Wood, Paper & Publishing	3	7	10	10	10	14.70%	8	3.70%
Computers, Electrical & Electronics	4	6	2	2	2	4.90%	2	59.00%
Food & Beverage	5	3	6	6	5	8.40%	6	23.00%
Other Primary and Manufacturing	6	2	9	9	9	4.80%	10	7.30%
Medical Devices, Precision and Optical Instruments	7	8	4	5	3	9.00%	4	63.00%
Software & Other Computer Services	8	5	1	1	1	10.10%	1	6.00%
Materials and Basic & Fabricated Metals	9	4	7	7	7	6.80%	7	6.00%
Machinery & Equipment	10	10	8	8	8	4.60%	5	26.00%

[82] In the case of the computers, electrical & electronics sector, the 'other manufacturing' subsector, and the medical devices, precision and optical instruments sector, 2005 data was used for the comparison of GDP and %GDP, as it was the latest data available.

Table 29: Matrix representing the change in economic and BERD measures for each enterprise sector between 1999 and 2007. [83,84]

Comaprison between 1999 and 2007/2005 1 demonstrates an increase, 0 demonstrates no change, -1 demonstrates a decrease									
Sector	Net Output/GVA	% GDP	Employment	% Employment	BERD	% BERD	FTE R&D	% FTE R&D	FTE R&D personnel as a % of total employment
Other Services	1	1	1	1	1	1	1	1	1
Chemical & Pharmaceuticals	1	-1	0	-1	1	1	1	1	1
Wood, Paper & Publishing	1	1	-1	-1	1	-1	-1	-1	-1
Computers, Electrical & Electronics	0	-1	-1	-1	1	-1	-1	-1	1
Food & Beverage	1	-1	-1	-1	1	-1	1	-1	1
Other Primary & Manufacturing	1	-1	-1	-1	0	-1	-1	-1	-1
Other Primary	1	-1	-1	-1	-1	-1	-1	-1	-1
Other Manufacturing	-1	-1	-1	-1	0	-1	-1	-1	-1
Medical Devices, Precision and Optical Instruments	1	1	1	1	1	1	1	1	1
Software & Other Computer Services	1	1	1	1	1	1	1	1	-1
Materials and Basic & Fabricated Metals	1	-1	0	-1	1	1	1	1	1
Machinery & Equipment	1	-1	-1	-1	1	1	1	-1	1

[83] GVA figures are used for the 'other primary' subsector and net output for the 'other manufacturing'.
[84] For the most part 2007 data was used as the comparator data, however, in the case of the computers, electrical & electronics sector, the 'other manufacturing' subsector, and the medical devices, precision and optical instruments sector 2005 data was used for the comparison of GDP and %GDP, as it was the latest data available.

Table 29 provides a summarised view of the change in the various economic and R&D measures by comparing 1999 and 2007/2005 data. The headings have the following meaning:

- % GDP relates to the contribution of a sector to the economy.
- % Employment relates to the proportion of national employment represented by a sector.
- % BERD relates to the proportion of national BERD that a sector represents.
- % FTE R&D relates to the proportion of national FTE R&D that a sector represents.
- % FTE R&D personnel as a % of total employment relates to the proportion of employment accounted for by FTE R&D personnel in a given sector.

The key for the matrix is as follows:

- A value of '1' represents an increase in the value of the measure; be it an increase in absolute terms for example an increase in employment between 1999 and 2007, or an increase in a proportionate measure for example an increase in the proportion of national employment contributed by a sector.
- A value of '0' represents static performance i.e. little change in an absolute or proportionate figure in comparing 1999 and 2005/2007 data.
- A value of '-1' represents a decrease in an absolute value or a proportionate value.

Whilst the matrix reflects a direct comparison between 1999 and 2005/2007, the following observations were made by examining the data points in the intervening years.

