PRICEWATERHOUSECOOPERS

Department of Enterprise, Trade and Investment

The Future Role of Manufacturing in Northern Ireland

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Appendices

Contents

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Annex A: Regional Forecasting Model and Data

Regional forecasts have developed a substantially new model of the Northern Ireland economy for the DETI targets project. This is intended to be used initially for forecasting EDF indicators to provide early warning of any substantial potential deviation from the targets adopted by EDF. The key features of the model of direct relevance to policy makers are:

- Inclusion of forecasts for EDF target variables including such things as inward investment, new company formation, expenditure on R&D and skills levels; and
- The linking of these 'policy' variables to the wider economy.

The model is thus capable of answering questions about the impact of potential changes in these 'policy variables' on the wider economy. An example might be, for instance, the impact of a higher rate of new company formation on aggregate GVA per head.

The model is very large, and is a substantial addition to the tools available to those responsible for making economic policy in Northern Ireland. It includes over 2,000 variables and equations and covers a much wider set of economic issues than any previous model of the Northern Ireland economy. We believe that it is unique, in that no similar system exists for any other UK region.

The model has been built on the framework of the Northern Ireland section of the existing RF/OEF model of UK regional economies, although the new model is much larger, includes a much more extensive range of variables and has a richer set of inter-relationships between variables.

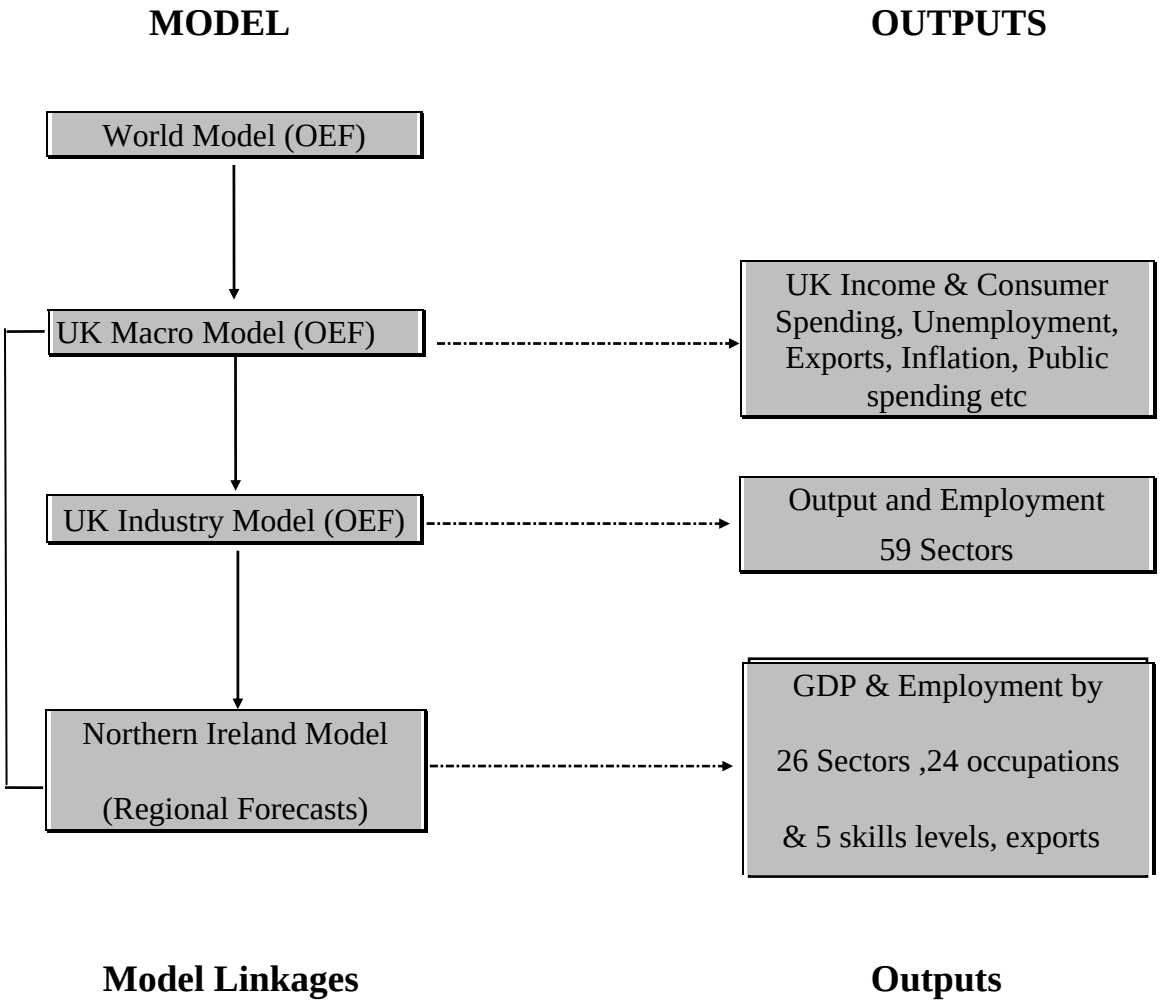
Links to National Models

Like the regional model the new NI model is closely linked to OEF models of the world and UK economies. These relationships are described in Chart 2.1 below.

The major link between the OEF models and the new NI model is at the level of individual industry output and employment forecasts from OEF's UK industry model (Chart 2.1). Each of the UK variables becomes an argument in the various regional model equations. The relationship between the MRM and the OEF models is thus not merely a mechanical imposition of constraints; it ensures that the projections are *fully consistent with a coherent macro-economic background*. Further, quantifiable alterations in the UK national or international context can be 'cascaded down' through the OEF models to the MRM and their regional implications traced out.

The OEF models are fully articulated econometric systems involving hundreds of variables and equations. These include a wide range of government policy variables, and forecasts are consistent with stated government policy on such things as public expenditure, tax and benefit rates. Interest rates are usually set so as to meet official inflation targets. In the long run, the UK economy is driven by a trend rate of growth, which is currently close to 2.5% per annum.

Chart 2.1: Modelling Framework

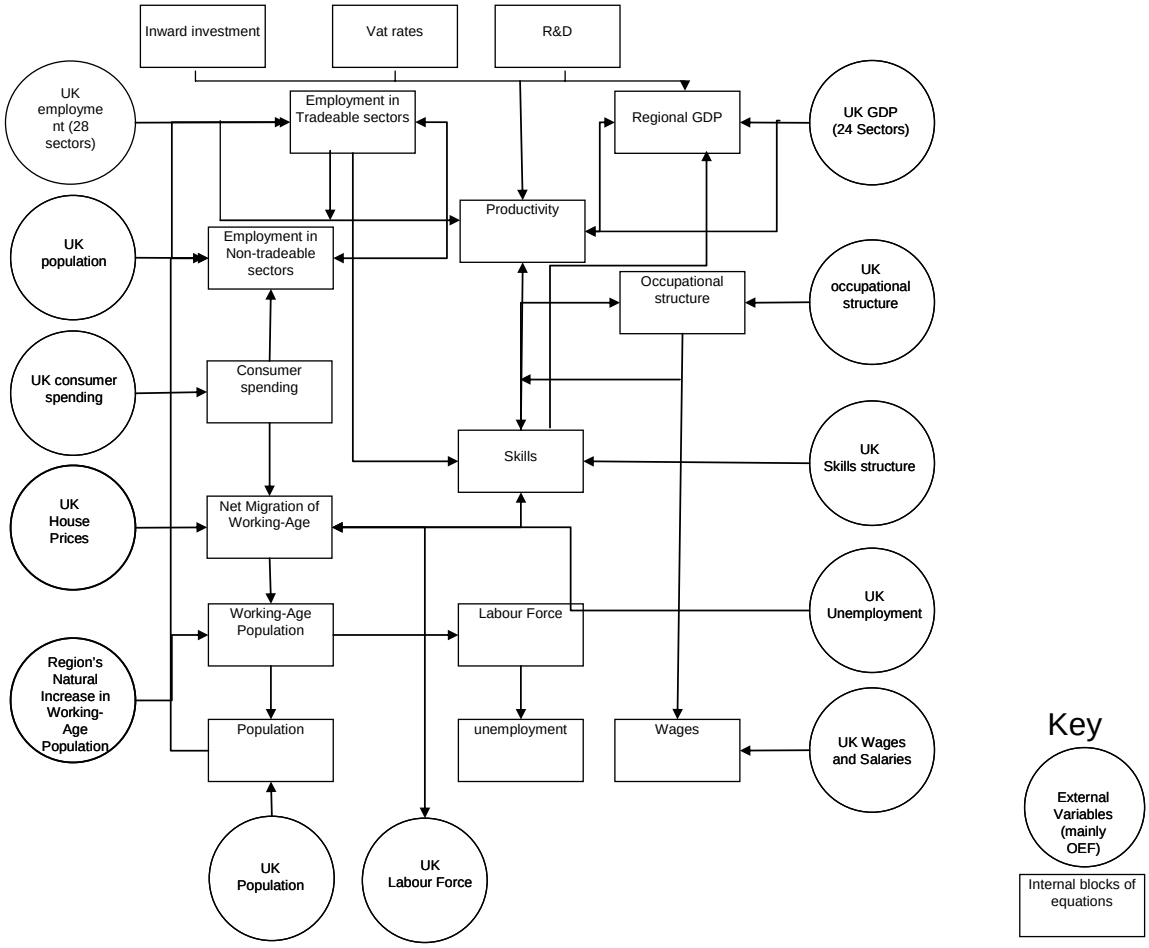


The Northern Ireland Model

The NI model is a *simultaneous system* with feedback links between labour supply, population growth, employment, output and wages. For instance, wage levels influence output and hence employment. Employment in turn determines unemployment which then affects net migration of working age people and hence population. Since employment and output in most service sectors are dependent either directly on population, or indirectly via consumers spending, a simultaneous loop is completed via the link between population and output and employment.

In a national economic model, labour market conditions, and especially unemployment, would be expected to influence wage rates to complete another feedback loop. However in the Northern Ireland case there is little evidence that falling unemployment has increased wages. Indeed, the converse has occurred. As unemployment has converged on the GB average, wage levels have diverged. This may be due to diverging skills levels, but research remains to be done to demonstrate this. As a result the wage equations in the Northern Ireland model do not include direct links to unemployment. Instead they are determined by extrapolating well established trends relative to national wage levels in each sector, with an additional term for relative skills levels.

Chart 2 sketches the various modules of the model.



Output and Employment

Output and employment are projected at a detailed level of industrial disaggregation (26 sectors). Employment is also projected for 24 separate occupations, and 5 separate skills levels. In each case the equations for Northern Ireland include a term for the equivalent variable at national, UK, level. In this way, national monetary and fiscal influences, as well as fluctuations in national and international demand, influence the projections for the Northern Ireland economy.

Most detailed attention has been given to those sectors in which Northern Ireland has most export potential. These are manufacturing, including food production with its links to agriculture, and financial and business services. In the case of manufacturing, the system begins by calculating the expected change of GVA in manufacturing based on national rates of growth for each separate manufacturing sub-sector. The ratio of actual change in GVA relative to the expected change is then modelled by an equation including the following policy-relevant terms and other influences:

- Inward investment
- New company formation

- Business expenditure on R&D
- Skills levels (level 0 and level 4/5)
- Wage levels
- Capacity utilisation in GB

In each case, the variables in the above list are expressed relative the national, UK, average. Employment in manufacturing is obtained through dividing GVA by productivity, measured as GVA per employee. Productivity, in turn, is estimated using a separate equation. This incorporates some of the same variables from the manufacturing output equation. For example, we assume that new inward investment projects have a higher productivity than that in existing firms, firstly because they embody new equipment and technology, and secondly because they are usually foreign-owned and foreign-owned companies in the UK typically have higher productivity than domestically owned companies. Inward investment thus increases productivity as well as output. The result is that output rises faster than employment when new inward investment is present. Similarly, we expect product innovation as a result of R&D to raise the average value of GVA by proportionately more than it raises employment.

In other sectors it is employment that is determined first, with output (GVA) subsequently calculated using a productivity relationship. This is done because employment data is more up to date and for many service sectors is felt to be more timely than the GVA series. In the case of business services, Northern Ireland's share of UK employment in the same sector is determined by the following variables:

- Inward investment
- New company formation
- Skills levels (level 0 and level 4/5)
- Wage levels
- Local demand (total employment used as an indicator)

Again, each of these variables is measured relative to the national average. In practice, skills levels in this sector are much the same in Northern Ireland as in GB and the relative variable has little influence and is omitted. It can however be included for policy simulation purposes. For employment in financial services, only the local demand and inward investment variables are included. New firm formation is negligible in this sector and is not included.

In other service sectors Northern Ireland employment is determined by trends relative to national employment in the same sector adjusted for the level of demand in Northern Ireland relative to the UK. For production sectors, other than manufacturing, employment is determined using estimated trends in Northern Ireland's share of UK employment. Similarly, productivity in these sectors is determined through extrapolating trends in past productivity relative to the UK average in the same sector.

The number of self-employed in each individual sector is projected as a multiple of the number of employed people in the same sector. The multiple in each case is the ratio of self-employed to the employed in the latest year. If there is any systematic trend in the ratio, this is reflected in the projected figures.

Employment by Occupation

Employment is projected for 24 separate occupation groups. Projections prepared by the University of Warwick Institute for Employment Research (IER) are used to calculate shares for each occupation within each sector. These are then applied to projected employment totals for each Northern Ireland sector to obtain projected total numbers in each occupation. There is no facility in the model at present for these occupation *shares* to change, but occupation *numbers* alter each time the sectoral employment forecasts are changed.

Employment by Skill Level

Two separate projections are included in the model. One is for the demand for skills, and the other is the supply of skills both among the employed and the working-age population as a whole. In each case the official classification of skills is used ranging from level 0 (no qualifications) to level 4/5 (graduate and postgraduate qualifications or equivalent). The demand for skills is projected in two stages:

1. the fixed (2001) proportion of each skills level in each occupation group within each sector is applied to the employment forecasts by sector and occupation
2. the projections obtained in stage 1 are adjusted by the extrapolated trend in the ratio of the actual to the expected (i.e. stage 1) proportions for each skills levels.

The supply of skills is measured as the proportion of each skill level among the working-age population as a whole. This is projected as a trend relative to the same proportion in the UK as a whole. The is currently no link in the model between the supply and demand for skills, and only the skill structure of the employed population influences changes in output or employment. The skills of the inactive population currently play no role in determining output or employment forecasts. However the model could be adjusted so that pools of unemployed or inactive people with skills could influence inward investment into Northern Ireland.

Exports

Manufacturing exports are projected for the UK as a whole in the OEF UK Macro Model based on trends in international demand, exchange rates, and UK capacity utilisation. For Northern Ireland, exports in manufacturing as a whole are firstly expressed as a ratio to GVA. The trend in this ratio, relative to the same ratio at national level, is then projected forwards. Actual manufacturing exports are then calculated on the basis of this ratio multiplied by UK exports and the ratio of NI manufacturing output to UK manufacturing output. A similar procedure is followed for individual manufacturing sectors. These are then scaled to the total of manufacturing exports.

Current OEF forecasts for UK exports predict double digit growth for several years as the level of world demand revives. This leads to a significant rise in the share of exports in UK manufacturing output, and we expect this to be reflected within Northern Ireland manufacturing.

Demography and Unemployment

Population is simultaneously determined within the model alongside all of the other variables. The only exogenous input is the natural increase in population, by the Registrar General's Office. Net migration of working age is forecast from an econometrically estimated equation with the following terms:

- unemployment rate in Northern Ireland
- change in number unemployed in UK
- employment rate in UK
- ratio of UK house prices to UK wages

The projected number of migrants is added to the natural increase to obtain the projected population of working age. For the total population, net migration is estimated as working–age migration plus 10%. This is then added to the natural increase for the whole population.

The economically active population is forecast as 76% of the working-age population. The number of unemployed is simply the difference between the number of economically active people and the number of employed and self-employed.

Policy Variables

The model includes a number of variables for economic activities that are assisted by government in Northern Ireland and hence directly amenable to influence by government policy. These include:

- jobs promoted and created through new inward investment in manufacturing and services separately
- jobs created through the creation of new companies in manufacturing and in financial and business services
- business expenditure on R&D in manufacturing and business services

Each of these variables has a series of equations. These project the variable and link it to the wider economy through its influence on manufacturing output and productivity and business services employment. Coefficients for these equations are either obtained from the economics literature or through estimation from historical data.

For inward investment, the number of jobs promoted in manufacturing and services is projected through an equation on UK business investment growth. These firms are assumed to create 76% of the promoted jobs spread over the three years following the year of grant offer. The productivity of the new firms in manufacturing is estimated to be twice that of existing manufacturing firms in Northern Ireland.

For new company formation the number of new firms is forecast through projecting the trend in the NI formation rate relative to the UK rate. The change in the stock of firms is then calculated as the previous stock plus new firms less closures. The closure rate is taken as the average over the period 1994-2002. To express the change relative to the UK average, an expected change in the stock of firms is calculated. This is the previous year's stock multiplied by the growth rate of the UK stock. The surplus (or

deficit) of new firms in Northern Ireland is the difference between the projected change in the stock of firms and the expected change. Each firm is estimated to have 5 employees, a figure based on past research undertaken at NIERC.

Business investment per employee in R&D in Northern Ireland is projected as a share of UK business investment per employee in R&D. The impact of this investment on output and productivity is estimated by an equation using coefficients based on the extensive economic literature on the impact of R&D investment.

Annex B: Analysis of historical trends

Introduction

This Section provides an analysis of the recent trends in the manufacturing sector and associated sub-sectors in Northern Ireland. In addition it supplies a comparison with the UK, US and EU trends. The objective of this Section is to provide an understanding of how the manufacturing sector is structured in Northern Ireland and how it has performed across a range of key economic variables, thus establishing a basis for the remainder of the report. This Section takes the following structure:

- Decline or growth?;
- Sector in context;
- Sectoral trends;
- Sub-sectoral trends;
- Wages;
- Manufacturing start-up rates;
- Ownership;
- Local trends;
- International comparisons;
- Financial support and investment; and
- Conclusions.

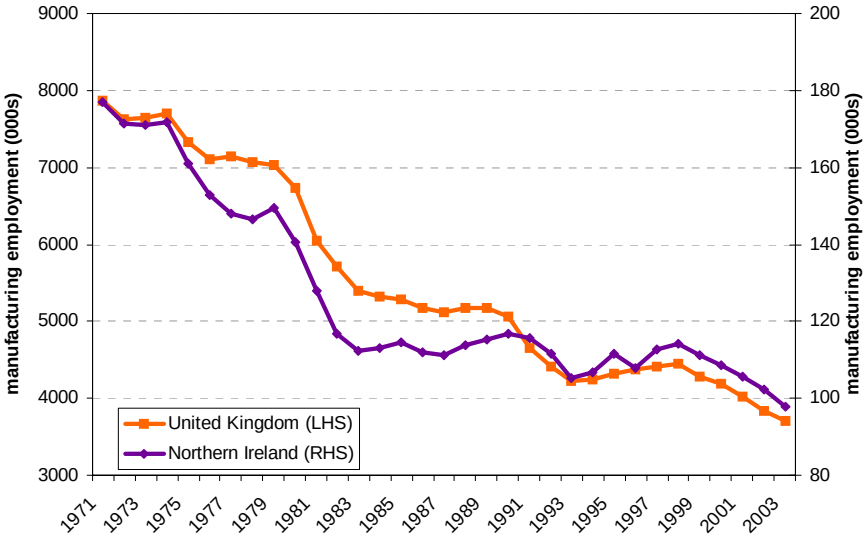
Decline or growth?

During the 19th Century, parts of Northern Ireland, in particular Belfast, underwent considerable industrialisation. The port of Belfast became one of the most important ship building areas in the world, and was key to the British Imperial economy and to both World War efforts. Belfast also became the centre for many linen mills and associated textile products such as rope. The importance of these two broad manufacturing sectors in the region's economy continued after World War II. However with the recent and much publicised decline in textiles and ship building in developed economies, the products through which the region became world leaders gradually contracted.

Employment data suggest recession

The long term trend in manufacturing employment in Northern Ireland, as in the rest of the UK, is downwards, as indicated in the chart below.

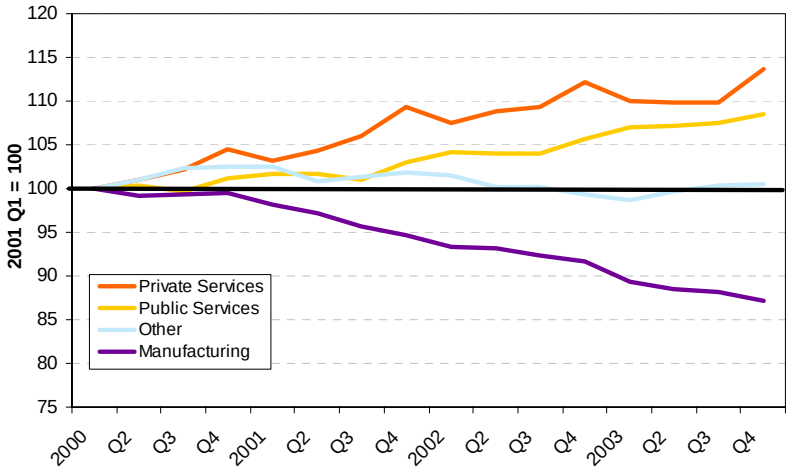
Chart B1: Employment in manufacturing, NI and UK: 1971-2003



Note: Manufacturing employment includes self employed
Source: DETI, NS, Regional Forecasts

The chart depicts a strong recent contraction in Northern Ireland employment since 1998 after a period of stability during the 1980's and 1990's. This stability was only mirrored in the UK during the mid-late 1990s with UK employment falling more steadily over the last 3 decades. Northern Ireland is now on an employment trend similar to elsewhere in the UK, with a very close match in the extent of contraction since 1998. By June 2004, manufacturing employment had reached an all time low of 88,920 in Northern Ireland. The short term series in the chart below sets out the recent Northern Ireland employment data in more detail.

Chart B2: Short term trends in employees in employment, NI: 2000Q1 – 2003Q4 (2000Q1 = 100)



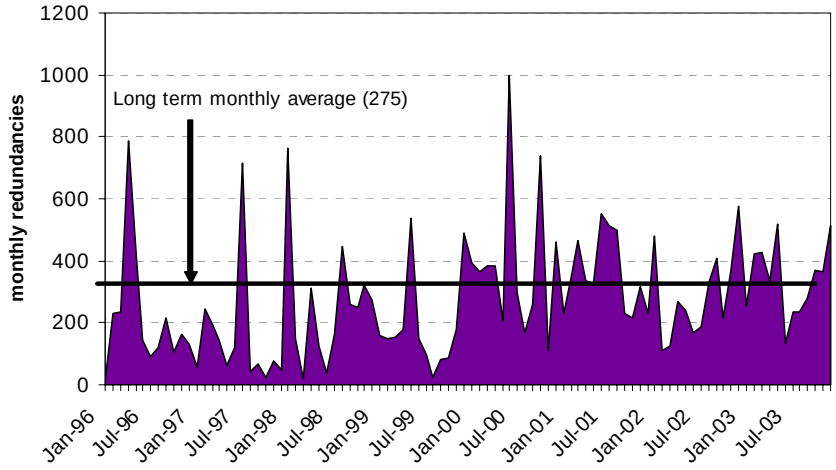
Note: Excluding self employed
Source: DETI

The 12 consecutive quarters of job loss in manufacturing would suggest a firmly "recessionary" trend for the sector. This is in contrast to the path of both public and private services which have grown over the same period. This transition from manufacturing to services is mirrored across many UK regions and has been a feature of UK economic growth for over 3 decades.