- In other services, BERD increased in fluctuating manner, with a step change between '05 and '07.
- In the chemical and pharmaceutical sector the % BERD was greater in '07 than '99, but less than the '05 value.
- In the computers, electrical & electronic sector the Net Output in '05 was greater than the Net Output in '99, but there were fluctuations in the year to year growth status of net output between '99 and '05. There was a dramatic drop in FTE R&D personnel between '99 and '01 with subsequent increases since then, but as of '07, the levels of '99 have not yet been recovered. There was a dramatic drop in BERD (€284 mill to €110 mill) between '99 and '01. BERD increased since then, and '07 levels surpassed '99 levels. Employment dropped by 20,000 (from 48,000) between '99 and '07.
- In the food & beverage sector, BERD decreased between '01 and then increased. The % BERD decreased in 2003 but has been increasing since. % FTE R&D decreased but showed growth again in '05 and again in '07. Overall it appears that R&D activity in this sector is on an upward trend, from a low in '03.
- % of GDP contributed by the software and other computer services was higher in '07 than in '99, but this measure peaked in '01 and appears to have declined to a steady value by '07. The % of national BERD was slightly higher in '07 over ' 99, but it peaked due to a step change in BERD in '01, and has grown very little since then resulting in a decline from the proportion of 45% of BERD held by this sector in '01. There was a step increase in FTE R&D personnel between '99 and '01 but the FTE R&D personnel has remained

reasonably static since. Thus, the % FTE, while higher in '07 than '99, declined from a peak in '01.

7.2.2 Sector Comparisons: Key Messages

7.2.2.1 Summary of the Economic and R&D Activity of the Enterprise Sectors Profiled

Economic Impact

- Net Output / GVA grew over the time period 1999 – 2007 in nine of the ten sectors reviewed (all sectors except computers, electrical & electronics[85]).
- Within the 'other primary and manufacturing' sector, the 'other manufacturing' subsector showed a decline in net output over the time frame considered[86] (though overall the total sector showed an increase in Net Output/GVA). In the computer, electrical & electronics industry the Net Output fluctuated during the time period[87].
- Based on an expanding economy, the relative contribution to GDP of four of the sectors reviewed was larger in 1999 than in 2007 (software and computer services, medical devices, other services and, wood paper and publishing).[88]
- Between 1999 and 2007 employment levels grew in only three of the ten enterprise sectors profiled: the medical devices, software & other computer services and the 'other services' sector. Growth in employment in these sectors was such that the proportion of national employment associated with each sector increased between 1999 and 2007.
- Employment levels decreased in the food & beverage, wood, paper & publishing, machinery & equipment[89], computers, electrical & electronics, and the 'other primary and manufacturing sectors' between 1999 and 2007.
- Employment in the chemical & pharmaceutical and, materials, basic & fabricated metals enterprise sectors remained reasonably static between 1999 and 2007.

[85] The latest available data set for the computers electrical & electronics sector was 2005.

[86] The latest available data set for the 'other manufacturing' subsector was 2005.

[87] Data only available up to 2005.

[88] Six of the sectors reviewed (food and beverage, chemical and pharmaceutical, materials and basic & fabricated metals, machinery and equipment, computers, electrical and electronics, other primary and manufacturing) was smaller in 2007 than in 1999.

[89] There was an increase in going from 2005-2007

R&D Activity

- In nine of the ten sectors, BERD was higher in 2007 than in 1999. The exception was the 'other primary and manufacturing' sector.
- Over the period 1999 to 2007, six sectors recorded an increase in contribution to national BERD: chemical & pharmaceutical, materials, basic & fabricated metals, machinery and equipment, medical devices, software & other computer services[90], other services[91].
- Over the period 1999 to 2007, six sectors recorded an increase in FTE R&D personnel employed (food & beverage, chemical & pharmaceutical, materials, basic & fabricated metals, machinery & equipment, medical devices, software & other computer services, and other services).
- Over the period 1999 to 2007, four sectors showed an increase in their share of national FTE R&D personnel (chemical & pharmaceutical, materials, basic & fabricated metals, medical devices and other services).
- The proportion of employment represented by FTE R&D personnel increased in seven of the ten sectors during the period 1999 -2007. This increase was measured in enterprise sectors regardless of whether employment increased or decreased, thus indicating that companies in these sectors were either hiring or retaining R&D personnel in greater proportions to other job functions.
- The BERD Intensity increased between 1999 and 2007 in all sectors except the 'other primary' and the wood, paper & publishing sector.
- The sectors that did not show an increase in the proportion of R&D personnel in employment included the wood, paper & publishing sector, the 'other primary & manufacturing' sector and the software & computer services sector. The former two sectors were associated with the lowest R&D activity in 2007 of the ten sectors reviewed. In this regard it is not surprising that these are the sectors that have not demonstrated a proportionate increase in the employment levels represented by FTE R&D personnel. The software & other computer services sector was associated with the highest level of R&D activity in 1999 with a proportion of 14 % of employment through FTE R&D personnel. So in 1999 this sector was at a high baseline to start with, relative to other sectors. Considering the significant increase in employment in this sector between 1999 – 2007 this sector has maintained a high level of R&D staff (representing 10% of employment in 2007).

[90] Software & other computer services shows an increase in % of national BERD when 1999 and 2007 are directly compared, however, the proportionate share of national BERD peaked in 2001 and showed decline up to 2007.

[91] There was a significant increase in BERD that occurred between 2005 and 2007 in the other services sector.

7.2.2.2 Sectoral View of the Top Performing Sectors

Economic v R&D Activity

- The services sector[92] showed by far the biggest economic impact in 2007 ranked 1st for contribution to GDP and employment (at 27.7% of GDP and 32.6% of employment), but only ranked as the 5th biggest sector for € investment in R&D (up from 6th in 1999), and ranked 3rd in terms of the number of FTE R&D employees (up from 6th in 1999). Based on an international comparison, this sector was found not to be specialised in terms of BERD or Value Added (although a subsector ' financial intermediation' was found to be specialised in both BERD and Value Added).
- The chemical & pharmaceutical sector was ranked 2nd highest in terms of impact on GDP in 2007, however, its GDP has been growing at a very low rate since 2001 and employment has remained static. There has been a ramping in BERD and the number of FTE R&D personnel since 2001.
- The 'other primary ' subsector was the 2nd highest employer of the sectors reviewed, however during the time frame considered there was a decrease in employment, and a decrease in Net Output between 2005 and 2007. The BERD and FTE R&D personnel declined to zero over this period.
- Despite having the 3rd highest impact on GDP in 2007, the wood, paper & publishing sector ranked lowest in terms of € investment and FTE R&D personnel.
- The food sector had the 3rd highest employment impact in 2007, however, the number employed in this sector decreased between 1999 and 2007. Despite the decrease in overall employment, the number of FTE R&D personnel employed in this sector increased.
- Based on the time period 1999 to 2007, only three sectors (software & other computer services, medical devices and 'other services') demonstrated an increase in absolute number of employees.
  - In addition to showing increasing employment, the software & other computer services, medical devices and 'other services' also showed an increase in their share of proportion of national employment and an increase in proportion of GDP.
  - These three sectors were underpinned by strong growth in R&D activity, demonstrating increased proportions of national BERD and FTE R&D personnel when 1999 and 2007 figures were compared.
  - Whilst BERD and the number of FTE R&D personnel employed increased systematically over the time period in the medical devices sector, growth in the software & computer services and the other services sectors was more erratic.

[92] Based on the economic impact of R&D active subsectors, and excluding software services.