Gross employment gain and loss - picture less clear cut

The overall employment series presented above is net and therefore masks any job creation that may be occurring and offsetting job losses. Although available redundancy data is by no means complete, in that not all job losses are officially recorded – particularly for smaller firms - it is an important factor to consider in the analysis. The monthly redundancy trends in manufacturing are set out in the chart below.

Chart B3: Manufacturing redundancies, NI: 1996 - 2003



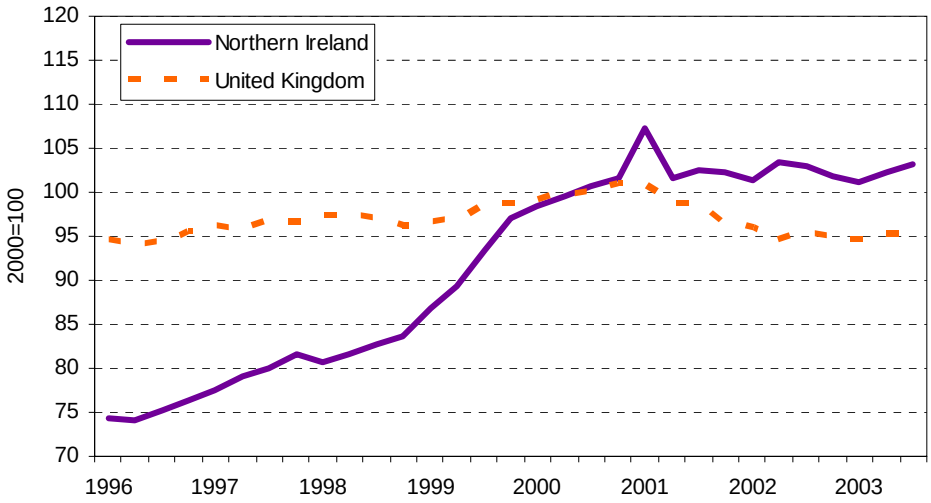
Source: DETI

The total manufacturing job loss over the period 1996-2003 as measured by redundancy statistics is recorded at 26,440 jobs. Given that, over the same period, recorded manufacturing employees in employment fell by 11,180, this suggests that at least 15,000 jobs were created since 1996 in manufacturing. This figure of almost 2,000 jobs per annum is a significant level of job creation, in contrast to the overall picture of decline. Although the short term recruitment and lay-off of workers may exaggerate redundancy data somewhat, there are also likely to be significant numbers of redundancies not recorded in the DETI statistics. This suggests that gross job creation in manufacturing may have been even higher.

No recession in output

Despite the recessionary pattern in overall employment, the output data suggests rather different trends. The figure below sets out the manufacturing output index data since 1996 for Northern Ireland and UK.

Chart B4: Manufacturing output index, NI and UK: 1996-2003



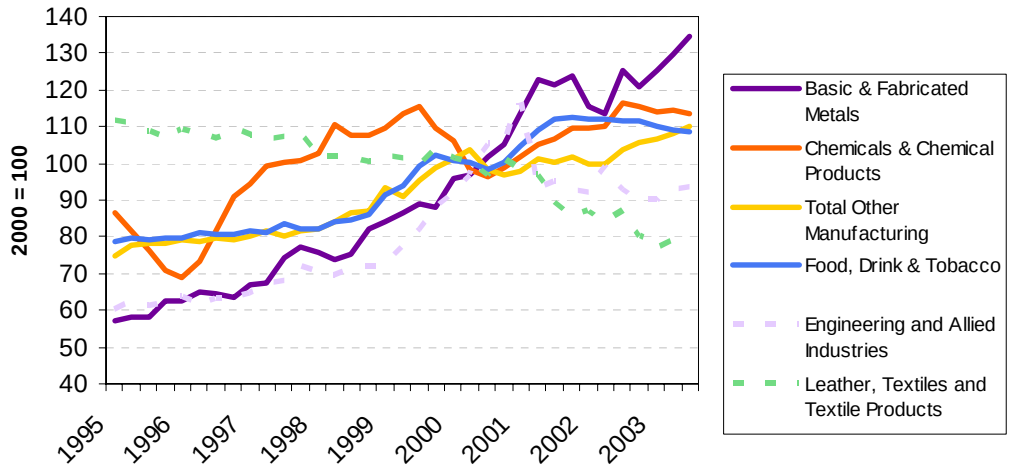
Source: DETI, NS

Manufacturing output rose considerably in the period 1996-2000 in Northern Ireland despite the corresponding loss in jobs over that period (post 1997). Growth in the Northern Ireland index has, since late 2002, been more closely correlated with the UK output index, and overall output below the peak experienced in 2001.

It is likely that the divergence in employment and output levels is at least in part explained by the loss of jobs in the least profitable firms and improvements in output levels from existing firms as trading conditions have improved. This suggests many firms were operating below capacity during the recent global downturn and as exchange rates have improved for exporters and world demand (particularly from the US) has begun to grow firms have been able to respond with increased output.

The sectoral output index provides further detail on recent trends and is set out in the chart below.

Chart B5: Manufacturing sectoral output index, NI: 1995-2003



Source: DETI

The sectoral picture shows marked contraction in textiles and also a sharp retrenchment in engineering output post 2001 after the collapse of the high tech boom. Metals, chemicals and, to a lesser extent, food have contributed to the overall growth in the manufacturing output index in recent years with metals particularly strong over the last 18 months.

Some slow down in exports

Recorded manufacturing exports have fallen since peaking in 1999, largely as a result of the decline in electronics and the continued closure of textiles firms. Despite the 4.4% real terms fall since 1999, current export values are still 7% above the level in 1998. The nominal fall in exports since 2000 of 0.8% is in contrast to the overall increase in manufacturing output of approximately 2.4% over the same period.

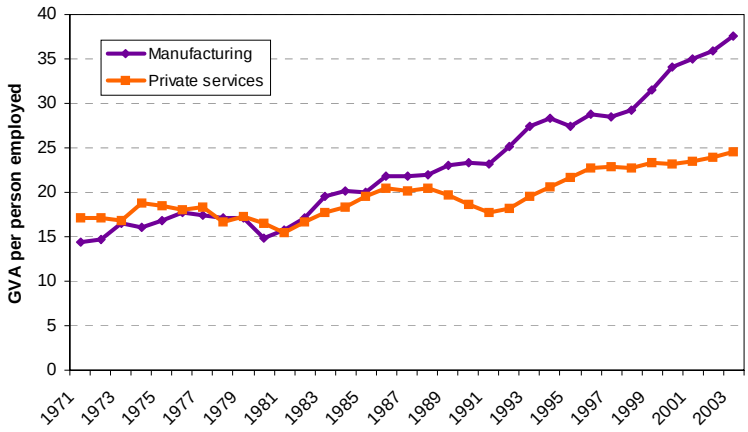
Table B1: Manufacturing exports, NI: 1992 to 2002

	Nominal Manufacturing Exports £m	Manufacturing Exports £m (2000 prices)
1992	1784	2194
1993	2175	2633
1994	2603	3076
1995	3013	3441
1996	2989	3334
1997	3127	3381
1998	3490	3649
1999	3974	4092
2000	4080	4080
2001	4076	4005
2002	4046	3911

Source: DETI, Regional Forecasts
Note: Real exports calculated using an RPI deflator

Another important contextual issue in relation to the manufacturing sector is the path of productivity over time. Manufacturing productivity rapidly outstrips productivity growth in the service sector, which is much more labour intensive, this is highlighted for Northern Ireland in the chart below.

Chart B6: Productivity in manufacturing and private services, NI: 1971-2003



Note: Manufacturing employment includes self employed
Source: DETI, NS, Regional Forecasts

The productivity pattern is confused somewhat by existing uncertainty over the true position of Northern Ireland Gross Value Added (GVA). The Annual Business Inquiry (ABI) data and Regional Accounts differ markedly in their measurement of Northern Ireland manufacturing GVA. According to the ABI, Northern Ireland GVA per employee in manufacturing was above the UK rate by 3% in 2000 but the Regional Accounts data suggests a deficit of 10%, this is discussed in more detail in the box below.

Box B1: Measuring output – the data debate

The two primary sources for manufacturing GVA data for Northern Ireland are Regional Accounts and the Annual Business Inquiry (ABI). The table below sets out the apparent divergence between the two sources.

Table A: Comparison of relative productivity

	Regional Accounts NI/UK	ABI NI/UK
1998	0.86	0.92
1999	0.88	0.99
2000	0.90	1.03
2001	-	0.99
2002	-	0.95

Source: Regional Accounts, ABI

Despite careful data consideration it has not been possible to reconcile these two data sources. Work is ongoing with DETI to attempt to resolve this crucial issue.

The ABI data, if it is to be believed, supports the strength of manufacturing output suggested by the output index, whilst Regional Accounts data provides less encouragement for the sector. The Regional Accounts data is the data used in the forecasts presented later in this report as it is available on a supposedly consistent basis for all regions and is consistent with UK national data presented in the Blue Book. In addition it covers all sectors of the economy, which the ABI does not, making it unsuitable for a whole economy model. The considerable lag in sectoral GVA data makes 2001 the most recent regional data available for modelling purposes.

Sector in context

The manufacturing sector remains a very important component of the Northern Ireland economy. Despite recent employment decline in Northern Ireland's most prominent manufacturing sub-sectors such as textiles, the manufacturing sector still accounts for 12.7% of total employment, equal to the UK average. Expressed as a percentage of working age population, Northern Ireland's manufacturing employment is below the UK average at 9.1% compared to 9.9%, largely a result of lower participation rates in Northern Ireland. This difference equates to 8,600 jobs, in other words if Northern Ireland's manufacturing sector was of UK average size relative to population, 8,600 more people would be working in the sector. Employment represents the most accessible indicator of trends in manufacturing. The table below sets out the concentrations of manufacturing employment in the UK regions in 2003.

Table B2: Total employment in manufacturing, UK regions: 2003

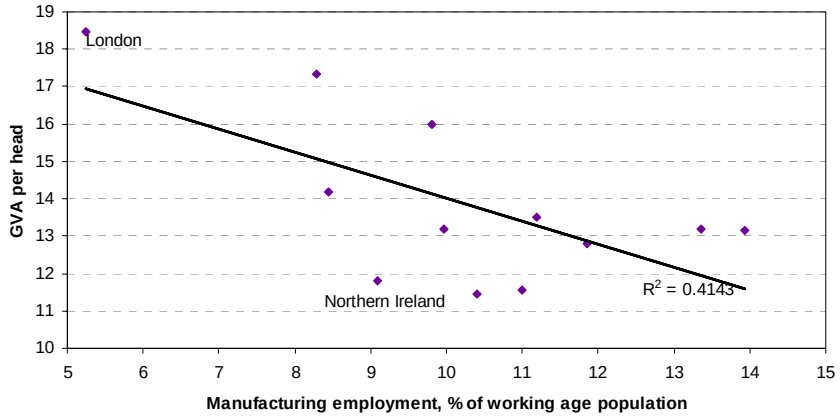
	% of total employment	% of working age population
West Midlands	18.2	13.9
East Midlands	18.4	13.4
Yorks & Humber	15.5	11.9
North West	14.5	11.2
Wales	15.8	11.0
North East	15.0	10.4
South West	12.5	10.0
East	12.9	9.8
Northern Ireland	12.7	9.1
Scotland	10.9	8.4
South East	10.0	8.3
London	6.0	5.2
United Kingdom	**12.7**	**9.9**

Note: Total employment includes self employment
Source: DETI, NS, Regional Forecasts

The table reveals that Northern Ireland is not as manufacturing dependant as is often suggested. Indeed on a working age population basis it has the 4th lowest manufacturing employment concentration and if London was excluded it would be well below the UK average.

In UK regions the concentration of manufacturing employment is loosely correlated with weaker economic performance, as indicated in the chart overleaf.

Chart B7: Correlation of manufacturing employment and GVA per head, UK regions: 2003



Note: Manufacturing employment includes self employed
Source: NS, Regional Forecasts

This chart suggests that the most productive regions in the UK have moved away from manufacturing sectors and into services sectors (though the removal of London does reduce the relationship considerably, reducing the R^2 correlation coefficient to just 14% from 41%). The position of Northern Ireland on the chart suggests that GVA per head is much lower than would be expected given the level of manufacturing employment, most probably a function of a relatively underdeveloped private services sector and a large public sector. This analysis provides an important backdrop to the examination of the role of manufacturing in the economy as it suggests that a smaller role for manufacturing in the economy is associated with greater prosperity.

Sectoral trends

Employment

The data presented above has set out the overall picture for the manufacturing sector but this aggregate data masks some very divergent trends at a sub-sectoral level. The table below sets out both the concentration of employment in the manufacturing sub-sectors and the job change over the last decade in Northern Ireland.

Table B3: Manufacturing sub-sectoral concentrations and employee change, NI 1993 to 2003

	Employees in Employment 03 (000's)	Location Quotient	Change 93-03 (000's)
Food	18.7	1.4	-1.6
Textiles	10.0	1.8	-14.4
Wood	3.3	1.4	0.6
Pulp & paper	6.4	0.5	0.3
Coke & oil	0.1	0.1	0.0
Chemicals	3.4	0.5	-0.2
Rubber & plastics	7.0	1.1	1.4
Other non-metalic minerals	5.7	1.6	2.0
Metals	6.2	0.5	1.5
Machinery & equipment	6.5	0.7	0.1
Electrical & optical	10.2	0.9	3.2
Transport equipment	11.0	1.1	-0.3
Other	4.2	0.7	1.6
Total manufacturing	**92.7**	**0.9**	**-5.9**

Source: DETI, NS, Regional Forecasts
Note: The location quotients presented are calculated by dividing the Northern Ireland employee level by the working age population. This figure is divided by a similar ratio from the UK data. As such a figure of 1 represents a sector of an equivalent UK average size.

The table depicts a very diverse pattern over the last decade. In employment terms only 4 of the 13 sub-sectors have lost jobs in the last decade, with textiles dominating the job loss total. Indeed without textiles job loss manufacturing would have expanded by 8,500 jobs over the last decade. Only 4 sectors employ more than 10,000 people in 2003 with food by far the largest sector. In UK terms, Northern Ireland has an above average employment concentration in 6 of the 13 sub-sectors with textiles and non-metals the most striking. Further details are provided in Annex F which sets out employment, GDP and productivity charts for Northern Ireland and UK for each sub-sector.

As in the aggregate analysis, it is worth considering the impact of redundancies on overall employment data. As discussed earlier, considerable caution needs to be exercised when using redundancy data; however it does provide a deeper understanding of underlying trends. Using the DETI redundancy data at a sub-sectoral level and allocating manufacturing job losses not classified into sub-sector, using existing employment shares, it is possible to estimate annual sub-sectoral redundancy levels for Northern Ireland. The volatility of the series makes it difficult to be certain of the conclusions but using actual ‘counts’ of redundancy figures the following estimates are arrived at.

Table B4: Estimated job redundancy and overall job creation levels, NI: 1996-2003

	Change in employees (96-03)	Calculated redundancy	Estimated job creation
Food	-760	-2,760	2,000
Textiles	-13,950	-10,860	-3,090
Wood	230	-400	630
Pulp & paper	60	-260	320
Coke & oil	-10	-480	470
Chemicals	-300	-880	580
Rubber & plastics	490	-740	1,230
Other non-metalic minerals	1,240	-320	1,560
Metals	970	-450	1,420
Machinery & equipment	-540	-1,390	850
Electrical & optical	660	-4,310	4,970
Transport equipment	-280	-3,400	3,120
Other	1,010	-200	1,210
Total manufacturing	**-11,180**	**-26,440**	**15,260**

Source: DETI, Regional Forecasts

This analysis suggests that there has been some job creation across most sub-sectors in Northern Ireland since 1996. Not all redundancies are reported as there are only 10,860 job losses recorded in textiles, while employee data suggests almost 14,000 jobs lost. If there was no job creation at all in this sector over the period, this would indicate just less than three quarters of redundancies are recorded. In all other sectors the redundancy levels are greater than the overall change in employees, suggesting some job creation offsetting the redundancy data. Assuming all job losses are reported, the data would suggest over 15,000 jobs have been created since 1996, almost 2,000 per annum. Using the estimate of three quarters reported this would rise to over 20,000 jobs created. Perhaps most notable is electrical and optical, where an increase of 660 jobs since 1996 masks 4,310 job losses, suggesting that almost 5,000 jobs have been created in this sector since 1996.

Output

The job losses reported have not been matched by corresponding output falls as productivity increases have allowed overall value added to rise in most sectors. The table below compares real value added change to employee change over the last decade, and sets out the change in productivity over the same period.

Table B5: Manufacturing employee, GVA and productivity change for selected sectors, NI: 1993-2003

	Change in Employment (%)	Change in GVA (%)	Change in Productivity (%)
Food	-7.8	42.3	54.4
Textiles	-59.0	-52.3	16.5
Wood	24.0	-15.9	-32.2
Pulp & paper	4.4	10.3	5.6
Coke & oil	0.0	560.0	560.0
Chemicals	-6.3	85.5	97.9
Rubber & plastics	25.3	46.4	16.8
Other non-metals	52.0	47.8	-2.7
Metals	31.8	61.7	22.7
Machinery & equipment	0.9	7.5	6.5
Electrical & optical	46.5	168.1	82.9
Transport equipment	-2.8	17.7	21.2
NEC	63.6	26.4	-22.7

Source: DETI, NS, Regional Forecasts

The table reflects a diverse picture across the sub sectors. In general measured GVA has grown faster than employment, or contracted less sharply. Output and productivity gains have been most pronounced in the electrical and optical sector. In three sectors productivity is recorded as having fallen, in two cases by large amounts. These are unlikely to be trend declines in productivity and in our view result from large annual fluctuations in productivity or from mis-measurement in the GVA data. Further detail can be found in Annex F.

Overall

The sectoral picture further supports our headline data which reveals a contrast between output and employment trends against a backdrop of overall decline in the relative importance of manufacturing within the wider regional economy. The analysis reveals the importance of textiles in job losses, with many other sectors showing significant improvements in productivity and creating significant numbers of new jobs. It is therefore important not to let the sharp contraction in textiles disguise the success in most other sectors.

Sub-sectoral trends

A useful exercise in exploring outlooks is to drill down and look beneath the sub-sectoral data for recent years and examine which industries have generated the most growth. Using SIC 3 digit data (of which there are 103 manufacturing industries) the table below sets out the top 20 growing industries over the period 1998 to 2002 in GB in % growth terms. By way of context the 20 industries with the largest employment contraction are also presented.

Table B6: Top 20 manufacturing 3-digit growth industries, GB: 1998 to 2002

	Jobs 98-02 (%)	Jobs 98-02
371 : Recycling of metal waste and scrap	54.6	2,540
372 : Recycling of non-metal waste and scrap	42.1	1,980
244 : Manufacture of pharmaceuticals etc	16.3	10,070
231 : Manufacture of coke oven products	12.7	80
354 : Manufacture of motorcycles and bicycles	11.1	500
267 : Cutting, shaping and finishing of stone	10.9	620
223 : Reproduction of recorded media	9.4	680
266 : Manufacture of articles of concrete etc	9.0	2,640
156 : Manufacture of grain mill products etc	7.3	950
281 : Manufacture of structural metal products	6.4	4,570
352 : Manufacture: railway/tramway vehicles	4.6	560
153 : Processing/preserving of fruit & veg	3.7	1,340
203 : Manufacture: builders' carpentry/joinery	3.4	1,430
221 : Publishing	1.1	1,610
154 : Manufacture of veg/animal oils/fats	1.0	40
334 : Manufacture of optical instruments etc	0.8	140
355 : Manufacture of transport equipment nec	0.7	10
233 : Processing of nuclear fuel	0.2	30
331 : Manuf: medical/surgical equipment nec	-1.6	-490
201 : Sawmilling and planing of wood etc	-2.7	-320

Source: NS

Table B7: Bottom 20 manufacturing 3-digit growth industries, GB: 1998 to 2002

	Jobs 98-02 (%)	Jobs 98-02
247 : Manufacture of man-made fibres	-68.4	-3,480
183 : Dressing and dyeing of fur etc	-64.5	-260
182 : Manufacture of other wearing apparel etc	-57.2	-77,390
177 : Manufacture: knitted/crocheted articles	-53.5	-17,190
171 : Preparation/spinning of textile fibres	-52.1	-9,720
193 : Manufacture of footwear	-51.7	-10,870
176 : Manufacture of knitted/crocheted fabrics	-48.9	-2,930
191 : Tanning and dressing of leather	-41.9	-1,800
283 : Manufacture of steam generators etc	-40.8	-3,220
173 : Finishing of textiles	-40.6	-6,700
363 : Manufacture of musical instruments	-39.7	-930
192 : Manufacture of luggage, handbags etc	-39.3	-2,890
181 : Manufacture of leather clothes	-39.3	-480
335 : Manufacture of watches and clocks	-39.2	-780
321 : Manufacture of electronic valves etc	-38.6	-19,810
323 : Manufacture of TV/radio receivers etc	-38.2	-13,480
313 : Manufacture of insulated wire and cable	-37.3	-7,390
294 : Manufacture of machine tools	-34.7	-10,940
268 : Manuf: non-metallic mineral products nec	-34.1	-4,880
273 : Other first processing of iron and steel	-33.9	-3,690

Source: NS

The tables provide an indication that despite the widespread difficulties in manufacturing over this period it has been possible for some industries to grow in GB. These industries cover a range of sub-sectors, though recycling, chemicals and electrical all feature strongly. Although by no means a consistent finding, the growth is generally in more technological, higher value added, industries.

What is also striking is that out of 103 3-digit industries, only 18 generated any growth during this challenging period. By contrast 6 industries lost over half their employment over this five year period and 33 over one quarter, further reflecting the difficulties.

A similar drilling down exercise was undertaken for Northern Ireland for the period 1995 -2001 and is set out in the tables overleaf.

Table B8: Top 20 manufacturing 3-digit growth industries, NI: 1995 to 2001

Industry	Jobs 95-01 (%)	Jobs 95-01
372 : Recycling of non-metal waste and scrap	543	190
300 : Manufacture: office machinery/computers	251	1763
274 : Manuf: basic precious metals etc	228	221
261 : Manufacture of glass and glass products	144	640
341 : Manufacture of motor vehicles	94	336
365 : Manufacture of games and toys	86	44
291 : Manuf: machin. for prod. of mech. power	70	307
246 : Manufacture of other chemical products	59	194
332 : Manuf: instruments for measuring etc	57	85
343 : Manufacture of parts for motor vehicles	57	1040
312 : Manuf: electricity distrib. apparatus	51	87
362 : Manufacture of jewellery etc	45	5
286 : Manufacture of cutlery, tools etc	43	55
285 : Treatment and coating of metals etc	41	836
266 : Manufacture of articles of concrete etc	37	889
287 : Manuf: other fabricated metal products	37	143
267 : Cutting, shaping and finishing of stone	36	90
244 : Manufacture of pharmaceuticals etc	32	327
153 : Processing/preserving of fruit & veg	29	153
366 : Miscellaneous manufacturing nec	27	59

Source: DETI

Table B9: Bottom 20 manufacturing 3-digit growth industries, NI: 1995 to 2001

Industry	Jobs 95-01 (%)	Jobs 95-01
316 : Manufacture of electrical equipment nec	-77	-772
351 : Building and repairing of ships/boats	-69	-1404
245 : Manufacture of soap and detergents etc	-60	-163
272 : Manufacture of tubes	-59	-55
171 : Preparation/spinning of textile fibres	-47	-1564
211 : Manufacture: pulp, paper and paperboard	-40	-56
241 : Manufacture of basic chemicals	-39	-482
364 : Manufacture of sports goods	-39	-12
173 : Finishing of textiles	-32	-528
177 : Manufacture: knitted/crocheted articles	-30	-640
155 : Manufacture of dairy products	-23	-601
247 : Manufacture of man-made fibres	-22	-195
295 : Manuf: other special purpose machinery	-19	-228
205 : Manufacture of other wood products etc	-17	-48
212 : Manuf: articles of paper/paperboard	-14	-313
175 : Manufacture of other textiles	-9	-147
201 : Sawmilling and planing of wood etc	-8	-46
152 : Processing/preserving fish etc	-5	-42
321 : Manufacture of electronic valves etc	-4	-97
282 : Manufacture of tanks, reservoirs etc	-4	-7

Source: DETI

There is only limited similarity between the GB and Northern Ireland lists with just 4 of the Northern Ireland top 20 and 4 of the bottom 20 industries appearing in the GB list, namely:

- Recycling of non-metal waste and scrap (top 20);
- Manufacture of articles of concrete etc (top 20);
- Cutting, shaping and finishing of stone (top 20);

- Manufacture of pharmaceuticals (top 20);
- Preparation / spinning of textiles fibres (bottom 20);
- Finishing of textiles (bottom 20);;
- Manufacturing of man-made fibres (bottom 20); and
- Manufacture of tanks, reservoirs etc.

However, there is more similarity in terms of the sub-sectors represented in the lists[1]. The number of jobs gained / loss varies considerably depending on the size of the industry. It is interesting to note that there are 5 industries in Northern Ireland which generated over 500 net additional jobs in the period 1995-2001; a factor often over-looked when the manufacturing sector is analysed.

Annex C provides a more detailed analysis of the manufacturing sub-sectors. It presents the analysis at a 4 digit level. Unfortunately due to data restrictions we were unable to produce comparable tables for GB. In addition, due to confidentiality reasons we are also unable to provide any statistics for the majority of 4 digit SIC sectors.

On the whole, caution needs to be taken when interpreting the drilling down exercise presented in Annex C. It was found that regardless of the broad manufacturing sectors that firms' are working in, there are always success stories. So for example, in the declining textiles sector, there are 4 digit sub-sectors that are among the top performers in relation to employment growth. However, the analysis is restricted by confidentiality, the compatibility of the data with GB, and is reliant on the consistency of firms being categorised into the correct SIC sectors.

In addition, and as noted by Invest NI and a number of consultees, every economy in the world is chasing the next product, the next sector and the next niche. If statistical analysis were able to successfully identify future growth sectors, they would already be producing in them. Furthermore, it was also noted that these future growth markets would not necessarily be shown in the data, especially since it only covers up to 2002.

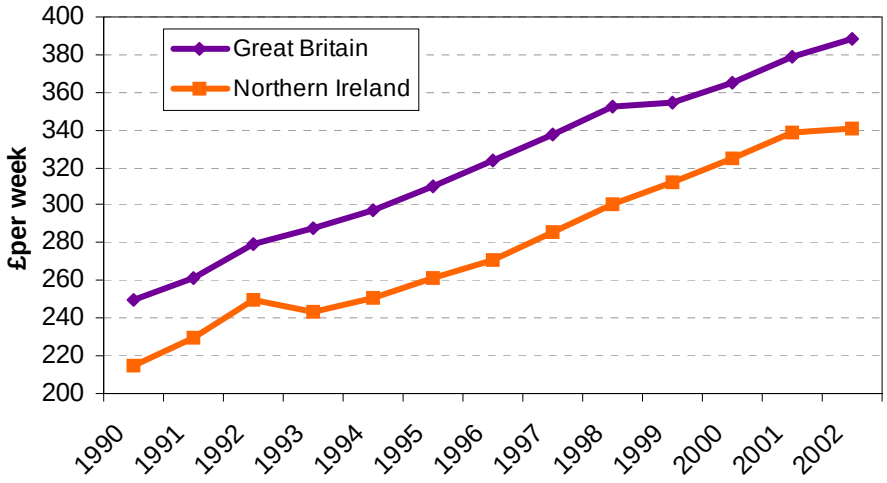
Annex C also provides some analysis on the extent to which manufacturing firms have been shifting to more service sensitive products and process. With the same restrictions and caveats on the data, we found little evidence to suggest that this trend had taken place. In order to fully address this issue more firm specific information or case studies would need to be available to form a definitive answer.

[1] The lack of read-across between Northern Ireland and GB is likely to also be a result of the different time period used. Work is ongoing to analyse GB for 95-01 as Northern Ireland 3-digit are only available bi-annually.

Wages

Moving away from employment and output data, we have examined wages data which shows average real wage increases despite the pressures in the sector. The chart below sets out wages since 1990 for male manual workers (the New Earnings Survey does not provide a consistent series for 'all workers' over time).

Chart B8: Trends in manufacturing wages, NI and GB: 1990-2002



Source: New Earnings Survey

The wage data suggest a relatively stable gap with UK wages of approximately 10-15%, and growth averaging around 4% per annum in Northern Ireland. After allowing for inflation, the rate of growth is below the rate of growth in productivity over the same period.

The Table below presents the change in average full-time gross weekly wages by selected SOC groups over the period 2000 to 2003.

Table B10: Growth in full time average gross weekly wages, by selected SOC 2000 major groups, 2000 to 2003

	Growth 2000 -03 (%)
Process, plant and machine operatives	12.1
Process, plant and machine operatives	11.9
Transport and mobile machine drivers and operatives	12.1
Skilled trades occupations	6.6
Skilled agricultural trades	14.2
Skilled metal and electrical trades	3.6
Skilled construction and building trades	12.2
Textiles printing and other skilled trades	15.8
Total	12.2

Source: DETI

The Table shows that over the 3 year period, gross weekly wages or employment costs to local business have increased faster in relation to labour fulfilling basic manufacturing processes as apposed to labour in skilled trade activities. This recent trend has important implications for the local economy. If the employment costs of basic manufacturing processes are rising faster than skilled processes then it is fair to assume that Northern Ireland's historically low cost base is being eroded. Although a comprehensive analysis of international wages would be required, the evidence suggests that Northern Ireland's competitive advantage may be (or has) shifted to skilled manufacturing.

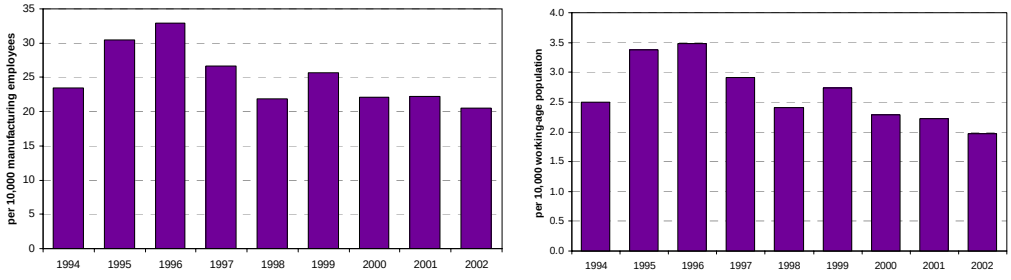
If this is the case then it may not be unreasonable for some Northern Ireland companies to find it cheaper to outsource basic production and specialise in the higher-skilled activities.

Analysis was also undertaken at 3 digit SIC sectors in relation to gross average weekly earnings. Due to confidentiality issues the statistical analysis is unable to be presented. However, the results of the analysis showed that, regardless of the broad manufacturing sector, there are activities that can generate high wages. In addition, regardless of the broad manufacturing sector there were 3 digit activities that were experiencing growth of average gross weekly wages of over 100% over the period 2000 to 2003, while in most cases there were also 3 digit sectors in the same broad manufacturing sector that experienced declines. Therefore this reinforced the emerging finding that although traditional manufacturing products and process may be in decline in the local economy, there are success stories and areas for high wealth creation in each 2 digit manufacturing sector.

Manufacturing start-up rates

Start-up data[2] for manufacturing in Northern Ireland suggest a decline in start-up rates from the level in the mid 1990's with 2002 start-up rates the lowest in the last 9 years. Start-up rates since 1994 are set out in the charts overleaf, expressed both relative to manufacturing employees and working age population.

Figure B9: Manufacturing VAT registrations, NI: 1994-2002

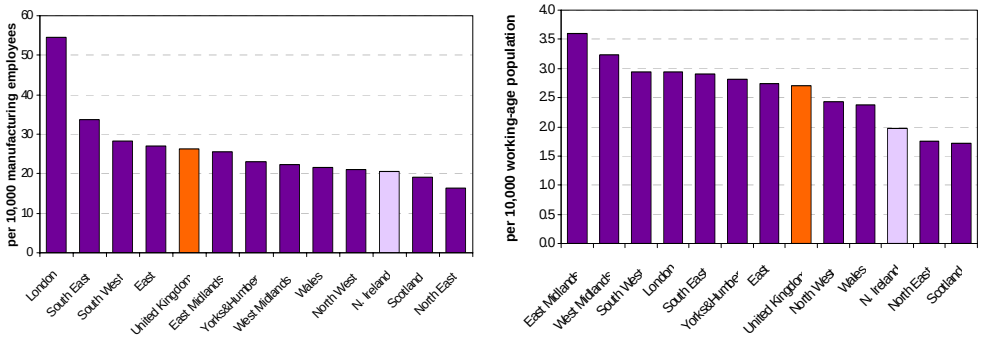


Source: NS, Regional Forecasts

[2] The data presented are for VAT registered businesses which does not include all manufacturing enterprises.

In a regional context Northern Ireland has below average start-up levels as depicted in the charts below.

Figure B10: Manufacturing VAT registrations, UK regions: 2002



Source: NS, Regional Forecasts

It is important to consider the impact of alternate denominators in the start-up analysis. Using employees in manufacturing is useful if one believes that start-ups are predominantly from people within their own sector, that is, leaving manufacturing employment to set up a manufacturing business. Using working age population assumes all people of working age represent potential start-ups. There is insufficient research available to determine which the correct method is and hence both are presented.

The use of denominator has little interpretive impact with only North East and Scotland having lower start-up rates on either basis. Using manufacturing employment as the denominator increases the differential between start-up rates in the South East and London from elsewhere. The level of start-ups in manufacturing at a regional level is a close map to overall prosperity in the regions, with the least prosperous regions having the lowest start-up rates. The regions with the lowest concentrations of manufacturing employment, London South East, Scotland, Northern Ireland are clustered together in start-up levels.

Focusing on the stock of VAT registered businesses, the Table below presents the number of registered businesses in the manufacturing sector and growth over the period 1998 to 2003.

Table B11: Stock of VAT registered manufacturing businesses in NI, 1998 to 2003

	1998	1999	2000	2001	2002	2003
Number of Manufacturing Businesses	3790	3810	3800	3865	3850	3845
Annual growth	-	0.5%	-0.3%	1.7%	-0.4%	-0.1%
Total number of businesses	51759	51965	52955	53675	53515	53770
Manufacturing as a % of total	7.3%	7.3%	7.2%	7.2%	7.2%	7.2%

Source: DETI

Over the period the number of manufacturing firms in Northern Ireland has remained fairly stable. As can be seen there has been a slight increase of 1.5% in the number of manufacturing firms in Northern Ireland over the period, compared to an overall increase of 3.9% in the total number of businesses across all sectors in the economy. Therefore despite the decline in overall employment terms, the number of manufacturing firms has remained remarkably stable.

Ownership

Foreign ownership is higher in Northern Ireland in manufacturing firms than elsewhere in the economy as reflected in the Table below.

Table B12: Share of employees/businesses in foreign owned business, NI: 1999-2002

		1999	2000	2001	2002
% employment in foreign owned businesses	Manufacturing	32.4	40.7	38.0	40.3
% employment in foreign owned businesses	All Others	4.6	5.0	5.6	6.2
% foreign owned businesses	Manufacturing	3.5	4.0	4.0	4.3
% foreign owned businesses	All Others	0.5	0.6	0.9	0.9

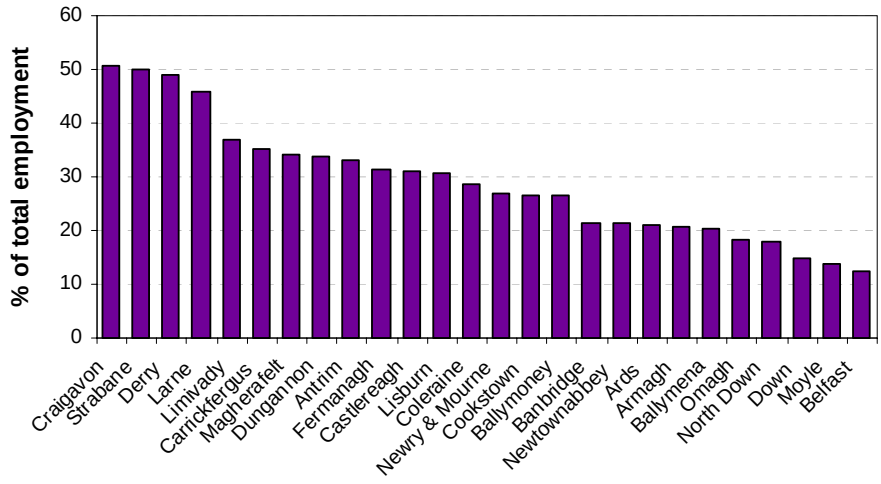
Source: IBDR, NS, Regional Forecasts
Note: % employment in foreign owned businesses is calculated by expressing the number of employees in foreign owned businesses as recorded in the IDBR as a percentage of the number of employees in manufacturing
% foreign owned business is calculated by expressing the number of foreign owned businesses as recorded in the IDBR as a percentage of the number of VAT registered enterprises

The much higher proportion of employment in foreign owned businesses reflects recent Foreign Direct Investments in the region and the closure of many smaller locally owned firms. The level of employment in foreign owned manufacturing remains relatively stable at round two fifths of employment, but only 4% of businesses, a reflection of the larger size of foreign owned firms. In the climate of rising manufacturing employment levels in other lower cost countries, there is an increasing risk of relocation amongst firms which are not locally owned. This presents an increasing threat to the viability of manufacturing employment in the region.

Local trends

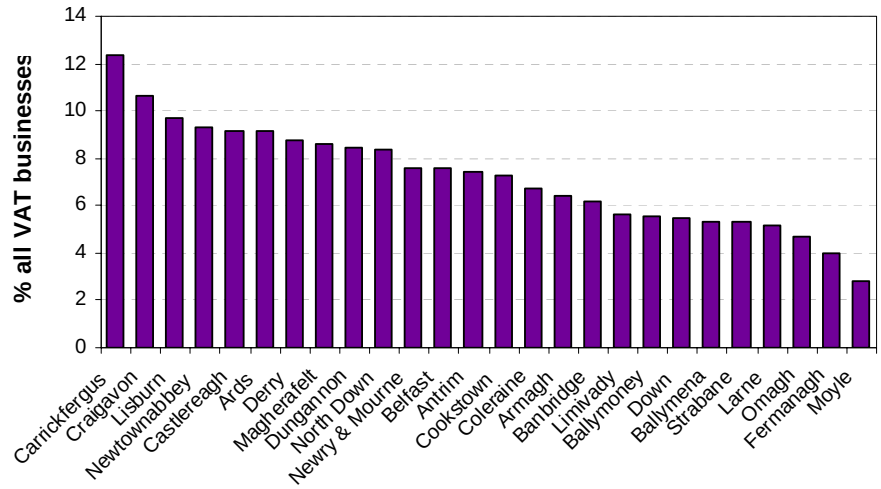
Using IDBR and Census data it is possible to look at the local importance of manufacturing across Northern Ireland. The charts overleaf set out the share of manufacturing in total employment, and total number of businesses in 2002 according to the IDBR.

Chart B11: Share of employment in manufacturing, NI DCs: 2002



Source: IDBR
Note: Data are workplace based

Chart B12: Share of manufacturing businesses in all businesses, NI DCs: 2002



Source: IDBR
Note: Data are workplace based

The census provides population, as opposed to workplace based data and provides a similar map of manufacturing employment concentration.

Table B13: Residence based employment in manufacturing, NI DCs: 2001

	employment in manufacturing as % of total employment
Antrim	13.9
Ards	13.3
Armagh	14.0
Ballymena	17.9
Ballymoney	17.8
Banbridge	16.3
Belfast	10.5
Carrickfergus	16.1
Castlereagh	11.4
Coleraine	13.1
Cookstown	17.5
Craigavon	23.3
Derry	16.2
Down	9.4
Dungannon	19.1
Fermanagh	14.6
Larne	18.3
Limavady	16.3
Lisburn	13.2
Magherafelt	16.8
Moyle	10.3
Newry and Mourne	13.2
Newtownabbey	14.3
North Down	11.4
Omagh	10.3
Strabane	19.2
Northern Ireland	**14.2**

Source: Census of population 2001

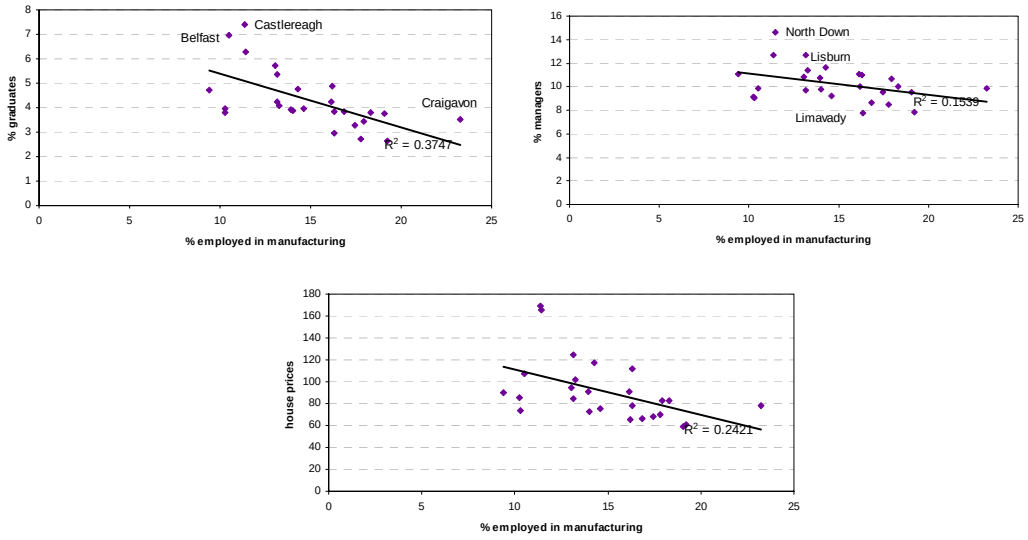
The analysis suggests that the North West and Mid Ulster including Craigavon, Magherafelt and Dungannon have the highest employment concentration, expressed in percentage terms, in the manufacturing sector. The Greater Belfast area has a smaller concentration of manufacturing as do farming dominated areas such as Omagh and Fermanagh. This pattern is similar to other regions where rising costs drive manufacturing out of the cities, which in turn become increasingly service sector dominated. Carrickfergus is the only exception to the overall pattern with a high concentration of manufacturing employment concentration despite its proximity to Belfast.

Examining share of businesses, as opposed to employment, moves Mid Ulster areas into the middle of the distribution as they have significant numbers of larger firms. Farming areas, with large numbers of small employers, move to the bottom end of the distribution.

Local level prosperity analysis

Looking back at the earlier analysis in this Section it is interesting to examine, using local level data, the hypothesis that more profitable regions have lower concentrations of manufacturing employment. Using average house price data from the University of Ulster, % of graduates in the population and % managers from the census and correlating against share of employees in manufacturing (also from the census to ensure residence placed comparisons) provides a basic approximation of the prosperity/manufacturing relationship.

Charts B13: Relationship between manufacturing employment and indicators of prosperity, NI DCs: 2001



Source: Census 2001

This analysis provides only limited support for the original hypothesis and perhaps warrants further investigation. Nevertheless, the relationships are all negative with '% graduates' the most pronounced. This simple analysis would appear to indicate that the most prosperous regions in Northern Ireland do indeed have lower concentrations of manufacturing employment. This analysis does not provide any direction of causation information. That is - does a lower number of graduates cause a lower concentration of manufacturing employment? Or is the relationship the other way round? One impact of this analysis is that, if manufacturing continues to decline, Northern Ireland's less prosperous regions are most 'at risk' and the differences between 'Belfast' and 'the rest' economy becomes sharper.

International comparisons

Northern Ireland output growth over the last 10 years has been over 3 times the UK rate but still much lower than the US figure. Manufacturing is much less important in overall employment terms in Northern Ireland than it is in the UK and the US compared to other economies. These countries are typified by a loss in employment over the last decade which has been most pronounced in farming. Wages growth has been strong throughout the industrialised economies (and particularly the UK) in comparison to prices which have grown more moderately, as a result of productivity improvements and low cost competition. The contrast of manufacturing output growth in the US (44.1%) and Japan (3.5%) is remarkable and reflects the divergent economic fortunes in the two economies.

Table B14: Selected international comparisons

Country	Share total employees in manufacturing (03)	% change in manufacturing employees (93-03)	% change manufacturing output (93-03)	% change manufacturing producer prices (93-03)	% change manufacturing wages (93-03)
NI	13.9	-5.9	27.2	*	35.7
UK	13.1	-10.5	7.7	13.9	51.7
Germany	17.7	-16.5	22.8	9.1	30.3
France	16.2	-3.5	21.7	6.6	22.9
Italy	22.8	-0.6	13.4	24.8	32.0
Spain	*	*	36.5	*	*
US	14.1	-11.4	44.1	14.8	34.7
Japan	*	*	3.5	*	*

Source: OEF

Financial support and investment

Government financial support to industry is an important stimulus to growth in manufacturing. Part of the employment created through financial assistance is in the form of new foreign direct investment (FDI). Over the period since 1995, just under a quarter of all jobs promoted in Northern Ireland have been in the form of FDI. Most recently manufacturing firms have become a small minority of FDI into Northern Ireland (only 14% since 1995), and hence the great majority of manufacturing jobs promoted in Northern Ireland have been expansions and re-investments in companies already located here (although a significant proportion of these are foreign owned). The decline in global FDI since 2000, and a more general decline in local investment since the end of the high-technology boom, has meant a general decline in the total number of jobs promoted in Northern Ireland.

Table B15: Jobs promoted and safeguarded, NI: 95/96 – 01/02

	Jobs promoted			Jobs safeguarded		
	Total	Manufacturing		Total	Manufacturing	
	000's	000's	%	000's	000's	%
95/96	5678	4952	87.2	2484	2484	100.0
96/97	6005	5596	93.2	5577	5519	99.0
97/98	7137	4505	63.1	4254	4254	100.0
98/99	5434	3744	68.9	2931	2879	98.2
99/00	7145	3875	54.2	1796	1796	100.0
00/01	7596	3234	42.6	1896	1896	100.0
01/02	2896	1537	53.1	1711	1621	94.7

Source: InvestNI

The table highlights both the marked fall in jobs promoted and the fall in manufacturing share in this total. In jobs safeguarded, manufacturing remains the dominant sector, further reflecting the difficulties facing manufacturing firms. The percentage of new investment within the jobs promoted has also fallen to 26% from a high of just under 50% in 98/99. Not all jobs promoted actually materialise. InvestNI estimate that of promoted jobs 75-80% are actually created. Moreover some of the jobs promoted may have been created without government assistance (deadweight). A shift-share analysis of Northern Ireland manufacturing suggests that Northern Ireland creates around 1,500 jobs each year in excess of what would be expected on the basis of UK wide sectoral growth. This is well short of the 4,000 jobs promoted by InvestNI each year since 1995, and hence implies a level of deadweight especially among the expansions and re-investments of locally based firms.