R&D vs Economic Activity

- The software & other computer services sector had the highest ranking in terms of BERD and the number of FTE R&D personnel employed in 2007, although the proportion of national share for both these measures has been decreasing since 2001. In contrast, the Net Output, proportion of GDP, absolute number of employees and share of national employment have increased in this sector between 1999 and 2007.
- The computers, electrical & electronics sector was ranked 2nd in 2007 in terms of BERD and numbers of FTE R&D personnel employed. However, it stands out as being the most fluctuating sector both in terms of economic and BERD profile during the 1999-2007 time frame; growth in Net Output measured during this time fluctuated from positive to negative from year to year; employment dropped by 41% (reduction of 20,0000 employees); BERD and the number of FTE R&D personnel dropped by ~ 50% between 1999 and 2001 (and then increased gradually between 2001 and 2007). The ranking position of this sector for GDP and employment dropped from 3rd in 1999 to 4th and 6th respectively by 2007.
- The chemical & pharmaceutical sector rank 3rd highest in terms of investment in BERD (and 4th in terms of employment of FTE R&D personnel). This sector has demonstrated static economic activity, with approximately constant levels of employment and Net Output associated with this sector between 1999 and 2007. However, an increase in the absolute number of FTE R&D personnel has been recorded over this time frame. So, while the number of employees may have remained constant, there has been a change in the nature of the work undertaken by employees/profile of some employees. The proportion of the work force in this sector represented by FTE R&D personnel has increased from 2.8 % in 1999 to 4.2% in 2007.
- The other services sector ranked 3rd in 2007 in terms of employment levels of FTE R&D personnel. There was a step change in terms of FTE R&D personnel employment and BERD between 2005 and 2007. Whilst this sector was found not to be specialised in terms of BERD and Value Added on an international comparison in 2005, the financial intermediation subsector was found to be specialised in both BERD and Value Added. The other services sector account for 20.5 % of GDP in 2005 when the financial intermediation subsector was excluded. The proportion of national BERD in this area was 2.5% in 2005, which was low in comparison to the proportionate investment by other countries in this area in 2005 (ranging from 5-8 % by Japan, France and Germany, to 25-30 % for Spain, Norway, Poland, Portugal). However, by 2007, the step change in BERD in this area (other services excluding financial intermediation) had raised the proportion of national BERD to 7.4%.

APPENDIX 1: Glossary of Terms

Number of firms

Results are presented for industrial local units with 3 or more persons engaged and industrial enterprises with 3 or more persons engaged - as per CIP for the manufacturing sectors.

Large, medium and small enterprise

Small Enterprise - fewer than 50 persons engaged.

Medium Enterprise – at least 50 but fewer than 250 persons engaged.

Large Enterprise - at least 250 persons engaged.

Gross Output

Gross Output is the same as Gross Domestic Product. It represents total expenditure on the output of goods and services produced in the country and valued at the prices at which the expenditure is incurred.

Net Output

Net Output is the difference between *gross output* and *industrial input* (it is a better measure of the relative economic importance of the different sectors than *gross output*).

Industrial input is defined as the cost of materials, industrial services and fuel and power used in the year.

Gross Value Added

Gross Value Added (GVA) is conceptually the same aggregate as Gross Domestic Product (GDP). They both measure the added value generated in an economy by the production of goods and services. The difference between the two concepts is that GDP is measured after including product taxes (e.g. excise duties, non deductible VAT, etc.) and deducting product subsidies while GVA is measured prior to adding product taxes but includes product subsidies. GVA can be computed for industrial groups and can be looked upon as the sum of wages and profits (compensation of employees and operating surplus in national accounts terminology) in each industry group.

Turnover

Turnover comprises the net selling value of goods manufactured by the enterprise, of industrial services provided by the enterprise for others, of goods sold without further processing and the value of miscellaneous items of turnover (such as rents, licence fees, royalties, etc.). It is valued:

- exclusive of VAT;
- exclusive of subsidies;
- inclusive of excise duty and other taxes payable on such goods, such as MCA charges;
- net of discounts allowed to customers (including allowances for returns);
- inclusive of transport charges to the customer's premises whether by the enterprise's own vehicles or by hired transport.

FTE R&D personnel

From Frascati Manual OECD 2002:

"One FTE may be thought of as one person-year. Thus, a person who normally spends 30% of his/her time on R&D and the rest on other activities (such as teaching, university administration and student counselling) should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this results in an FTE of 0.5. Since the normal working day (period) may differ from sector to sector and even from institution to institution, it is not meaningful to express FTE in person-hours."

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