Table B16: Jobs promoted by sector, NI; 95/96 – 01/02

	Jobs promoted				Jobs safeguarded			
	95/96-98/99		98/99-01/02		95/96-98/99		98/99-01/02	
	Average	% of manufacturing	Average	% of manufacturing	Average	% of manufacturing	Average	% of manufacturing
Food	519	11.0	388	12.5	668	17.6	363	17.7
Textiles	578	12.3	186	6.0	816	21.6	433	21.1
Wood	21	0.4	14	0.5	54	1.4	63	3.1
Pulp & paper	117	2.5	21	0.7	243	6.4	86	4.2
Chemicals	190	4.0	131	4.2	185	4.9	0	0.0
Rubber & plastics	180	3.8	85	2.7	42	1.1	117	5.7
Other non-metalic minerals	139	3.0	62	2.0	50	1.3	11	0.5
Metals	175	3.7	119	3.8	80	2.1	0	0.0
Machinery & equipment	295	6.3	57	1.8	283	7.5	88	4.3
Electrical & optical	1535	32.7	1295	41.8	695	18.4	554	27.0
Transport equipment	865	18.4	728	23.5	572	15.1	291	14.2
Other	88	1.9	12	0.4	98	2.6	44	2.1
Total manufacturing	**4699**	**100.0**	**3098**	**100.0**	**3784**	**100.0**	**2048**	**100.0**

Source: InvestNI

There has been a decline in the number of jobs promoted in all sub-sectors but particularly in the food and textiles industries. Electrical and optical was the dominant investment sector during the period 95/96 – 01/02, a reflection of the high tech boom. However there have been few jobs promoted in this sector since the end of the high tech boom in 2001.

Table B17: Jobs promoted / safeguarded by sector and the profile of the top / bottom 20 manufacturing growth sectors in NI; 95/96 – 01/02

Sector	Jobs promoted 98/99 to 01/02 (% of manufacturing)	Profile of top 20 3-digit growth sectors	Jobs safeguarded 98/99 to 01/02 (% of manufacturing)	Profile of bottom 20 3-digit growth sectors
Food	12.5	1	17.7	2
Textiles	6	0	21.1	4
Wood	0.5	0	3.1	2
Pulp & paper	0.7	0	4.2	0
Coke & oil	0	0	0	2
Chemicals	4.2	2	0	3
Rubber & plastics	2.7	0	5.7	0
Other non-metals	2.0	3	0.5	0
Metals	3.8	4	0	2
Machinery & equipment	1.8	1	4.3	1
Electrical & optical	41.8	3	27	2
Transport equipment	23.5	2	14.2	1
NEC	0.4	4	2.1	1

The Table above cross references the data presented in Table B16 with that presented in Tables B8 and B9. We would expect to see jobs promoted correlated with the profile of the top 20 growth sectors, representing investment in future, sustainable economic growth. Analysis of Table B17 shows that while nearly 42% of all manufacturing jobs promoted were in Electrical and optical, yet only 15% of the sectors (or 3 sectors) were identified among the top 20 growth sectors. In addition, only 3.8% of those jobs promoted were in the Metals sector, yet 20% (or 4 sectors) were identified among the top 20 growth sectors.

On the other hand we would not necessarily expect to see jobs safeguarded correlated with the profile of the bottom 20 growth sectors. One could ask why would government invest in declining sectors? However government does have a social responsibility to maintain employment opportunities for all. For example, as would be expected, a fifth of jobs safeguarded where in the textiles sector where a fifth of the bottom 20 growth sectors were identified.

As whole, the data on jobs promoted does map with the potential growth opportunities for the future, while the relationship with jobs safeguarded is less obvious as expected.

In future, Northern Ireland may attract relatively fewer manufacturing jobs through new FDI. The increasing attractiveness of low cost locations in Eastern Europe, some soon to be within the EU, and in the Far East is likely to diminish Northern Ireland's success in attracting FDI in manufacturing. Although the Republic of Ireland, with costs similar to Northern Ireland, continues to attract manufacturing firms, this is primarily due to the important advantage of low corporation tax.

Although it has been stated that there is a need to compete for investment on a basis other than cost, for example quality, it is interesting to note the return in terms of investment that Republic of Ireland has accrued as a result of cost competition on the back of favourable taxation policy.

Conclusions

The analysis of recent trends has provided a number of interesting conclusions. Although manufacturing employment is in long term decline throughout the UK, Northern Ireland has lost proportionally fewer jobs than GB. As a result, Northern Ireland has steadily increased its share of UK manufacturing employment. However, it still has a manufacturing sector that is proportionally smaller than most GB regions. Northern Ireland's record is particularly good outside the declining textile and clothing sector, with considerable job creation, especially over the post cease-fire period since 1995. Analysis of redundancy data suggests at least 2,000 manufacturing jobs have been created on average, each year since 1998 despite the well documented difficulties. A downturn since 2000 coincides with the collapse of the high-tech boom and is expected to be temporary.

Although manufacturing employment has provided a valuable source of additional jobs in areas of formerly high unemployment within Northern Ireland, the evidence suggests that manufacturing is associated with less prosperous rather than more prosperous areas. Over the last 30 years manufacturing employment has fallen from over 180,000 to 90,000 compared to positive growth in services. This may be an argument for re-assessing policy for the promotion of manufacturing in these areas Northern Ireland.

However, the analysis also shows that while employment has been in decline in the region, output has performed considerably better. From 1996 to 2001 manufacturing output consistently grew with the exception of one quarter. Since Q2 2001 the level of output has remained relatively stable. In addition, over the period 1998 to 2003, the number of manufacturing firms has also grown, albeit modestly.

At broad manufacturing sub-sectoral level, Northern Ireland's manufacturing, outside the textile and clothing sector, has grown distinctly faster in employment terms than in GB. Although the evidence is mixed, there is data to suggest that this faster growth has also been reflected in something of a catch-up in labour productivity.

Analysis at 3 digit and 4 digit SIC sectors suggested that there were no clear messages for future growth sectors. However, regardless of the broad manufacturing sub-sector the evidence suggested there were examples of success and failure. This is also true in the contracting textiles sector where two 4 digit industries are among the top 10 employment growth sectors in Northern Ireland.

In addition, the analysis of wages showed that over the period 2000 to 2003, the average gross weekly earnings of labour fulfilling basic manufacturing processes, compared to those in skilled trade activities, have increased at a faster rate.

The evidence therefore suggests that opportunities exist in each broad manufacturing sector, however Northern Ireland's comparative advantage is more likely to exist in higher skilled production processes. Therefore industrial policy must be geared towards:

- identifying these niche areas of growth; and
- encouraging / supporting local business to make the shift to higher skilled and higher technological production processes.

Investment in manufacturing has fallen significantly as global conditions have worsened, but Northern Ireland's relative attractiveness is also under threat. The loss of Structural Financial Assistance after 2006 will have implications on attracting inward investment. As a result, Northern Ireland industrial policy must be designed to promote and foster a manufacturing sector that competes on skills and innovation. Policy must encourage expenditure in R&D, an outward looking focus and a business environment that attracts investment from world leaders.

Annex C: Sub-sectoral analysis

In order to provide a more detailed sub-sectoral analysis, SIC 4 digit data was used to highlight the top and bottom 20 growing industries over the period 1998 to 2002 in NI in percent employment growth terms. Unfortunately due to data restrictions we are unable to produce comparable tables for GB. In addition, due to confidentiality reasons we are also unable to provide any statistics for the majority of 4 digit SIC sectors. Therefore the tables below simply highlight the sectors and do not present any statistical information.

Table C1: Top manufacturing 4-digit growth industries, NI: 1998 to 2002

SIC code	Industry
2742	Aluminium production
2752	Casting of steel
1723	Worsted-type weaving
3350	Manufacture of watches and clocks
2611	Manufacture of flat glass
2751	Casting of iron
2972	Manufacture of non-electric domestic appliances
1714	Preparation and spinning of flax-type fibres
2953	Manufacture of machinery for food, beverage and tobacco processing
1587	Manufacture of condiments and seasonings
3002	Manufacture of computers and other information processing equipment
2662	Manufacture of plaster products for construction purposes
2416	Manufacture of plastics in primary forms
2221	Printing of newspapers
2614	Manufacture of glass fibres
3720	Recycling of non-metal waste and scrap
2622	Manufacture of ceramic sanitary fixtures
2464	Manufacture of photographic chemical material
2743	Lead, Zinc and tin production
3161	Manufacture of electrical equipment for engines and vehicles not elsewhere classified

Source: DETI

Table C1 above provides a more detailed look at the fastest growing sectors in the Northern Ireland economy over the period 1998 to 2002. It is interesting to note that while the analysis thus far has indicated that the textiles sector has been the fastest contracting industry in Northern Ireland, the third fastest growing 4 digit sector is 'Worsted-type weaving' that falls under textile weaving. In addition, the 'preparation and spinning of flax-type fibres' falls among the top 10 fastest growing sectors, suggesting that despite a severe contraction in the textiles sector as a whole, there is still scope for firms to grow in niche areas. The production in, the 'preparation and spinning of flax-type fibres' can now involve very sophisticated technology, presenting a different face to that of the traditional labour intensive one that the sector is often viewed as. This point is reinforced by the table below. A total of 3 textiles sectors are among the 20 bottom growing 4-digit SIC industries.

It is also interesting to note that four of the top 20 growth sectors can be classified into the manufacture of basic metals (including the top 2), while another 4 can be classified as the manufacture of other non-metallic mineral products. These two sectors can also be viewed in terms of traditional heavy manufacturing industries, in

fact a quarter of the bottom 20 growth sectors can be classified under the manufacture of other non-metallic mineral products, while an additional sector can be classified into basic metals. Again the evidence suggests that there are niche markets in areas historically viewed as traditional manufacturing. It would be interesting to return to this analysis in a few years to see if these two broad sectors still represent such a high proportion of the top 20 growth sectors given that the majority of EU accession countries have higher proportions of their cheaper employment in the traditional Basic metals and other non-metallic mineral sectors.

Finally, three of the top 20 4 digit growth sectors are found in the manufacture of electrical and optical equipment sector, which had the highest estimated job creation over the period 1996 to 2003. In addition, as has already been shown, this sector had the largest percent increase in GVA over 1998 to 2003 and the third largest increase in productivity. Therefore the evidence suggests that regardless of the broad industry, there are opportunities for local businesses. However, as already noted, they tend to require the adoption of high-tech and high skilled production methods.

Table C2: Bottom manufacturing 4-digit growth industries, NI: 1998 to 2002

SIC code	Industry
1724	Silk-type weaving
1542	Manufacture of refined oils and fats
1713	Preparation and spinning of worsted-type fibres
2626	Manufacture of refractory ceramic products
2954	Manufacture of machinery for textile, apparel and leather production
2665	Manufacture of fibre cement
2871	Manufacture of steel drums and similar containers
2830	Manufacture of steam generators, except central heating and hot water boilers
2840	Forging, pressing, stamping and roll forming a metal; powder metallurgy
2666	Manufacture of other articles of concrete, plaster and cement
2623	Manufacture of ceramic insulators and insulating fittings
2225	Other activities relating to printing
2651	Manufacture of cement
1716	Manufacture of sowing threads
3511	Building and repairing of ships
2710	Manufacture of basic iron and steel and of ferro-alloys
2122	Manufacture of household and sanitary goods and of toilet requisites
3615	Manufacture of mattresses
1930	Manufacture of footwear
2452	Manufacture of perfumes and toilet preparations

Source: DETI

In relation to the bottom 20 growth sectors there is a relatively wide mix manufacturing activities across 11 of the 14 manufacturing sectors. Therefore, regardless of the manufacturing sector, there are plenty of opportunities and success stories for local business to expand employment. However as noted by Invest NI and number of other consultees, every economy in the world is chasing the next product, the next sector and the next niche. If statistical analysis were able to successfully

identify future growth sectors, they would already be producing in them. Furthermore, it was also noted that these future growth markets would not necessarily be shown in the data, especially since it only covers up to 2002.

Turning our attention to output, the table below replicates the analysis of Table 3.5 at 4 digit SIC level. The Table below shows the top 30 4 digit SIC sectors in relation to change in productivity over the period 1998 to 2002. Again, given confidentiality, we are restricted to just presenting the sectors and not the statistical information.

Like in Table 3.5, GVA has grown faster than employment or contracted less sharply. In addition, output and productivity gains have been most pronounced in the electrical and optical sectors. Furthermore, analysis of the underlying data suggests that although just over half the sectors listed below increased employment, the increases can not account for all the growth in productivity. In total the positive change in productivity in 27 of the 30 sectors below can not be accounted for by changes in employment. Therefore, there must exist other drivers of productivity growth (for example, new technology, new production process, training etc.). Unfortunately the lack of data prevents us from confirming the true extent to other drivers of productivity growth.

Table C3: Top manufacturing 4-digit growth industries, NI: 1998 to 2002

4 digit SIC
3320: Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3220; Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
3161: Manufacture of electrical equipment for engines and vehicles not elsewhere classified
3340: Manufacture of optical instruments and photographic equipment
2231: Reproduction of sound recording
1920: Manufacture of luggage, handbags and the likes, saddlery and harness
3150: Manufacture of lighting equipment and electrical lamps
3162: Manufacture of electrical equipment not elsewhere classified
2411: Manufacture of industrial gases
2232: Reproduction of video recording
2420: Manufacture of pesticides and other agro-chemical products
2215: Other publishing
3350: Manufacture of watches and clocks
2125: Manufacture of other articles of paper and paperboard not elsewhere classified
2742: Aluminium production
1541: Manufacture of crude oils and fats
2924: Manufacture of other general purpose machinery not elsewhere classified
2524: Manufacture of other plastic products
1561: Manufacture of grain mill products
3130: Manufacture of insulated cable and wire
3001: Manufacture of office machinery
2651: Manufacture of cement
3310: Manufacture of medical and surgical equipment and orthopaedic appliances
2682: Manufacture of other non-metallic mineral products not elsewhere classified
2310: Manufacture of coke oven products
2233: Reproduction of computer media
2875: Manufacture of other fabricated metal products not elsewhere classified
1587: Manufacture of condiments and seasoning
3710: Recycling of metal waste and scrap
2415: Manufacture of fertilizers and nitrogen compounds

Source: DETI

On the other hand, only 8 of the bottom 30 sectors below experienced a rise in productivity that was not due to employment decline. Again, therefore suggesting that if we take out the effects of employment, there have been increases in productivity across most sectors.

Table C4: Bottom manufacturing 4-digit growth industries, NI: 1998 to 2002

4 digit SIC
1586: Processing of tea and coffee
1724: Silk-type weaving
2122: Manufacture of household and sanitary goods and of toilet requisites
2441: Manufacture of basic pharmaceuticals
2513: Manufacture of other rubber products
2822: Manufacture of central heating radiators and boilers
3430: Manufacture of parts and accessories for motor vehicles and their engines
2416: Manufacture of plastics in primary forms
2442: Manufacture of pharmaceutical preparations
1823: manufacture of underwear
2744: Copper production
2452: Manufacture of perfumes and toilet preparations
2743: Lead, zinc and tin production
2512: Retreading and rebuilding of rubber tyres
1714: Preparation of spinning of flax-type fibres
1572: Manufacture of prepared pet foods
1596: Manufacture of beer
2732: Cold rolling of narrow strip
2722: Manufacture of steel tubes
1772: Manufacture of knitted and crocheted pullovers, cardigans and similar articles
1712: Preparation and spinning of woollen-type fibres
1725: Other textile weaving
2430: Manufacture of paints, varnishes and similar coatings, printing ink and mastics
3541: Manufacture of motorcycles
3210: Manufacture of electronic valves and tubes and other electronic components
2862: Manufacture of tools
2751: Casting of iron
2413: Manufacture of other inorganic basic chemicals
3140: Manufacture of accumulators, primary cells and primary batteries
2464: Manufacture of photographic chemical material

Source: DETI

Another useful analysis is to understand the changing costs to manufacturing firms. Using 4 digit ABI data the change in employment costs as a proportion of turnover was calculated, in addition to the change in purchases as a proportion of turnover.

In our discussions with key stakeholders it was suggested that manufacturing firms may be undertaking a shift towards service sensitive products and processes. If this were the case we would expect to see a firms employment costs as a proportion of turnover increase while purchases as a proportion of turnover would fall. The reason for this argument is that if firms were to move to more service sensitive products and processes then there would be a shift from the heavy raw material inputs of traditional manufacturing into more skilled high technology manufacturing. The Table below presents a summary of the analysis. It shows that out of the 197 4 digit SIC sectors that contained information in both 1998 and 2002, the change in employment costs as a percent of turnover and the change in purchases as a percent of turnover.

Table C5: Changes in employment costs and purchases as a percent of turnover, 1998 to 2002

Summary	Employment costs as a percent of turnover	Purchases as a percent of turnover
Sectors experiencing an increases	100	117
Sectors experiencing no change	2	0
Sectors experiencing a decreases	95	80
Total	197	197

Source: DETI

As can be seen there is a fairly even split between the number of sectors experiencing a rise in employment costs as a percent of turnover. It is fair to say that if there was a shift in production then expectations would be for more sectors to experience an increase in employment costs as a percent of turnover. In fact some of the sectors that were found to increase may be explained by growth in wages in general. Regardless, there is by no means an obvious shift in the manufacturing sector to activities which require a higher proportion of wages in turnover. In addition, the evidence suggests that as a whole, there has actually been an increase in purchases as a proportion of turnover over the period. On the aggregate level therefore, the evidence implies that there has not been an obvious shift to service sensitive products and processes. The Table overleaf presents the top 20 4 digit sectors that experience an increase in employment costs as a percent of turnover and the top 20 sectors that experienced a decrease in their purchases as a percent of turnover.

Only two sectors appear on both lists:

- Manufacture of Basic pharmaceuticals; and
- Manufacture of electrical equipment for engines and vehicles not elsewhere classified.

Perhaps these two sectors have shifted their activities to more service sensitive production techniques, however given the lack of evidence for the Manufacturing sector as whole, more information or case studies would need to be accessible to form a definitive answer.

Table C6: The top 20 increases in employment costs as a % of turnover and the bottom 20 increases in purchases as a % of turnover in NI at 4 digit SIC (1998 to 2002)

The top 20 increases in employment costs as a proportion of turnover	The bottom 20 increases in purchases as a % of turnover
2214: Publishing of sound recordings	3140: Manufacture of accumulators, primary cells and primary batteries
2464: Manufacture of photographic chemical material	3320: Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
3350: Manufacture of watches and clocks	3220: Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
1930: Manufacture of footwear	2420: Manufacture of pesticides and other agro-chemical products
3511: Building and repairing of ship	3340: Manufacture of optical instruments and photographic equipment
3130: Manufacture of insulated wire and cable	2411: Manufacture of industrial gases
2441: Manufacture of basic pharmaceuticals	2231: Reproduction of sound recording
3541: Manufacture of motorcycles	1587: Manufacture of condiments and seasoning
2466: Manufacture of other chemical products not elsewhere classified	3161: Manufacture of electrical equipment for engines and vehicles not elsewhere classified
2614: Manufacture of glass fibres	1724: Silk-type weaving
2611: Manufacture of flat glass	1585: Manufacture of macaroni, noodles, couscous and similar farinaceous products
2232: Reproduction of video recording	3120: Manufacture of electricity distribution and control apparatus
2952: Manufacture of machinery for mining, quarrying and construction	3001: Manufacture of office machinery
2953: Manufacture of machinery for food, beverage and tobacco processing	2871: Manufacture of steel drums and similar containers
3512: Building and repairing of pleasure and sporting boats	3663: Other manufacturing not elsewhere classified
2931; Manufacture of agricultural tractors	2441: Manufacture of basic pharmaceuticals
3161: Manufacture of electrical equipment for engines and vehicles not elsewhere classified	1541: Manufacture of crude oils and fats
2875: Manufacture of other fabricated metal products not elsewhere classified	2415: Manufacture of fertilizers and nitrogen compounds
1717: Preparation and spinning of other textile fibres	3162: Manufacture of other electrical equipment not elsewhere classified
2040: Manufacture of wooden containers	1910: Tanning and dressing of leather

Source: DETI

Annex D: Global trends in manufacturing: literature review

Introduction

This Appendix aims to build on the conclusions of the Section III. It provides a discussion of the existing evidence on global manufacturing trends. Given that Section III found that total manufacturing employment has been in decline across the UK for the majority of the last 3 decades while there continues to be opportunities in niche markets, this Appendix highlights recent developments in the sector internationally as well as presenting the aims of the UK's manufacturing strategy. In addition, given that the analysis in Section III found that manufacturing employment is loosely correlated with weaker regional economic performance, the review of the existing evidence provides a discussion of the drivers of economic growth. This Appendix then examines the potential components of a new manufacturing strategy, highlighting the challenges in Northern Ireland before offering suggestions for future industrial policy.

Therefore this Appendix takes the following structure:

- Manufacturing trends;
- Key drivers of economic growth;
- Components of a new manufacturing strategy; and
- Best's suggestions for future industrial policy.

Manufacturing Trends

It is well known that, in the most advanced economies, the services sector has been growing more rapidly than industry and agriculture in the last two decades. On the contrary, in the rest of the world, the most dynamic sector has been manufacturing. This shift in manufacturing activity from the richest economies to the low and middle income economies has also been associated with a shift in international trade. The EU and US still boast the largest shares of world trade, however these shares have been in gradual decline in the past three decades.

"Manufacturing and manufacturing related activities play a major role in the economy. This is why 'manufacturing' is so important for European society. It should not be allowed to deteriorate, or simply to move to other parts of the globe"
(ManuFuture 2003).

IBEC (2004) highlight that the pace of change in the global economy has quickened significantly and the skills and economic power of India, China and other Asian economies are increasing all the time. They highlight that while Ireland's employment growth has been impressive over the last number of years, there is a worrying trend of job losses in manufacturing industry since employment peaked in 2001 (in the last two years that manufacturing employment has now fallen back to 1996 levels). These losses are not confined to the old traditional sectors as might be expected; indeed the bulk of them are in the modern sectors of manufacturing.

DTI (1999) identify four key drivers which are changing the nature of competition and the way manufacturers do business: revolutionary changes in ICT, the increasing pace of change in science and technology, increasingly global competition, and changing consumer demand. In addition ManuFuture (2003) highlight five similar principal drivers of change as: increasingly competitive climate, advances in science and technology, environmental challenges and sustainability requirements, socio-demographic factors, and regulatory environment and standards. From the literature we have summarised the key drivers changing the nature of the sector in the table overleaf.

Table D1: A summary of global trends affecting the manufacturing sector

Drivers of change	Implications
Revolutionary changes in ICT	Changes in ICT are transforming every stage of the manufacturing process. These range from finding sources of research and applied development to use of the latest CAD techniques, to changing the relationship with customers and suppliers, to the way in which products can be marketed and sold;
The increasing pace of change in science and technology	Change is forcing manufacturers not only to invest faster than ever before in their next generation of products but also to keep abreast of the latest manufacturing techniques and processes in order to manufacture them competitively. ManuFuture (2003) state that the need for innovation is increasing, while the complexity of problems to be solved is growing. Advances in science and technology are particularly relevant in the fields of electronics, information technology and biotechnology. The development of new production processes based on research results, and the integration of thus far separate technologies, may radically change both the scope and scale of manufacturing;
Increasingly global competition	Increased global competition also requires manufacturers to add more value in their production processes to stay ahead of the cycle and to compete against lower cost rivals. ManuFuture (2003) note that the international context is evolving, primarily due to the emergence of new actors in manufacturing and to economic fluctuations. How manufacturing companies will work in the future will depend even more on flexibility and speed as well as on localised production. Manufacturing is also likely to have become increasingly service-sensitive. This servation of manufacturing will have consequences for the organisation of production, supply-chain management and customer relations. In most manufacturing sub-sectors, global comparisons show that European manufacturing industry has been, and continues to be, successful in maintaining its leadership. However, this position is threatened in other countries by two factors: • EU industry faces continuing competition from the other developed economies, particularly in the high-technology sectors; and • Low-wage economies are increasingly threatening the more traditional manufacturing sectors.
Changing consumer demand	Changing consumer demand, including for more sophisticated, customised and environmentally sound products, places new demands on manufacturing and R&D processes. Manufuture (2003) note that customers' demands are increasing; in addition, individual needs have to be balanced with the necessity for products and production processes to be safe and eco-efficient.
Socio-demographic factors	Future manufacturing will be called upon to provide solutions to meet new societal needs and the demands of an ageing society. Concerning the labour supply, the manufacturing and research sectors will be confronted with the retirement of the current large age groups. Innovation may require new sets of skills, the availability of which, both in manufacturing and research, could become a critical factor in the sectors outcome.
Environment / sustainability issues	The manufacturing sector will have to comply with stricter environmental regulation in the future. Indeed markets may demand more environmentally friendly material and products. To realise efficiency gains, manufacturers may need to adopt energy and resource-saving technology. In addition, regulatory environment and standards may facilitate change in manufacturing sector. The intellectual property rights system might have to respond to changes in an innovation process that is increasingly based on knowledge sharing and networking. The adoption of new technologies in manufacturing will also depend on the availability of industrial standards and testing procedures to ensure reliable and interchangeable devices

Source: Based on DTI (1999) and ManuFuture (2003)

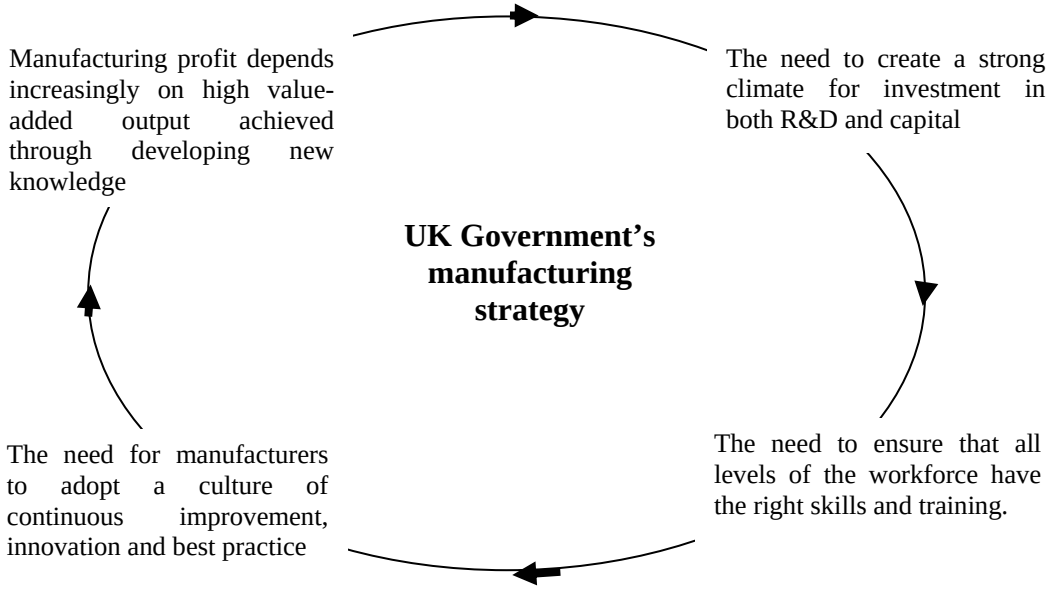
The increased intensity of global competition in the last few decades has presented challenges to UK manufacturing. The reduction of tariff barriers and transport costs, easier communications and increased capital flows has allowed low wage countries to compete more effectively in low value-added, labour-intensive products, shifting production out of the advanced industrialised nations. With the enlargement of the EU, the 10 low-wage economies will be competing directly with Northern Ireland and UK manufacturing businesses (discussed in more detail later in this Section). Once seen as a low-wage, developed economy, Northern Ireland will have this comparative advantage eroded further. Consequently, this is likely to impact further on the decline in traditional manufacturing sectors (for example textiles), resulting in higher levels of structural unemployment.

According to DTI (2002), businesses in Britain that produce basic or commodity-like products using labour-intensive processes will find pressures they cannot resist from low-wage countries. But innovative companies, which adopt leading edge technology and design, with advanced management and production techniques, to create high value-added products that consumers want to buy, will benefit from the opportunities in the global marketplace.

O'Malley and Roper (2003) state that in both Northern Ireland and the Republic of Ireland, there was a shift in manufacturing employment from the more traditional sectors towards high-tech sectors during the 1990s and early 2000s. But by the end of the 1990s, this process of structural shift in industrial employment seemed to have gone somewhat further in the south.

The aim of the UK Government's manufacturing strategy is to help more manufacturers to move up the value chain and to reap the benefits of high-skilled, knowledge-intensive manufacturing operations. DTI (1999) identify four linked themes which government and manufacturers should address.

Figure D1: UK Government's manufacturing strategy



Source: Based on DTI (1999)

However IBEC (2004) notes that there is a certain complacency which rests on the theory that manufacturing can be outsourced while the higher paid employment in R&D, innovation and marketing is retained in Ireland. As some major western manufacturers are beginning to realise, much of the prized higher income activity can also be performed equally well in lower cost countries – a trend that will gather pace if we do not meet the challenge.

The share of medium and high-tech production in manufacturing added value rose from 59% in 1985 to 61% in the industrialised economies in 1998. The corresponding figures for developing economies were 42.5% to 49%. Consequently, as ManuFuture (2003) note, the North-South technology gap has been partially eroded.

The US perspective

The recent Comprehensive Strategy launched by the US Department of Commerce to address the challenges to US manufacturers, emphasizes the impact of harsh recession of mid-2000 over the US manufacturing sector as well as the negative effects of cyclical changes following the recession. In line with other advanced economies, manufacturing employment in the US has been falling over the past three decades.

The main characteristic of the modern manufacturing sector in the US is growth of productivity which exceeds that of America's strongest trading partners. This stronger performance of US manufacturing in raising its productivity gives some ground to believe in the sector's ability to adjust to increasing competition at home and abroad. Technological innovation is emphasised as one of the most important instruments for increasing productivity.

Other features that characterise the development of US manufacturing today are the significant retrenchment in business investment in technology, the uncertainty caused by terrorist attacks of 9/11 and dropping US export due to slow economic growth in US main trading partners.

US manufacturing relies on productivity growth as a basis for recovery and development. Invention, innovation and product quality are used by US manufacturers to meet the competitive challenges.

In the context of aggressive global competition the main challenges for US manufacturing are created by the emergence of new competitors, who have adopted the rules of a market economy, in place of the government planning systems (China and Russia in particular), further liberalization of trade and elimination of trade barriers, increasing costs of business compliance and a shift to global outsourcing.

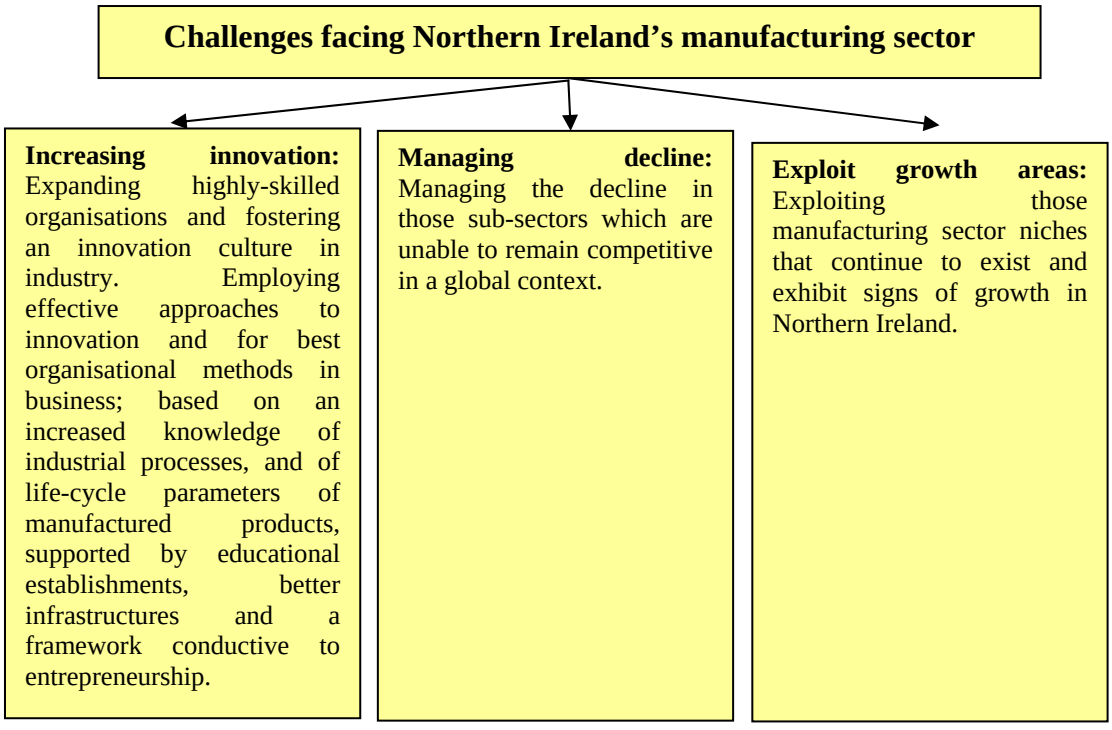
A recent article by The Economist (2004) on Japanese manufacturing follows this argument. It notes that Japan's weak spot is in low-cost, mass production, which has been steadily leaving for lower-wage countries. Low-cost manufacturing in Japan is likely to be limited to niche products. Many manufacturers are responding to competition by keeping core technologies secret and at home, while moving low-

value-added production and assembly operations abroad. This 'in-sourcing' has raised profits in several ways, which highlight three longstanding advantages of the Japanese approach to manufacturing: specially trained workers, low defect rates and "lean" processes that hold down inventory costs and boost production flexibility. In addition, leading firms such as Toyota and Canon have developed integrated manufacturing systems that are far more sophisticated and complex than rivals can manage. In other sectors, companies have learned how best to protect trade secrets that have long made them competitive, often bringing back home, activities that might otherwise risk exposure to rivals. And most big firms believe that they can keep an edge in future by continuing to invest in new generations of products.

However, The Economist cites an influential recent article by a professor at Tokyo University, "A twenty first-century strategy for Japanese manufacturing", which highlighted that it is too simple to suggest that Japan should focus on high-value-added production. What Japanese manufacturers really excel at, he argued, are "products whose functions require many components to be designed in careful detail and mutually adjusted for optimal performance". This requires close teamwork within a company, as well as co-operation with suppliers.

These changes pose a number of significant challenges for the NI economy and the manufacturing sector (ManuFuture, 2003). It is important to encourage Northern Ireland's firms to move up the value added chain but on its own this is not enough. The diagram overleaf sets out some of the broad challenges facing Northern Ireland's manufacturing sector.

Figure D2: Broad challenges facing Northern Ireland's manufacturing sector



Source: Based on ManuFuture (2003)

If the manufacturing sector is to survive in Northern Ireland, it will need to remain competitive in a global market, through both productivity improvements in existing firms and by the development of new high value added niche sectors. There may also be scope for Northern Ireland to leverage opportunities off UK strengths. For example, the pharmaceuticals sector is seen as a growth area for UK manufacturing and could very well prove to be a potential area of opportunity for Northern Ireland.

The Pharmaceutical Sector: a growth area for UK manufacturing

All the word's leading pharmaceutical companies have significant manufacturing or research and development operations in the UK. DTI (2004) report that the sector employs 83,000 people across all business segments. In addition, the UK is the world's largest exporter of pharmaceuticals by value. In 2003, exports and the trade surplus hit record levels of £11.8bn and £3.1bn respectively. In addition, UK R&D spend totalled £3.5bn in 2003, exceeding by far that in any other European country.

It is also noted that the pharmaceutical sector has a global market, overwhelmingly in the developed world, worth around £250bn a year and a growth rate of 4% to 5% a year.

Source: Based on DTI (2004)

The discussion therefore shifts to consider the role and importance of productivity and the drivers of economic growth in not only the manufacturing sector, but in the economy as a whole.

Drivers of economic growth

Economic growth is derived from two sources; increases in inputs such as labour, education and the stock of physical capital; and increases in output per unit of input, which in the long-run are knowledge driven. Sustained growth in a region's per capita income can only occur in the latter case i.e. through a rise in productivity.

There are significant and persistent differences in economic performance between and within UK regions. The impact of this untapped potential could be very significant. HM Treasury (2001) estimates that if all lagging UK countries and regions improved their productivity performance to at least that of the current average then the average person in the UK would be around £1000 a year better off.

In 1999, the UK's poorest regions, Northern Ireland, Wales and the North East, had a GDP per capita nearly £7,000 or around 40% below that of London, the richest region. Analysis of regional disparities by HM Treasury suggest that, on average, productivity differentials account for around 60% of regional GDP per capita differentials.

The persistence of these differentials over large parts of the last century, points to significant market failures in under-performing regions and localities. If the economic processes driving growth were working effectively, we would expect these differences to disappear over time. New technologies and best practice would diffuse from the leading regions to the followers. Firms would discover new investment opportunities in the lagging regions. The additional investment in human and physical capital,

coupled with the adoption of new techniques, would generate relatively faster growth in the lagging regions and stimulate a catching-up process. That this has not occurred, points, among other things, to market failures in the under-performing regions and localities. This creates a strong case for well-judged government intervention to correct for such market failures.

Long-term unemployment rate figures suggest that these labour market mismatch problems are particularly pronounced in the North East, Northern Ireland, the West Midlands, London and Wales.

Our underperformance is also the result of market failures leading to inadequate incentives to acquire skills. Such markets failures occur as a result of:

- **Externalities:** for example where an employer invests in training but the worker is poached by another firm, the training employer will not get the full return for their investment in skills; *and*

- **Imperfect information:** where employers and employees cannot identify the full benefits of training.

Across the economy as a whole, labour productivity measured by GDP per hour is about 30% higher in the US and France and 17% higher in Germany. In manufacturing, labour productivity is 55% per cent higher in the US, 32% higher in France and 29% higher in Germany.

NIEC (2000) state that labour productivity growth accounts for at least half of GDP per capita growth in most OECD countries and considerably more than that in many of them. In the Republic of Ireland for example productivity growth accounted for over 70% of GDP per capita growth between 1990 and 1998.

NIEC (2000) report that over the period 1983-93 productivity was the main driver in the Northern Ireland economy behind growth in output per person. Looking at 1993-98, a decrease in economic dependency was the main driver of economic growth. Therefore, greater utilisation of labour not growth in productivity has been the main contributor to growth in the Northern Ireland economy over the past 5 years. Population trends suggest that the opportunities are there to sustain this in the short to medium term, but its potential is not unlimited. **So the target of industrial policy in Northern Ireland must be to raise the rate of productivity.**

Part of the productivity gap between Northern Ireland and the UK is due to a structural disadvantage related to industry-mix and plant-size structure. However, there is a strong body of evidence that manufacturing plants in Northern Ireland on average operate at lower levels of technical efficiency when compared to their counterparts in other regions of the UK. NIEC (2000) cite the results of a forthcoming paper that shows that establishments in the Northern Ireland manufacturing sector have lower levels of labour productivity than establishments in other UK regions, despite evidence that they have higher capital expenditure per employee. The available information suggests that there is scope to improve productivity both within individual firms and sectors and by shifting from traditional low-productivity sectors to newer high-productivity ones.

HM Treasury (2001) found that both regional participation rates and working-age population shares seem to be correlated with regional productivity levels, suggesting that highly productive regions may attract more people who wish to participate in the labour market. It could also be indicative of a higher proportion of workers leaving the labour force in low productivity regions. This suggests that policies should tackle both productivity and labour market weaknesses if they are successful to affect regional GDP per capita gaps.

UK manufacturing productivity growth picked up sharply in the late 1990s, however the middle part of the decade was marked by stagnation, contributing to a sharp rise in unit labour costs relative to the UK's main competitors.

High labour shares imply low levels of profitability and / or low returns to physical and intellectual capital. Therefore it could be argued that high labour shares will tend to characterise less knowledge-intensive businesses, particularly where the firm's research and development is being conducted outside the domestic economy. From an economic development point of view, however, a high labour share may be desirable as labour income will tend to be 'retained' within the region whereas returns to capital or knowledge – in the case of externally-owned industries – might easily flow abroad as remitted profits or through transfer pricing arrangements.

O'Malley and Roper (2003) highlight the different development paths of manufacturing North and South. They show that sales per employee and GVA per employee in the South are almost twice their Northern average and also rose significantly faster from 1998 to 2000. However value added as a proportion of turnover was very similar at 30% - 35% of sales. Wages and salaries however were a significant higher share of value added in the North than in the South. The implication is that the remainder of value added, including returns to capital and knowledge inputs, were more significant in the South than in the North. They focused on comparable levels of labour productivity in individual sectors North and South and categorised the sectors into three types:

- A group of mainly mature industries in which the productivity of the Northern and Southern industries are very similar (i.e. plus or minus 10%). This group includes textiles; wood and wood products; pulp, paper and printing; rubber and plastics; basic metals; fabricated metal products; machinery and equipment; electrical machinery; motor vehicles and other transport equipment; and recycling;

- In four mature sectors productivity differs significantly (by more than 10%) North and South being higher in the South in each case. These include food, drink and tobacco; furniture; clothing; and non-metallic mineral products; *and*

- A group of sectors dominated by inward investment into the South with notable North / South difference in sales per employee and productivity. This group includes printing and the production of recorded media; chemicals and chemical products (including pharmaceuticals); office machinery and equipment; metal, precision and other instruments; and radio, television and communications equipment.

These contrasts between productivity performance, North and South, emphasise that within the Island economy, significant productivity differences exist, creating the potential for improving overall performance by developing all-island benchmarking and the island-wide dissemination of best practice. According to O'Malley and Roper (2003) the gains from any such initiative, however, are unlikely to be evenly shared. DTI (2002) reported that Northern Ireland's strengths include telecoms / electronics, life & health technologies, textiles & clothing, food processing and software, the majority of which have lower levels of productivity than the South of Ireland.

Despite its many strengths, UK manufacturing also suffers from long-standing weaknesses – lower levels of skill, investment, R&D and innovation – that contribute to lower levels of productivity than in France, Germany and the US. If we could raise the levels of productivity in UK manufacturing to their levels, and other things remained the same, value added in manufacturing would be more than £70bn higher. By improving productivity and competitiveness, we will create better paid jobs for our manufacturing investors.

HM Treasury (2000) state that the evidence about the factors underlying regional and sub-regional economic performance suggests that skills, innovation, investment, enterprise and competition are the key factors driving productivity growth in UK regions and localities. The evidence on skills in explaining regional economic differentials is particularly strong.

Table D2: Factors affecting regional and sub-regional productivity

Factors	Implications for productivity
Skills	These can be attributed to failures in the regional and local production of skills. Incentives to acquire human capital are reduced in low-growth regions by the lack of high-skilled jobs in such regions. In addition, market failures may exist in the matching of workers and their skills in a travel to work areas. These may be compounded by constraints on labour mobility.
Investment	Efficient investment decisions by entrepreneurs, banks, venture capital providers and other source of investment finance, require region and locally specific information. Depressed and remote areas may suffer from poor access to capital on account of a lack of information and uncertainty about investment opportunities in those areas.
Innovation	The dissemination of knowledge of best-practice and new technologies decreases with distance, suggesting that there is an important regional and local dimension to innovation. Tackling market failures in the adoption and creation of new technologies and best-practice techniques, on account of, for example inadequate product market competition or information failures, are vital to productivity growth in an area.
Enterprise	The sizes of labour, capital and product markets are all constrained by geography. High levels of entrepreneurial activity in every region and locality are essential for high levels of competition, innovation, investment and skills in an area – and hence for job creation and productivity
Competition	Markets can have an important regional and local dimension as they are segmented by transportation costs and consumer tastes. Ensuring that markets are competitive in every region and locality is essential in ensuring firms face incentives to innovate, keep prices down and minimise their costs of production

Source: Based on HM Treasury (2000)

Components of a new manufacturing strategy

IBEC (2004) note that any response to current manufacturing trends must be to put in place a highly knowledge based economic model that relies on commercialised Research and Development. “We need industries whose modus operandi pivots around flexibility and ongoing change – flexibility within industries and across industries” (IBEC, 2004). Cost competitiveness is becoming more important as lower cost economies gain the skills to perform the higher value added activities. In recent years, Ireland’s cost competitiveness has reversed and the undoubted gains made in the first half of the 1990s have been significantly eroded.

The UK Government’s manufacturing strategy requires a close partnership between government, industry management and the workforce (DTI 2002). The strategy identifies seven pillars to help build a vibrant, knowledge-intensive, high-skilled manufacturing base. These key elements for success are presented in the table below.

Table D3: The 7 pillars of the UK's manufacturing strategy

Factors	Implications for productivity
Macroeconomic stability	Elimination of boom and bust helps encourage an environment of steady growth and productivity improvement, giving manufacturing companies conditions where they can invest with confidence.
Investment	All sectors have an opportunity to narrow the productivity gap with their competitors by increasing investment in new technology, new products and advanced processes. The economy as a whole benefits when UK companies invest and foreign-owned companies decide to build manufacturing in the UK.
Science and innovation	To raise UK manufacturing innovation performance, by making best use of the excellent UK science base, by utilising technology from a range of sources, and by demonstrating the benefits which accrue to innovative companies. In particular, investment, skills and best practice, and close attention to customer needs, are essential if companies are to innovate successfully. Knowledge transfer activities can overcome information failures between business and the science base. The government has an important role in fostering innovation for example in encouraging R&D collaboration and knowledge sharing thus enabling individual companies to capture knowledge spin-off from each other's research, and collectively to enjoy the benefits of economies of scale and scope in innovation. Similar benefits can arise from policies to reinforce the development of clusters. By locating near each other, innovative companies engaged in related activities can gain spillover benefits whereby the innovation activity of one company benefits others;
World-class best practices	Adoption of best practice implies a culture of continuous improvement. Taken as a whole, UK manufacturers can increase their competitiveness considerably by adoption of world-class practices. As an indication of potential gains from learning from others, the CBI estimates that if UK firms adopted the best practice levels achieved by their international competitors, the UK could increase GDP by about £60bn.
Skills development	Improved skills across the workforce and the creation of a system that reflects the needs of individuals and employers are essential for the fulfilment of the Government's productivity and social inclusion agendas. The quality of labour input is a key driver of productivity growth, both in manufacturing and in the wider economy. Higher-skilled workers are better able both to exploit the potential of physical investment, and to adopt new ideas and interventions. Skill improvements complement other investments such as physical capital or R&D. If firms are unable to hire workers because of skills shortages, or if they cannot re-organise production, then their inability to undertake complementary investments may constrain their ability to invest in new plant and or more sophisticated machinery.
Strong infrastructure	The UK needs a modern, efficient public infrastructure to enable business to reduce costs, increase efficiency and improve its competitiveness. This is a major challenge given decades of under-investment. The transport system is of central importance, together with a thriving broadband market due to the growing importance of e-business in all sectors.
The right market framework	The government wants the UK to be the best in the world to do business, a place where manufacturing innovates and thrives. This requires competitive and dynamic markets and motivated, well-informed and confident participants – business, consumers, employees and investors.

Source: Based on DTI (2002)

The overall aim of the strategy is to narrow the productivity gap, across the economy, with our major competitors. At a more specific level below this, targets for the UK include, for example:

- To increase the level of exploitation of technological knowledge derived from the science and engineering base, as demonstrated by a significant rise in the proportion of innovating businesses citing such sources;

- Of the firms assisted by Trade Partners UK, at least 15% of those new to exporting, and 50% of established exporters, should have improved their business performance;

- To use Regional Selective Assistance and Enterprise grants to lever in £3.75bn of capital investment and create / safeguard over 75,000 jobs by 2008; *and*

- In the business best practice and knowledge transfer areas, targets are set rigorously at sub-programme and project level. Each industry forum programme has targets tailored to the sector concerned, for example, and each LINK programme has targets tailored to the particular technology which is being promoted.

With regards current policy / actions in Northern Ireland to assist and support the manufacturing sector, we have summarised these under the pillars of the UK strategy.

Table D4: A summary of Northern Ireland manufacturing strategy

Factors	Actions / policy
Investment	Companies are being helped to build their capability through R&D, innovation, technology transfer, marketing and skills development. The agency provides tailored business solutions and where finance is needed helps its clients explore commercial avenues before using public resources. Invest NI is committed to the development of a vibrant local venture capital market. It recently published Venture Capital – Out Approach, explaining the need for Government intervention at an institutional level, where necessary facilitating the creation of new venture capital funds; and also at an individual company level, through direct equity participation, to address any remaining gaps in the market.
Science and innovation	**Think|create|innovate: The Regional Innovation Strategy for Northern Ireland,** was published in June 2003, with the objective of co-ordinating and sustaining a systemic approach to innovation and R&D across all sectors of the economy and society with the overarching objective of making Northern Ireland a genuinely world-class innovating region. It sets out four key priorities: • To create a coherent R&D and innovation infrastructure; • To enhance the use of R&D and innovation by the business sector; • To develop a culture of innovation and enterprise; and • To sustain the regional innovation system. **The research & Technological Development Centre of Excellence Programme** has established 18 company and University-based Centres of Excellence, with investment of over £100m in both established and emerging technologies, including electronics, communication and IT and nanotechnology. In addition, 3 funds specifically support innovation and knowledge transfer: • The **Proof of Concept Fund** supports the development of ideas from university R&D into industry; • The **Higher Education Innovation Fund** will promote and support an enhanced university . industry interface; and • The **NITECH Fund** is designed to increase the level of knowledge and technology transfer into the commercial environment. An enhanced action plan now sets out a strategic framework and a prioritized list of initiatives to demonstrate the benefits and applications of design principles to at least 150 companies through events, case studies and the media. 24 **Knowledge Transfer Partnerships** help businesses develop and grow by accessing knowledge and expertise in UK universities, colleges and research organizations. A further five are under negotiation. Partnerships are being promoted between Northern Ireland universities and international research institutions through **Technology Missions** (for example a telecommunications mission to Asia and nanotech missions to Boston and Tokyo have already taken place).

Factors	Actions / policy
World-class best practices	Invest NI has supported the development of the **UK Micro- and Nanotechnology network**, to provide a forum for exchange of knowledge and best practice. Invest NI, provides support for technology transfer in smaller companies in Northern Ireland. Its **Technology Advisory Service** helps small business focus on innovation and provides project management, monitoring and links with universities and further education colleges.
Skills development	The Department for Employment & Learning is developing a Skills Strategy and has reviewed Further Education and Modern Apprenticeships. Invest NI offer through their **Company Development Programme** and their **People Excellence Programme**, general advice and training for firms in areas such as legislation and human resources.
Strong infrastructure	An integral feature of Northern Ireland's **Regional development Strategy** was the production of Regional Transportation Strategy, with a Belfast Metropolitan Transport Plan and Regional Strategic Transport Network Transport Plan. Over £55m of **Strategic Road Improvement** schemes have been completed in the past two years, schemes to the value of £50m are currently under construction and further schemes to the value of £350m are expected to be built in the next 5 years. Northern Ireland has a full digital, fully fibre optic **communications network** providing a minimum of 2.5 Gigabits per second (Gbps) capacity expandable up to 100 Gbps. There are telecom links to the rest of the UK and Ireland by undersea and underground cables as well as radio and microwave technology providing secure, resilient and high capacity connections to the rest of the world. DETI has recently awarded a contract for the delivery of 100% broadband access to every business and household in Northern Ireland by December 2005.

Source: Based on DTI (2004)

DTI's 2004 report reviews the manufacturing strategy two years on from its inception. The table below summaries the performance under each of the 7 pillars. It notes that although major improvements have occurred across all the pillars, there is still plenty to be done by Government and industry.

Table D5: The 7 pillars of the UK's manufacturing strategy – 2 years on

Factors	The success of each pillar
Macroeconomic stability	The report notes that while many of the major economies experienced recession, the UK grew continuously throughout the downturn that began in 2001. In addition, the UK is the only G7 economy not to have experienced at least one quarterly contraction in output over the last three years.
Investment	Nine Regional Venture Capital Funds have over £250m under management with 143 investments made in 107 companies by the end of March 2004. The Early Growth Fund programme has made 34 investments totalling a value of £4m. The take up of the Small Firms Loan Guarantee is up 52% from 2003, with £409m guaranteed in 2003/04. UK Trade & Investment has helped approximately 20,000 businesses annually to sell and invest overseas, whilst also attracting high quality foreign investment to the UK, and helping the UK increase its share of EU inward investment from 19% in 2002 to 23% in 2003. In addition, the Export Credits Guarantee Department (ECGD) has provided guarantees and insurance to a range of UK exporters in the civil, aerospace and defence sectors in 2003/04. It supported £2.9m worth of capital goods and project export business and investments to 44 countries. However, it is noted that investment in UK manufacturing is a long-term weakness which requires further support. This involves a stable economic environment, new business support, additional Capital funds, tax incentives and continuation of the activities from UK Trade & Investment.
Science and innovation	There has been an increase in knowledge transfer activity, with 213 new spin-off firms set up in 2001 /02. There were 348 in 2000/01 and 203 in 1999/00, compared to an average of 70 a year in the previous 5 years. Income from contract research rose from £188m in 1996/97 to £328m in 2001/02. In addition, it is reported that there has been a move in the right direction with UK business research and development investment. After a period of decline from 1.5% of GDP in 1981 to 1.16% in 1997, research and development investment increased to 1.24% in 2002. However, it is noted that regardless of UK manufacturing sectors that lead the world in innovation (i.e. aerospace, pharmaceuticals and biotechnology) measures of innovation show that the UK's overall performance is well behind that of the US and roughly equal to the EU average. Therefore further support is planed such as enhancing the Ten Year Science and Innovation Investment Framework, R&D Tax Credits, implementing the Innovation Report Action Plan, establishing a cross-departmental Ministerial Group on Innovation and the Knowledge Economy, and provision of a forum for businesses to work with Government on delivering on innovation by the Innovation Stakeholder Group.
World-class best practices	The Manufacturing Advisory Service (MAS) has become a success. By March 2004 it has responded to almost 27,000 enquiries, carried out over 6,400 free diagnostics and advisory visits, and completed more than 1,400 in-depth consultancy projects. It has also generated average 'added value' to manufacturing companies of £102,000 a year with total 'added value' to all companies reaching £53m by March 2004. In addition, Industry Forum programmes are now seen as 'engines for change' in their sectors with 1,700 companies participating. Furthermore, an evaluation of the Partnership Fund in 2002 found that workplace partnership had changed attitudes and behaviours and contributed directly to business improvements and improvements in union-management relationships. Again, the report notes that more needs to be done such as improvements to MAS, continuing the delivery of DTI's new Achieving Best Practice in your Business products, and encouraging industry to continually benchmark performance and adopt best practice.

Factors	The success of each pillar
Skills development	The number of Modern Apprenticeships trainees grew from 75,800 in 1997 to 255,500 in 2004. With a total of over 60,000 learners and 10,000 employers involved in Employer Training Pilots, this demand-led approach is already influencing the supply side, with colleges and other providers delivering more flexible training solutions. In addition, over 6,000 young people are working towards the new vocational GCSE in Engineering. Looking forward, the report notes that Government will focus increasingly on the demand-led agenda by improving the co-ordination and leadership of the sector skills agenda, introduce a Leadership and Management Programme across England, launch the national Inspired Leadership Index (so that leaders and top managers can compare their own leadership skills and values), attract young people into manufacturing, increase the number of Employer Training Pilots, develop a system of vocational qualifications and develop a network of Engineering Specialist Schools. Furthermore industry needs to fully promote up-skilling of the workforce, work with Sector Skills Councils and the Learning & Skills Council to develop apprenticeships that fully meet its needs, and participate in a new initiative to improve leadership and management in SMEs.
Strong infrastructure	There is evidence some improvements such as railway passenger numbers up 25% on 1997, railway upgrades, 19 new railway stations and 9 re-opened, 24% increase in the amount of freight moved by rail since 1997, availability of broadband in the UK grown to 85%, the proportion of internet connected businesses using broadband rising from 50% in 2002 to 63% in 2003, and the UK is now the third best of the G7 countries with respect competitiveness of broadband networks and joint third with USA for extensiveness of broadband coverage. Again, there are a number of priorities for the future. These involve publishing a new Transport Strategy, a real-terms increase in funding for transport, increase broadband penetration, and industry to work with RDAs and public sector to define regional priorities necessary for competitiveness and to bring broadband to every community by 2005.
The right market framework	There have been a number of positive results in relation to this pillar. For example, the Government has strengthened their input to the better regulation agenda, both domestically and in Europe. There have also been major improvements in the organisation of DTI to foster a more efficient and effective information channel between Government and Industry. However looking to the future, Government will, promote industry competitiveness and impact assessment across the EU policy agenda, work with other member states to develop a systematic competitiveness impact assessment for use in EU policy making, and develop a new planning policy statement on Planning for Economic Development. In addition, industry needs to engage with regional and local planning bodies to ensure business views are fully captured in regional spatial strategies and local development documents.

Source: Based on DTI (2004)

Responding to the challenges of global competition and domestic compliance pressures, the US Government launched the Manufacturing Initiative in 2003 designed to support manufacturing and develop sectors with growth potential. The general stance behind this programme is the commitment of the Government to create jobs and ensure economic growth. The Initiative is supported by the Comprehensive Strategy to Address Challenges to US Manufacturers of January 2004.

The initiative focuses on issues of government abilities to help domestic manufacturers to compete. The Government is addressed by the manufacturers to create economic conditions to foster a healthy and competitive manufacturing sector while removing obstacles/impediments it created through increased business costs (in particular, energy and healthcare). World-class training and skills development are key areas of Government actions.

The US manufacturers articulated for the Government the main challenges they face:

- lack of focus from government upon changing environment for manufacturing and its competitiveness;

- government should focus on encouraging economic growth both at home and abroad;

- efforts in controlling manufacturing costs – manufacturers strive to reduce costs to increase productivity and competitiveness but this is offset by costs arising from government policies (i.e. uncontrollable costs). Regulatory costs are associated with environmental regulations, compliance with workplace safety and product safety requirements as well as time spent for filing government paperwork and keeping records;

- government should support technological development and aid both innovation to enter the US marketplace and investment in research in any field in order to achieve a spill-over effect; and

- emphasis should be placed on education – lifelong education and promotion of scientific / engineering professions are essential factors for increasing innovation. High school is seen as insufficient for entering modern manufacturing work force.

US manufacturers also raised concern about the impact other government policies may have on manufacturing sector development. Government decisions and policies are not made in a vacuum and any decision in taxation, environmental protection, energy policy, personal injury compensation, etc. affects manufacturing and very often creates additional burden for the sector.

Recommendations of US manufacturers for further government policies and actions to support manufacturing have been grouped under the following headings:

- Creating conditions for manufacturing growth:

    - making tax cut permanent;

  - reduce cost of tax complexity and compliance; and
  - research and experimentation tax credit.

- Reducing costs of manufacturing:
  - reduce the cost and improve the availability of healthcare; and
  - modernize legal system to eliminate disincentives for investment in manufacturing (liability etc).

- Reducing costs of regulation and legislation:
  - establish inventory of potential regulatory reform that would lower cost of manufacturing.

- Creation of Energy Plan that encourages conservation, improves infrastructure and improves domestic production:
  - adequate and economical supplies; and
  - alternative energy sources.

- Investing in Innovation
  - review of federal funding for research; and
  - strengthen partnership to promote manufacturing technology transfer.

One of the responses the US Government made to challenges encountered by the manufacturing sector, is the continuing support to the Manufacturing Extension Partnerships (MEPs). MEPs were first created in 1988 to provide small manufacturers with business services for better productivity and competitiveness. Researchers from the Census Bureau's Centre for Economic Studies found that MEP clients experienced 3.4% to 16% more growth in labour productivity over 5 years than similar non-member firms.

The programme was originally intended as 12 federally supported centres with federal funding ending after 6 years. However over the years the programme expanded this idea and grew into 400 locations. Today the programme is a nationwide network of not-for-profit centres in over 400 locations in the US, whose sole purpose is to provide small and medium sized manufacturers with the help they need to succeed. The centres, serving all 50 States and Puerto Rico, are linked together through the Department of Commerce's National Institute of Standards and Technology. Centres are funded by federal, state, local and private resources to serve manufacturers. That makes it possible for even the smallest firms to tap into the expertise of knowledgeable manufacturing and business specialists all over the US.

MEP products and services cover all the core business activities of a company which can be improved in order to strengthen competitiveness and maintain effective and

efficient operations: programmes to eliminate waste of resources, strategic management tools, introduction of quality systems, developing industrial marketing, launching eBusiness and other learning tools.

Each centre works directly with areas manufacturers to provide expertise and services tailored to their most critical needs, which range from process improvements and employee training to business practices and applications of information technology. Solutions are offered through a combination of direct assistance from centre staff and outside consultants. Centres often help small firms overcome barriers in locating and obtaining private-sector resources.

Since the beginning of MEP, assistance has been provided for over 149,000 firms. In a survey of MEP clients over the period from October 2002 through September 2003, 5,015 companies around the country reported that, as a result of MEP services, they:

- Created or retained 35,028 jobs;
- Increased sales by $953 million;
- Retained sales of $1.84 billion;
- Realized $681 million in cost savings; and
- Invested $940 million in modernization.

With regards to Northern Ireland, Best (2000) analyses the historic industrial strategy. He attacks the old system of preferential assistance to Northern Ireland's industry (e.g. Standard Capital Grants), for preserving a fairly stable economy whilst effectively concealing the reality of eroding competitiveness. He states that a low growth, low productivity, low innovation economy has powerful self-reinforcing barriers to change. HM Treasury (2001) highlights the central role that competition plays in driving productivity growth, by providing strong incentives for firms to innovate and adopt new technologies and working practices. It helps reduce slack in organisations and is crucial in the reorganisation of market structures, by reallocating resources away from inefficient firms or declining sectors, to more efficient firms and growing sectors. Therefore, this industrial policy of subsidisation in Northern Ireland fostered a state-dependant, reactive business model. The powerful driver of growth and cornerstone of most successful industrial policies, the entrepreneurial firm, was missing from the region.

Best (2000) concludes that the business model in Northern Ireland cannot be characterised as entrepreneurial. It is unable to absorb advanced technology skills. The fact that Northern Ireland's businesses failed to use three-quarters of its technically educated graduates suggests that a regional competitiveness advantage is not being developed in knowledge-intensive sectors and activities.

The challenge facing policy makers, in Best's view, was how to break this historic pattern and introduce a model which encourages and fosters technological advance, skill development, techno-diversification, and networking. In other words, to enable

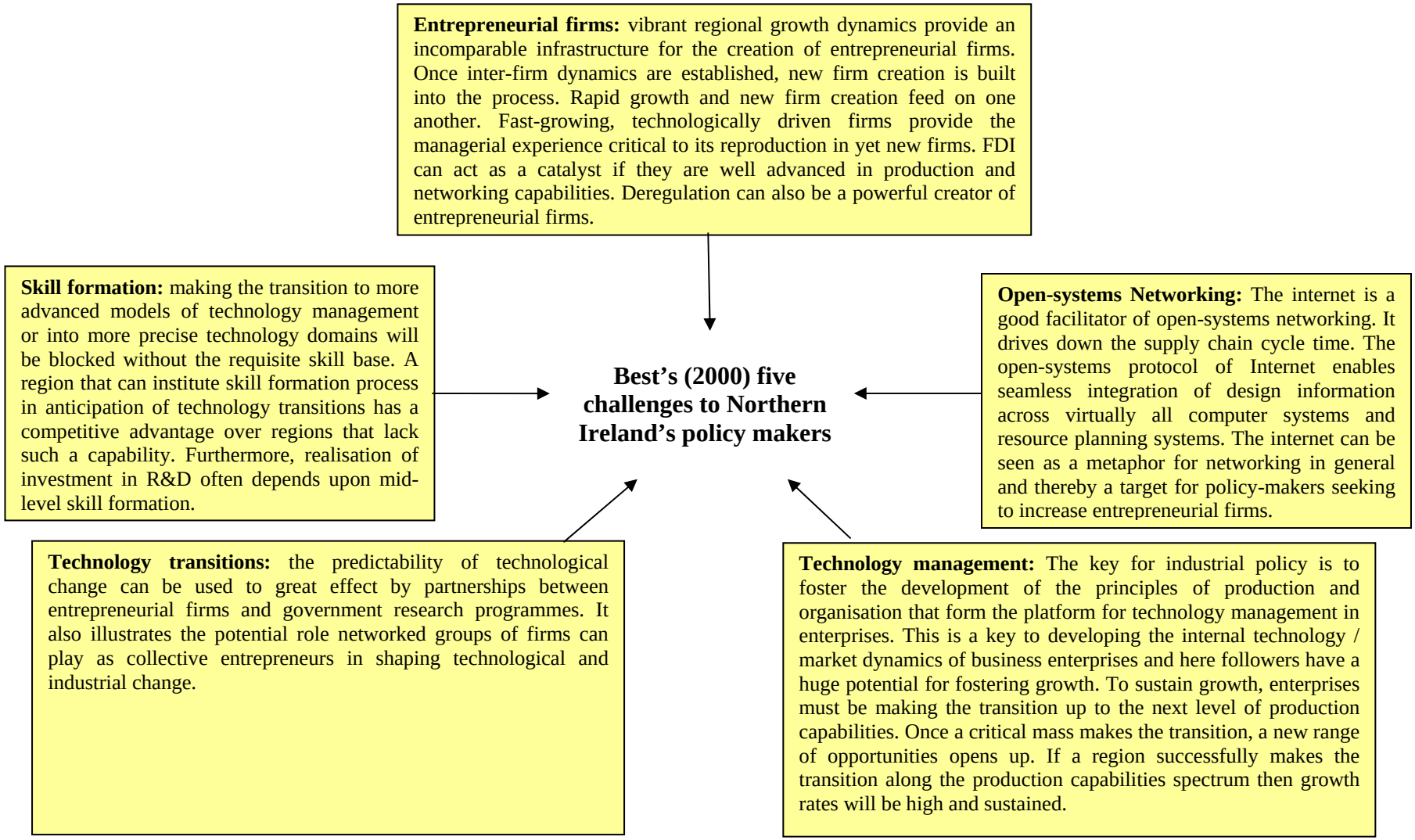
firms to pursue an entrepreneurial, proactive, product-led business strategy, instead of consigning firms to a non entrepreneurial, reactive, price-led business strategy.

He highlights that Northern Ireland lacks sufficient numbers of entrepreneurial firms, which are instrumental in integrating new technology into production and thus improving productivity. The current business model is not helpful in fostering technological advance and innovation. Few companies are organised for product-led competition. As a result, innovation is low by international comparisons, particularly with countries with similar levels of advanced engineering and science skills. In addition, Northern Ireland's productivity is poor compared with the UK, which itself is some 20% - 40% behind leading European economies and the US.

> *"The Government believes that a successful regional and sub-regional economic policy must be based on building on the indigenous strengths in each locality, region and country. The best mechanisms for achieving this are likely to be based in the regions themselves"* (HM Treasury 2001).

Best (2000) present's five challenges that policy makers need to address in order to advance the three elements of: business model, production capabilities and skills in Northern Ireland.

Figure D3: Challenges facing Northern Ireland's policy makers



Source: Based on Best (2000)

Taking Best's five challenges, the remainder of this section sets out the issues associated with each, and concludes with proposals identified in the literature, to realise each of these issues.

Unexpected productivity performance. Case of Oberbayern in Germany

The European Competitiveness report of 2003 addressed the question of why industries in some regions are more competitive than others. The research presented in the report concluded that there are several factors that could contribute to more-than-expected productivity growth:

- government policy (including regional innovation strategy);
- entrepreneurship culture;
- cluster activity; and
- regional spillovers.

The region of Oberbayern in Germany is one of the examples of unexpected productivity performance. Manufacturing in Oberbayern covers traditional machinery and car makers but also new areas such as biotechnology and new materials. Services dominate the local economy but there is a distinct tendency to retain manufacturers by specially designed industrial sites / clusters, based on three main industries: ICT (grouped around Infineon, Siemens, Oracle and the Microsoft subsidiary), media (print, film, new media) and biotechnology. Resources for the creation of industrial clusters were provided by receipts of past privatizations of state-owned enterprises.

The region also created a policy framework to ensure economic success by providing adequate supplies of inexpensive energy, supporting the development of transport infrastructure, improving educational facilities and raising awareness of new technology development.

Entrepreneurial firm

The entrepreneurial firm is characterised as being driven by a technology capability / market opportunity dynamic, which is built into the ongoing operations of the firm. These firms pursue market niches by developing unique production capabilities, often of a technological form, which creates new market opportunities. They pursue product-led competitive strategies and depend upon high performance work systems. The business model incorporates design and manufacturing in order to shorten new product development cycles3. These firms are also involved in open-systems

[3] As discussed by Best (2000), the shorter the design / manufacturing cycle, the greater the opportunity and capability to introduce technological innovations into production. Being first to the market with a new technology is important, but having the shortest design / manufacturing cycle time is more important in that technological refinements can be introduced more rapidly. Over time, the technological gap widens between companies with rapid and slow design / manufacturing cycle times. This is reinforced by higher profit margins which create funding for increased research, design and engineering which in turn, enhances the investment in and introduction of new technologies.

networking. Each of these characteristics, in turn, reinforces and replenishes entrepreneurial firms.

Firms that experiment and develop unique or new capabilities must decide which of the new possibilities to purse and which to push outside the firm (otherwise known as techno-diversification). Those not pursued internally become 'market' opportunities for other firms to advance their productive capabilities. If the firm is part of a networked group of firms each specialising in a complementary capability, a technical change at any stage of the network will create new pressures and opportunities for specialists in each of the complementary capabilities. Therefore, an advance in design and technology are both diffused and interactive across production networks.

The goal of the entrepreneurial firm is to develop the organisational capabilities to differentiate the firm's product in the market place and establish an ongoing relationship with customers. Success requires product development, technology management and innovation capabilities. To the extent that firms are successful, the mode of competition shifts from price-led to product-led.

To remain competitive, today's companies need to do more than simply deliver products or services that are better or cheaper than those of their rivals. They must innovate by adding features, improving performance and reducing prices more quickly. They must be faster to launch new lines. If they want to grow, they may have to create entirely new markets. The focus on product-led competition is what distinguishes such entrepreneurial firms. They pursue product-led competitive strategies and operate high-performance work systems. To compress new product development cycle times they integrate design and manufacturing processes. These entrepreneurial firms are continually innovating production processes and their products.

Innovation, according to HM Treasury (2001), is a key driver of productivity growth. Innovation has accounted for around two-thirds of UK economic growth in the post-World War II period. Most research suggests that genuinely new technologies and cutting-edge production processes are produced by a few world-leaders in relatively few countries. These are then disseminated and adopted by other firms and across other countries and regions.

At the level of the whole economy, differences in innovation performance (including innovation in management practices) account for much of the UK's labour productivity gap with the US. The Community Innovation Survey (CIS) shows that 3.2% of UK manufacturing turnover was devoted to innovation activities in 1996, against a European average of 3.8%. This relatively poor performance arises from a lack of recognition of the value of innovation rather than a weakness in the UK science base, which is generally regards as excellent on a range of international performance measures.

Companies with high R&D investment, like pharmaceuticals, biotech, oil and gas, and the food processing sector, are the most successful all-round performers. The most rapidly growing manufacturing sectors tend to have the highest levels of innovation, as proxied by R&D.

Universities have a vital role to play in the innovation process. The cornerstone of this is the role of universities in educating highly qualified manpower (discussed later in this section). This not only provides business with the manpower to undertake R&D and innovation but it is also the basis of the networks which exist between universities and industry. The converse is also true: manufacturing industry needs to work more closely with academia to spot the commercial opportunities from scientific research. UK firms need also to take full advantage of the opportunities to participate in collaborative R&D offered by the European Framework Programme of support for technical research and development.

DTI's (2004) report notes that while larger employers are capable of forming productive links with the science base without outside intervention, SMEs and middle market manufacturers need the help of brokers or intermediaries to do this.

Experts recognise that the stimulation of innovation in manufacturing is a key issue for the future, but they also note that innovation is a very complex process. It does not only require knowledge acquisition and new ways of integrating new and existing knowledge; a favourable political, fiscal, financial and competitive environment is equally crucial.

The prime driver for generating such innovation, and presenting solutions to the problems that industry is facing, is undoubtedly an increase in research and technological development activities. A second driver is increased, but targeted, international cooperation in research on manufacturing. In this respect, the experience gained in IMS and EUREKA is particularly valuable. The enlargement of Europe and better relations with developing countries will also provide scope for more innovation and sustainable development. The ManuFuture (2003) report highlights that the improvement of existing instruments available to encourage international cooperation in industrial research should be considered.

Thirdly, the provision of better education and training schemes able to support the development of new production and consumption paradigms is important. The setting-up of new educational programmes and training activities should also help attract young people to technological careers. Universities have a key role to play in developing improved multi-disciplinary skills, as well as engendering a spirit of innovation. Integrating research, innovation and educational activities under a common research contract is also seen as an excellent way to achieve a concurrent development of skills and technologies.

The fourth driver is a robust operating environment for industrial innovation. This mainly involves a consistent general policy framework and an efficient financial support to all phases of research and innovation. The support of entrepreneurs and the development of innovative SMEs are also seen as a political priority for Europe. The fifth driver is the necessary improvement of the competitiveness of research. A better approach to research and stronger research-industry relationships and interactions, particularly through public-private partnerships, should reduce the time from idea to market. Increased networking will tackle the fragmentation and duplication of effort. Development of world-class multi-disciplinary centres and Networks of Excellence

will build a better knowledge-base, as well as attracting and retaining the best scientists.

> *"In summary, the challenge facing Europe is to transform traditional manufacturing industry and create new actors in manufacturing in the medium to long-term, while at the same time enabling the EU to maintain leadership in manufacturing-related research. This requires a large combination of cross-sectoral multi-disciplinary initiatives and long-term oriented voluntary actions"* (ManuFuture 2003)

Industry – Science Relations

There is an overall perception in Europe that there exists a gap between scientific progress and advancement, and deteriorating industrial competitiveness. This is often referred to as the "European Paradox".

To address this issue research was undertaken (by European Commission, 2002a) within a specially designed benchmarking initiative to identify the possibilities for facilitation of relations and define a framework for Industry – Science Relations (ISR), including analysis of best practices in EU Member States.

The main findings of this research emphasize that policy-related framework conditions such as legislation, institutional settings in public science and promotion programmes foster the establishment and development of ISR. Key areas for policy intervention were identified in R & D collaboration programmes, addressing generic disadvantages of small enterprises in ISRs, institutional reforms in public science, connecting industry and science in training and higher education, and facilitating the commercialisation of new research findings via patents and start-ups.

The Strand report of the FutMan project (European Commission 2002b) emphasises that joint research between industry and academic institutions is crucial. This network will allow the industry to access break-through technologies, increase dialogues and exchange of ideas while allowing much needed R&D funds for academic institutions to explore new ideas.

Open-systems networking

Agglomerations or 'clusters' of firms and skilled workers have important implications for regional economic performance. Clusters of firms gain from spill-over effects from other firms' innovative activity, the existence of advanced or 'thick' local labour markets, and market benefits both in terms of overall market size and through linkages between firms up and down the supply chain. These effects can help create virtuous circles for successful regions whilst locking in economic decline in less successful ones.

Open-system networks are the link between firms and the region. Regions that make the transition to product-led competition can enjoy a competitive advantage over regions in which the dominant mode of competition is price. Entrepreneurial firms driven by technology capability and a market opportunity dynamic are forever advancing their own capabilities which create a virtuous circle. Regional technological capabilities produce entrepreneurial firms, which upgrade regional technological capabilities, which generate more entrepreneurial firms.

Clusters emerge in a region or locality as firms exploit one or more of the advantages that location near their competitors can bring (HM Treasury, 2001):

- **Knowledge spillovers:** knowledge spillovers are especially strong amongst firms that locate in the same geographic region. Informal networks and the movement of skilled labour and management are important for disseminating best-practice techniques and tacit knowledge. Firms that rely on innovation for their success may therefore experience substantial advantages from locating close to each other;

- **Market size and linkages:** firms benefit from locating both close to their customers and to their suppliers, including both suppliers of physical goods and those providing business and other services. Firms will therefore tend to cluster close to their suppliers and in areas of high demand; *and*

- **Sophisticated or 'thick' labour markets:** employers benefit from locating in areas with an abundance of labour with the skills they require. Similarly, workers can more easily find a job in a location with a lot of firms requiring their skills. Hence, clusters of high productivity firms tend to be supported by thick labour markets, especially for skilled labour and specialised management. Empirically, skilled labour has been found to be the most important determinant of firm location decisions, especially in R&D intensive activities.

Open-system networking or 'horizontal integration', translate the problem of the individual entrepreneurial firm into a growth opportunity for a region's collective enterprises. Discarded possibilities are often opportunities for new divisions within subsidiaries or spin-offs or for new firm creation. This pursuit of new capabilities also creates partnering possibilities for firms undertaking complementary capabilities. Therefore, open-system networking offers greater flexibility for new product development and innovation than does vertical integration.

HM Treasury (2001) highlight that there are important barriers that prevent the effective dissemination of technology, not only between developed and developing countries, but also between OECD countries and firms, so that the spread of more innovative and efficient ideas is sometimes highly localised.

Best (2000) notes that industry in Northern Ireland has been dominated by a combination of a few large, vertically-integrated enterprises and small firms that supply to the local market. As a result, and the absence of entrepreneurial firms, the

degree of techno-diversity in Northern Ireland is limited. Without techno-diversification and new firms, industrial specialisation did not occur and the region became further locked into the traditional industries and skills. In addition, Best (2000) notes that open-systems networking operates on only a limited scale in Northern Ireland which limits regional capabilities for new product development and innovation.

According to Best (2000), most attention is normally focused on financial markets as the enablers of the emergence and development of the entrepreneurial firm. However he notes that important as financial commitment is, the driving force must be the technological and market opportunities for establishing a firm with the profitability to make an attractive return to suppliers of finance. The resulting open-systems business model expands opportunities for yet more entrepreneurial firms. It sets higher performance standards in rapid new product development and disruptive innovation.

Cluster Development. Case of Emilia-Romagna, Italy

Emilia-Romagna is one of the Italian regions that experienced rapid growth based on SMEs and a number of dense clusters. The main characteristics of the clusters are the concentration of advanced human capital, social capital (attitudes to cooperate, exchange opportunities and information) and institutional integration and local-regional governance (active business organizations, efficient local governments, active trade unions).

Despite the context of lower educational levels, smaller public-private investment in R&D and capital markets than in other OECD countries the region has developed internationally competitive firms, gained wealth and achieved low unemployment. The key success factors for SMEs in the region are technical specialization, accumulation of sophisticated knowledge and openness, internationalisation and expansion of networks.

The textile cluster represents 18% of regional manufacturing employment and its strength is based on long experience and expertise in design and the use of information technology supported by entrepreneurship as a part of the local culture.

In the 1990s the cluster organization CITER started to promote the following main objectives:

- market intelligence collection;
- market analysis;
- technology diffusion, innovation promotion;
- supporting design activity;
- information about technical standards and assistance for certification;
- providing technical training; and
- participating in international projects and partnerships.

CITER was partly financed by the regional government and by the services CITER provided. The organization has its office in Capri with laboratories and other facilities. The project areas of CITER include: fashion, marketing, training, quality certification, international cooperation, software, technical analysis and external relationships. Each area, along with press and administration, has a person responsible and their backgrounds vary from technical to creative-artistic to meet different needs of clients and provide a wide range of services. The mission of CITER has been changing through time but the case proved to be successful and served as a basis for the creation of other similar technical centres.

Technological management

Studies have shown that under-performing regions and localities have particular problems in absorbing new technologies. This is likely to be a key explanation for regional variations in their innovative performance. New innovations are not always

readily transferable, but need to be adapted to industry, country and region specific circumstances.

Improving the ability of under-performing UK regions and localities to adopt new innovations is likely to be crucial in enabling them to improve their productivity level to those of the best-performing regions. Key factors that improve a region's activity to adopt new technologies include skills of the workforce and investment in appropriate R&D and physical capital, including information and communications technologies and new machinery.

A distinguishing feature of the entrepreneurial firm is production capability and in particular technology management. In the new technology driven economy, technology management is about the capability to develop and introduce new technologies, machines, materials, techniques, and methods into production to improve production performance. It includes the capability of enterprises to create, develop, adopt, combine, re-engineer, upgrade and otherwise advance technologies for purposes of increasing productivity.

Best (2000) finds that the requisite production capabilities for a knowledge-driven industrial system on a scale to drive a high rate of growth are lacking in Northern Ireland. In addition, evidence suggests that high performance work systems are not widely pursued outside the externally-owned sector. Furthermore, technological management is not considered a powerful resource for growth in most Northern Ireland business enterprises.

There is evidence that UK managers are generally less well-skilled when compared to their European counterparts, especially in terms of their adaptability, entrepreneurial and technical skills and on the ability to look to the future. Poor management and leadership can also hinder the introduction of high performance working practices that have a positive effect on productivity and workplace performance.

According to Best (2000) the defining feature of the new competition of today is rapid new product development created by the marriage of productivity and innovation, and the redefinition of both. Whereas productivity and innovation were a trade-off in the old competition, they have become a dynamic in the new. A major requirement for Northern Ireland industry is sufficient production capabilities or technology management capabilities. Technology advance is the most powerful driver of growth and technology management is a means of converting the world's vast pool of technological and scientific knowledge and experience into improving production capabilities and productivity.

> *"The knowledge economy offers great opportunity, but it will not drive economic growth without attention to production capabilities"* (Best, 2000).

Technology transition (investment)

HM Treasury (2001) states that investment in physical capital is a key factor underlying a country's growth performance. The UK as a whole has a relatively small capital stock compared to its major competitors. The US has 56% more capital

services per hours worked than the UK, France has 48%, and Germany 32% more. On a regional dimension, net capital expenditure per employee in manufacturing shows that investment rates in manufacturing vary considerably across the UK. However, the existing data does not suggest that there is a general under-investment in physical capital in the poorest regions of the UK. To get a better indication of the disparities in regional performance one needs to look at investment at a sectoral level, both within manufacturing as well as in the service sector in each region.

According to HM Treasury (2001), the available data on net investment in manufacturing suggests that variations in business investment are unlikely to be very important in explaining regional GDP per capita differentials. At the sub-regional level, in contrast, poor access to finance in deprived local areas is likely to have a significant detrimental impact on productivity and employment in those areas.

According to DTI (2002) successful firms have relatively high investment in R&D, designers and market researchers, and focus on building skilled labour. As a result they compete more on quality and less on price and are less vulnerable to competition from low cost producers, and from adverse movements in the exchange rate.

Research by NIESR shows a direct link between inward investment and the economy's productivity. Everything we do to improve the overall business environment in the UK therefore has a direct effect on our overall levels of productivity by bringing more foreign investors, as well as improving the prospects for domestic manufacturers.

A substantial capital investment gap has opened up between the UK and US for ICT, an important driver for growth. Government must work with the financial markets to ensure the necessary capital for investment is available.

ManuFuture (2003) reports that investments in research and technology are responsible, depending on the sectors, for between 25% and 50% of economic growth. In addition, it finds that enterprises in Europe are clearly not investing enough in research. This raises many potential problems linked to the sustainable competitiveness of the European manufacturing sector in an increasingly complex and globalised economy.

One avenue for improving technology transition is through encouraging FDI. Inward investment brings significant spillover benefits to UK firms in terms of new jobs, skills transfer, R&D, and the introduction of new processes, new technologies and advanced manufacturing facilities. Foreign investors employ more capital and more skilled workers, and their plants have higher productivity than the average of all UK firms. These productivity gains spill over to other companies along the supply chain as the higher-productivity firm demands better performance from its supplier.

Evidence on the effects of FDI suggest that policy should target firms not for their employment creation but for the wider potential they bring. It is important FDI will create strong linkages with local firms via open-systems networking discussed above. As a result, knowledge, innovation and technology transition spill over into domestic firms.

Discussion by O'Malley and Roper support this argument. They point out that the shift in manufacturing employment from more traditional to high tech industries raises questions regarding the real economic significance of certain growth trends. This applies particularly to Ireland, where some major high-tech sectors have had very rapid growth of gross output, combined with high and rising output per employee, and hence less remarkable growth in employment. These sectors tend to be largely foreign owned, import most of their inputs, and withdraw large profits from Ireland. They may also have an incentive, for tax reasons, to inflate the value of their production recorded in Ireland. In these circumstances, one might reasonably ask how 'real' is the economic contribution of such industries? How much of the recorded value of the production of such industries is really retained in the domestic economy, accruing as income to Irish residents?

Forfas carried out an annual survey of Irish economy expenditures, which aimed to measure the value of expenditures by industries within Ireland's economy, on Irish wages and salaries, Irish services and Irish-produced materials and components. During the 1990s, this survey found that foreign-owned industry in Ireland had Irish economy expenditures amounting to about 35% of the value of its sales (with some variation between years). By comparison, Irish-owned industry (excluding the food industry) had Irish economy expenditures amounting to about 65% of the value of its sales. Therefore, a given amount of output from foreign-owned industry is worth much less to the Irish economy than an equivalent amount of output from Irish-owned industry. Nevertheless, the output of foreign-owned industry is by no means worthless for the economy of the South, since even 35% of a very high value of sales can be a large amount. (REWORD).

Looking at gross output per employee in foreign-owned industry compared to locally-owned industry gives a different picture. Gross-output per employee in foreign-owned industry was 2.3 times as that for Irish-owned industry in 1991, rising to 4.4 times as high in 1999. O'Malley and Roper estimate that Irish economy expenditures per employee were about 20% higher in foreign-owned industry than Irish-owned in 1991, rising to 100% higher in 1999. Thus, a given amount of employment in foreign-owned industry was worth more to the economy of Ireland than an equivalent in Irish-owned industry.

Therefore the data on output of the predominantly foreign-owned high-tech sectors gives an exaggerated impression of the importance of such industries for Ireland's economy. O'Malley and Roper show that the evidence on the importance of the externally-owned sector in the North is less comprehensive that that in the South. Looking at the evidence on local linkages suggests that in contrast to the South, the overall level of sourcing in the North by Multinational enterprise (MNE) plants has fallen since the early 1980s. In 1983, 26% of material purchases by MNE plants were made from within Northern Ireland compared to 19.7% in 1998. Cross-boarder sourcing by Northern based MNE plants have raised slightly since the early-1980s from 3.4% in 1983 to 5% in 1998.

Recent studies examining knowledge transfers from MNEs to their suppliers have also noted a significant difference. In Northern Ireland, contracts between MNE plants and their suppliers were more frequent than in the South, but these were typically of the

more incidental kind (i.e. of the type normally associated with the supplier-buyer relationship). In the South, developmental links or partnerships between MNEs and their suppliers were more common. O'Malley and Roper feel that this may reflect the longer history of supplier-development-type initiatives in the South, as well as the development of the clusters of high-tech industry.

Skill formation

DTI (1999) show that all manufacturers, large or small and whether from a 'traditional' or high-technology sector, are and must see themselves as part of the knowledge driven economy. In addition, many UK manufacturers are already integrating this challenge into their thinking and actions but that many need to move faster. Economic evidence points to the benefits of cultivating continual skill development to enable knowledge-intensive manufacturing to yield competitive high value-added production. EC evidence shows that cutting-edge companies can flourish in countries with high wage levels, while labour- intensive manufacturing will shift to low wage countries. This experience is common to many industrial companies.

Example of high value-added activity

Switzerland, with its high wage levels, won 31% of the global market for textile manufacturing equipment in 1997. This figure was double its global share ten years previously. The explanation again lies in capital and knowledge-intensive production techniques. High and sustained levels of spending R&D, followed by levels of investment necessary to turn these innovations into manufacturing success, led to productivity improvements that easily supported the wage levels set by the Swiss labour marker.

Source: DTI (2002)

UK manufacturing also appears to underinvest in training when compared with the rest of the economy. They provide fewer days training, devote less management time, are less likely to have a training plan and provide less new technology training than employers as a whole. ManuFuture (2003) highlights that the EU is currently under-performing when compared to the US and Japan with regards the average time spent in education. Spending on education as a percentage of GDP has been in steady decline, potentially leading to a weakness in the long term.

The growth process in knowledge intensive industries is limited by the supply of engineering and scientific personnel required to staff rapidly growing firms. Regional growth will be choked if the requisite numbers and types of graduate engineers are not produced by the education system. Three conditions must be met for success:

- Characterisation of the demand for specific technological skills;
- Investment in technical education; *and*
- Skill formation in the workplace.

A region that can institute skill formation processes in anticipation of technology transitions has a competitive advantage. According to Best (2000) skill pools and schools are local, immobile resources. Furthermore, graduates from regional colleges and technical schools around the world tend to remain in the region. The industrial development role of the regional college or university involves responsive collaboration with industry and government in skill formation appropriate to that region.

In terms of skill formation, Best (2000) draws a number of conclusions. He states that Northern Ireland has a range of university level disciplines in engineering and science-related areas, particularly in IT, which few regions of its size in the world process. The University system has world-class research facilities in several areas but active industry / university partnerships are too few, as is active student involvement. FE colleges enjoy little guidance particularly in the crucial area of manpower planning. Finally, every successful rapid and sustained industrial growth experience is simultaneously an account of proactive and strategic institutional development of visible and invisible colleges of knowledge diffusion. He concludes that this area of manpower planning is not adequately addressed in Northern Ireland.

Examples of good practice

Joint research programmes, which promote direct collaboration between industry and science, are a well-established policy intervention mechanism. In this area, good practice particularly refers to thematically focused programmes which apply a bottom-up approach of defining joint research themes, have a long-term perspective of cooperation and rely, at least partially, on an 'infrastructure' approach, i.e. the establishment of institutions and/or facilities that are operated both by enterprises and science institutes and maintain cooperation after funding has ended.

Competence Centres in Sweden and Kplus in Austria

The basic idea behind the creation of competence centres is the concept that active involvement from industry in academic research brings about mutual benefits. From 1998 to 2000 the budget for the competence centre programme was about €53m, i.e around 1% of Swedish R&D expenses. Participating universities and enterprises are each contributing one third of this amount. The program started in 1995 and at present comprises 28 competence centres at 8 universities and about 220 participating industrial companies. The competence centres are specialised in specific research fields within the following areas:

- energy transport, environmental technology (8);
- production and process technology (7);
- biotechnology and biomedical technology (5); and
- information technology (8).

About 20% of industrial partners are small and medium-sized firms (with less than 250 employees). Each centre is closely connected to the activities, long-term priorities and plans of a host university. The university has the responsibility for the centre administration and contributes to their financing by providing a base organization and other resources.

In Austria, the Kplus Competence Centre Programme is similar; however the consortia bidding for the grant are formed in a self-organized way between business and academia. In addition to the subsidies, some help is provided in the preparation phase of the proposal and the establishment of the organisation of the centre. Management advice is also provided throughout the duration of the project. Enterprises bear a minimum of 40% of the costs.

Examples of good practice (continued)

"An-Institutes" in Germany

Administrative framework and bureaucracy in Universities can impede interaction with industry. A German initiative has found the solution in the establishment of external institutes, An-Institutes, created to serve as "intermediaries" between universities and industry and enabled to take short decision paths and react to market demands and opportunities in flexible ways. An – Institutes may have completely private or semi-public structures, but in most cases they operate as non-profit institutions and pay lower taxes. They are officially acknowledged by Universities and operate under cooperation agreement. Some federal lands even have special rules and legislation for An-Institutes.

For interested companies, especially SMEs, An-Institutes are especially flexible unlike Universities with a variety of faculties and international institutes. This advantage allows them to be involved in regional networks and attract attention. They have good access to Universities and their basic research. Mostly all the directors of An-Institutes teach and undertake research at Universities. An-Institutes are able to offer excellent research opportunities to the students and often attract those with most potential. The activities of An-Institutes at Universities represent a considerable portion of technology transfer.

As a general rule, An-Institutes carry out research in areas close to science based industries (IT and microelectronics). The budgets of the Institutes vary: some receive funding from contracts with private clients and from projects for public clients, others totally rely on contracts for public and private clients.

Suggestions for future industrial policy

> *"An important goal in fighting against the perceived trend of 'decline in manufacturing' is to help generate long-term visions for the development of new manufacturing approaches in Europe. These should promote sustainable industrial growth and in improved quality of life for society as a whole"*
> (ManuFuture 2003).

Best concludes that despite individual examples of success, Northern Ireland's business model is flawed, there are too few entrepreneurial firms while networks are underdeveloped. In addition, production capabilities, particularly technology management capabilities, require development and wider application. Furthermore, the skill formation process needs to be better planned. Best finds that Northern Ireland lacks enough entrepreneurial firms to propel regional growth, while open-system networking operates only on a very limited scale.

NIEC (2000) believe that Best's report highlights five key strategic objectives which an economic development strategy for Northern Ireland should target:

- **Productivity:** The key focus of industrial policy has to be on driving up productivity. Policies should aim to build up a region's productive skills rather than merely allow it to bid for business more cheaply. The approach should cover both encouraging structural shift from low productivity to high productivity sectors and driving up productive capabilities within firms and industries through use of high performance work systems;

- **Innovation:** Sustained growth in productivity must be built on innovation. Process and, particularly, new product innovations account for 80% of productivity growth;

- **Capabilities:** movement from less technology and skill intensive sectors to more complex and knowledge intensive sectors involve transitions to technology management capabilities based on more advanced principles or production;

- **Entrepreneurship:** To inspire a wider culture of entrepreneurship will require close cooperation between departments with responsibilities for economic development and education; *and*

- **Outward focus:** it is clear that to be competitive a small economy like Northern Ireland must be outwardly focused, tapping into world best practice through the development of networks and partnerships and through a targeted approach to inward investment.

An example of intermediaries working for Manufacturing

The **Institute for Manufacturing**, part of the University of Cambridge, works closely with industry providing education, research and practical support to companies of all sizes and across sectors. There are around 150 staff and researchers and a wide international academic and industrial network operating through a series of Centres and programmes.

- Key centres cover Strategy and Performance, Technology Management, International Manufacturing, Distributed Automation and Control, Production Processes, Economics and Policy;

- An Industry Links Unit delivers an annual programme of over 80 events, workshops and seminars and a portfolio of tools to help manufacturers improve performance; and

- The Manufacturing Leaders Programme and Automotive Leaders Programme prepare high potential managers for general management positions.

Source: DETI (2004)

An example of intermediaries working for Manufacturing

The **Warwick Manufacturing Group (WMG)** based at Warwick University, is involved in publicly and privately funded research on innovation in products and manufacturing processes, with a focus on research, development and application for a range of industrial sectors – including research in areas such as logistics, manufacturing strategy, supply chain management, benchmarking and business process improvement. Research teams have academic and industrial backgrounds, and industry is closely involved in the delivery of its research, technology transfer and training programmes.

A programme between WMG, the Premium Automotive Group and Advantage West Midlands Regional Development Agency, with underpinning support from the Engineering & Physical Sciences Research Council, is working to ensure that every link in the automotive supply chain has access to the latest technologies and business techniques/

Source: DETI (2004)

Best (2000) concludes by presenting a number of proposals to guide industrial policy in Northern Ireland. These include:

- **Apply the principle of systems integration:** the notions of business model (entrepreneurial firms and open-system networking), production capabilities and skill formation need to be addressed together, not separately;

- **Concentrate on Entrepreneurial firms:** many will fail, but in the process the region's capabilities and skill base are advanced and new growth potential is created. Emerging firms benefiting from experiences and skills gained in previous entrepreneurial efforts may well reap the rewards;

- **Diffuse high performance work organisation**;

- **Foster open networks:** in a small region like Northern Ireland, this will mean partnering with enterprises located in other regions. Investing in networks, instead of companies, means that the industrial policy-making agency is not dependent upon the successful introduction and implementation of new principles or practices in any single firm;

- **Develop technology management capabilities:** this powerful policy tool for industrial policy-making is missing from the vision documents in Northern Ireland;

- **Integrate technology management and skill formation:** Northern Ireland's education system is a source of potential competitive advantage. Every entrepreneurial firm has access to the skill base and R&D partnering capabilities the university system offers. However, most of the research centres are highly under-utilised. Over the years, the university system has produced thousands of highly skilled professionals that work in and run entrepreneurial companies elsewhere. This is a strong asset that has yet to be converted into a regional capability;

- **Partner with firms bringing inward investment to advance capabilities:** inward investment should be assessed in terms of advances in the business model, production capabilities, and skill formation.

- **Link visible and invisible colleges:** Regional technology colleges have played a key role in industrial growth in the Republic of Ireland. Linking Further Education in technical skill development with research activities at university level could enhance the growth impact of both levels of education in Northern Ireland; *and*

- **Administer the research, technology development, and innovation infrastructure:** industrial policy to support long-term growth in high-income regions involves government funding commitments in research and technology infrastructure. Developing governance capabilities for integrating university research, technology development and industrial innovation is the heartland of industrial policy in knowledge-intensive industries.

The challenge is to devise a successful strategy to develop domestic manufacturing firms in high value added sectors with the capacity to sell nationally and internationally, while maintaining the stock of new and existing inward investment in manufacturing. In addition, there needs to be an impetus on re-skilling those previously in traditional sectors so that the demand of high-tech manufacturing is match by an adequate supply of skills.

Conclusions

The evidence suggests that in the more advanced economies, the services sector has been growing more rapidly than industry and agriculture in the last two decades, while in the rest of the world, the most dynamic sector has been manufacturing. The key drivers changing the nature of competition have been identified as:

- Revolutionary changes in ICT;

- The increasing pace of change in science and technology;

- Increasing global competition;

- Changing consumer demand;

- Socio-demographic factors; *and*
- Environment / sustainability issues.

As a result, the UK Government's manufacturing strategy is designed to help more manufacturers to move up the value chain and to reap the associated benefits. However existing evidence suggests that manufacturing cannot be simply outsourced while the higher paid employment is retained, as these activities can also be performed equally well in lower cost countries.

As labour productivity growth accounts for at least half of GDP per capita growth in most OECD countries, the evidence suggests that the target of industrial policy in Northern Ireland must be to raise the rate of productivity growth. Evidence about the factors underlying regional and sub-regional economic performance suggests that skills, innovation, investment, enterprise and competition are the key factors driving productivity growth in UK regions and localities.

Northern Ireland's old system of preferential assistance to industry (e.g. Standard Capital Grants) has been blamed for preserving a fairly stable economy whilst effectively concealing the reality of eroding competitiveness. In addition, the low growth, low productivity, low innovation economy has had powerful self-reinforcing barriers to change. However as the previous Section found, there are opportunities for local business across all manufacturing sectors. Intuitively, the traditional production techniques would achieve this success or growth. As a result, the literature has set out five challenges that policy makers need to address in order to advance the three elements of: business model, production capabilities and skills in Northern Ireland:

- Establish entrepreneurial firms;
- Encourage open-systems networking;
- Strengthen technological management;
- Foster technology transition; *and*
- Encourage skill formation

These challenges are key to ensuring that local businesses successfully shift to higher technological production techniques, based on a strong skills base, which incorporate innovative solutions and products. However, there is also a need to encourage more business start-ups to move away from the reliance of grant aid. As a result the evidence highlights five key strategic objectives which an economic development strategy for Northern Ireland should target:

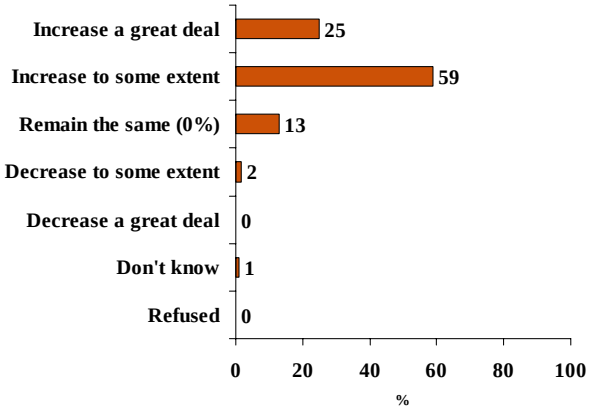
- Raising productivity;
- Encouraging innovation;

- Increase technological capabilities;
- Inspire entrepreneurship; *and*
- Foster an outward focus.

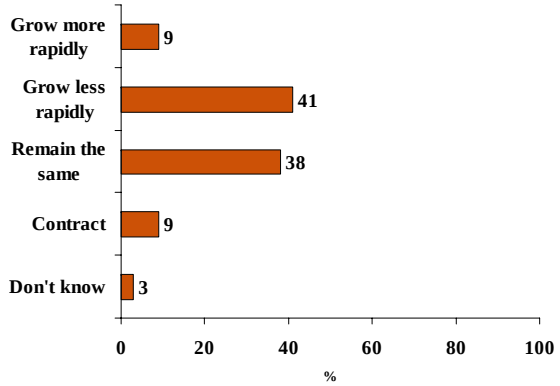
In order to achieve these targets, it is our belief that proposals to guide industrial policy in Northern Ireland should be structured around the wider manufacturing strategy for the UK. In particular they should be developed under 6 of the 7 pillars of the UK strategy, with macroeconomic stability being outside our control.

Annex E: Findings from the manufacturing survey

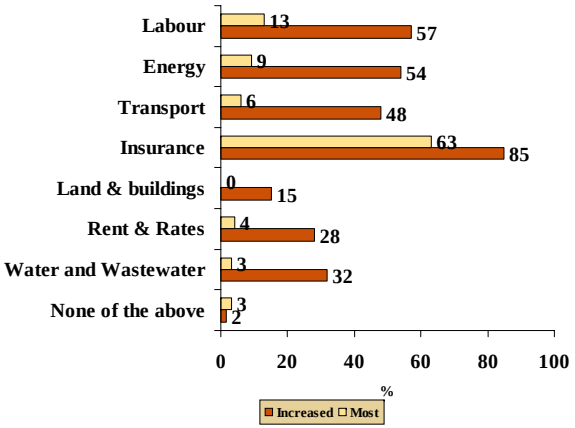
Increase/decrease of cost of operating your business in Northern Ireland



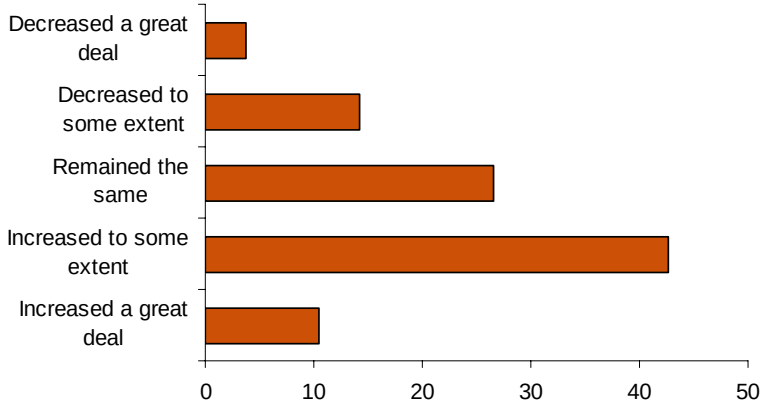
Future trends in business costs – over next 12 months



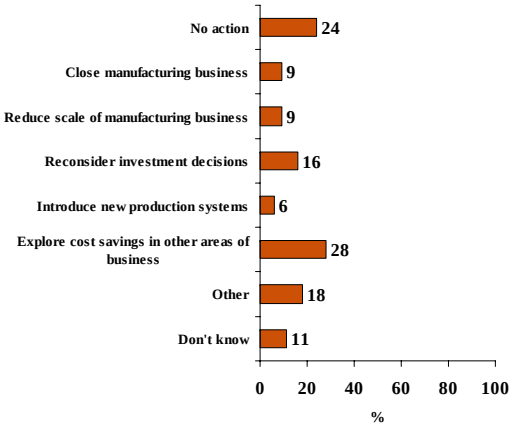
Which area experienced greatest increase in costs



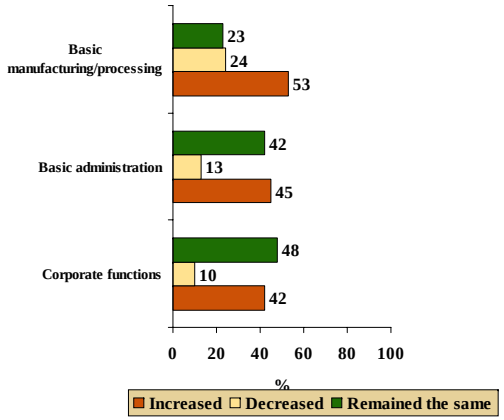
Over the past 12 months has your operating profit increased, decreased or remained the same?



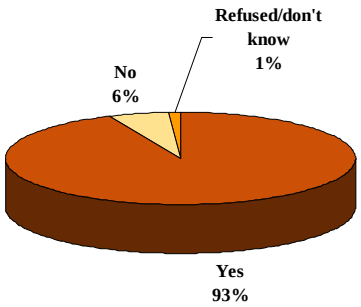
Planned actions if proposal of industrial derating goes ahead



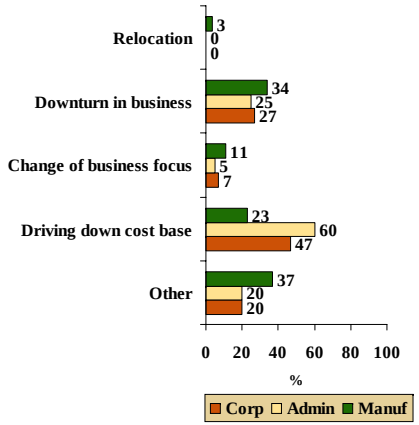
How have the number of employees in your business changed over the last 5 years.



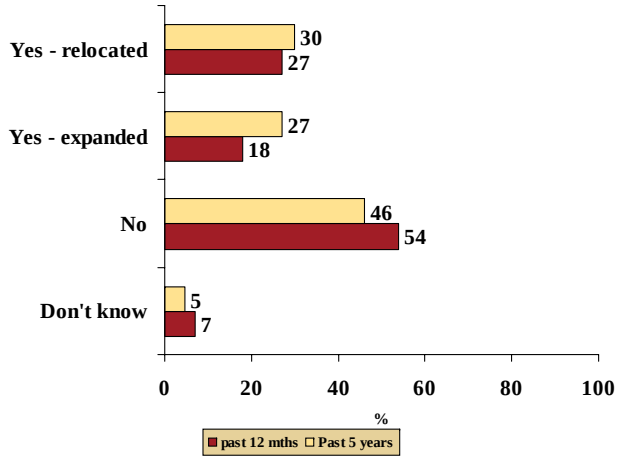
Operated in NI more than 5 years



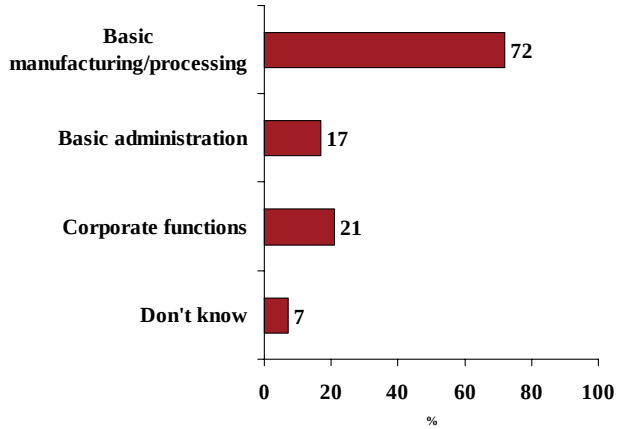
Main reasons for reducing the number of employees



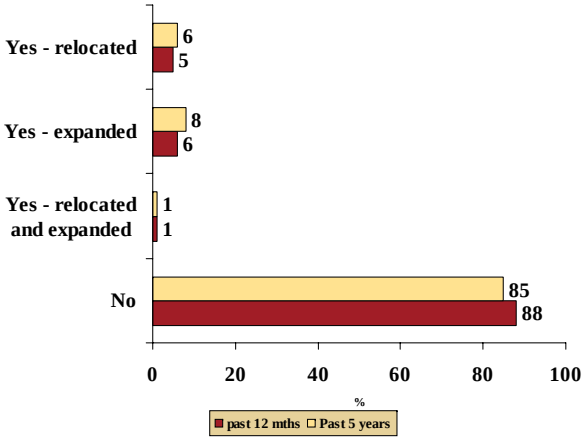
Knowledge of other companies relocated or expanded outside of NI



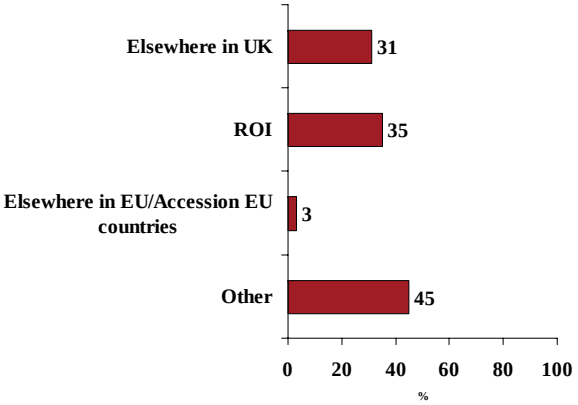
Type of activities were relocated or expanded



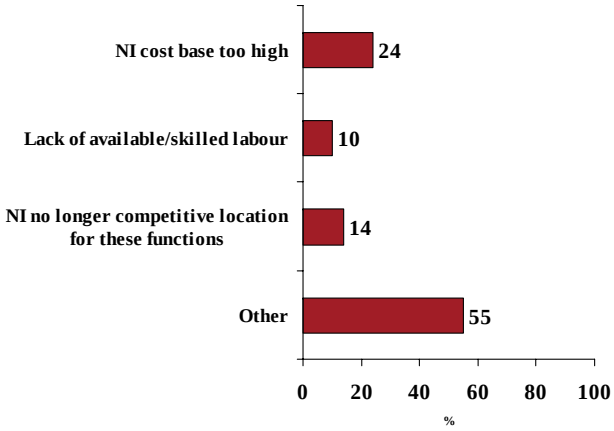
Have you relocated or expanded outside NI



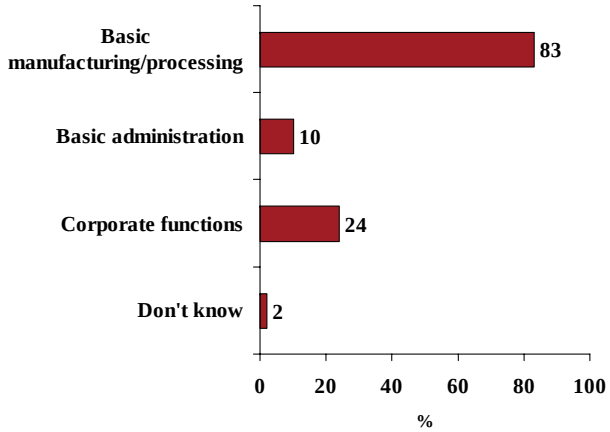
Where did you expand / relocate



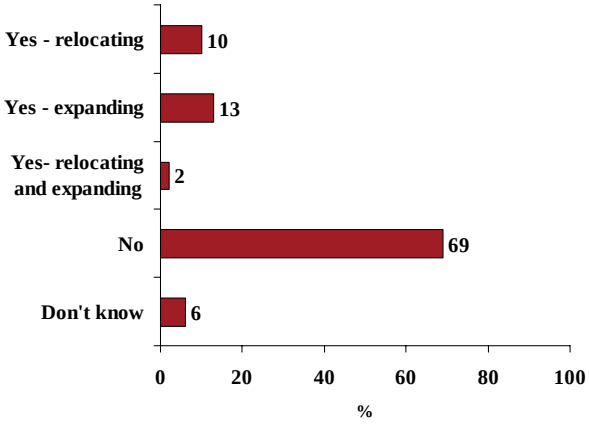
Main reason for relocating or expanding



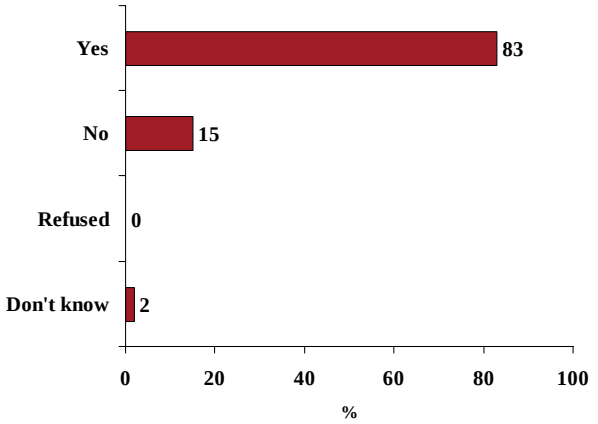
What functions are you considering relocating or expanding



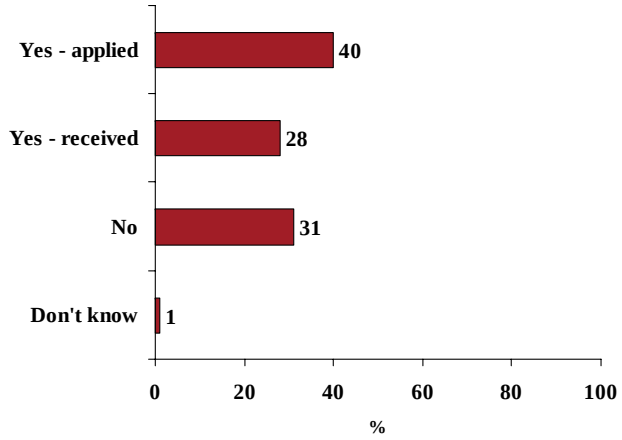
In the future are you considering relocating or expanding



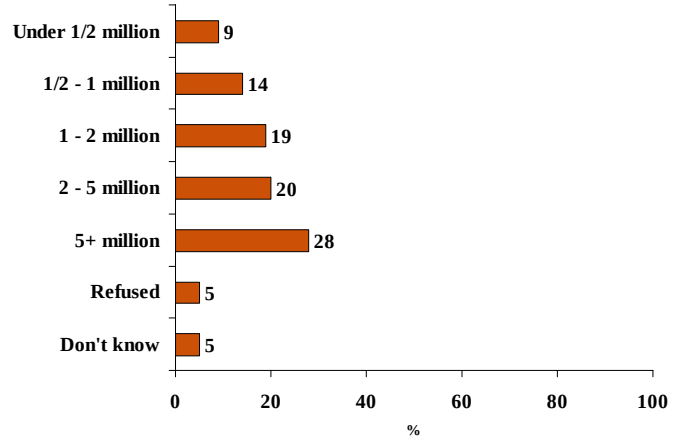
Awareness of available services and assistance in NI



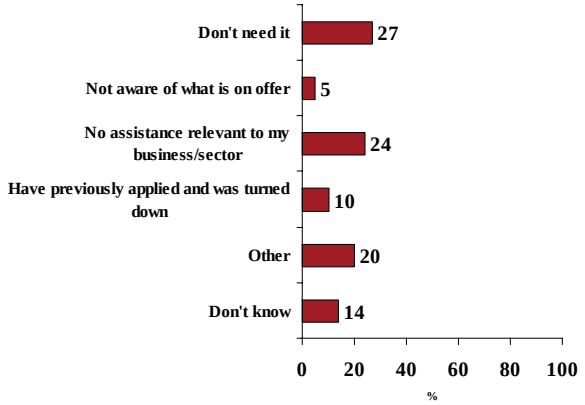
Applied or received assistance from Invest NI



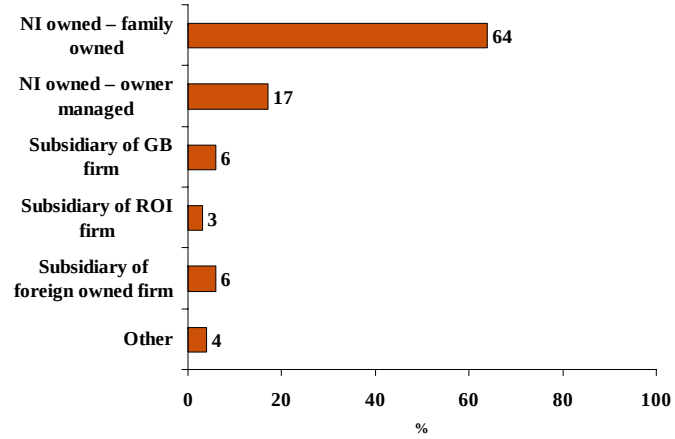
What was your turnover in the last financial year?



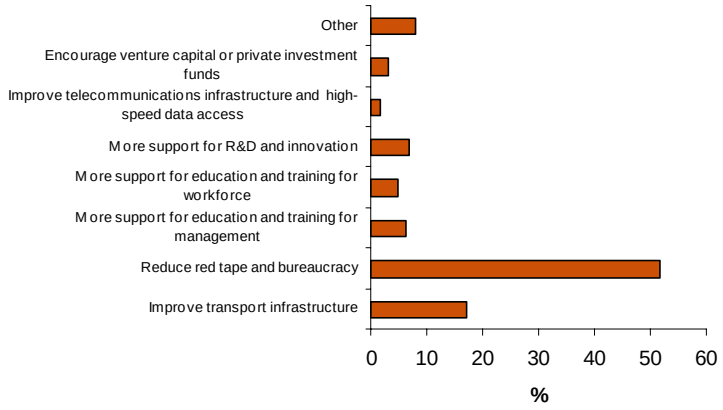
Why have you not applied for assistance from Invest NI



How would you classify the ownership of your firm?



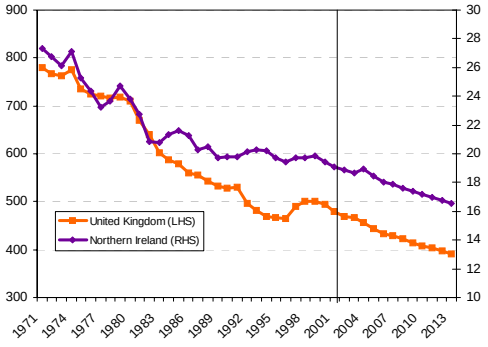
What action could government take to assist your business?



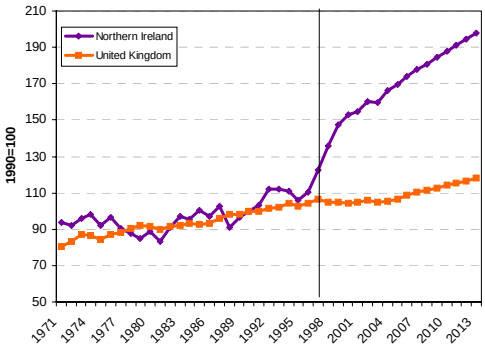
Annex F: Detailed Forecasts

Food and Drink

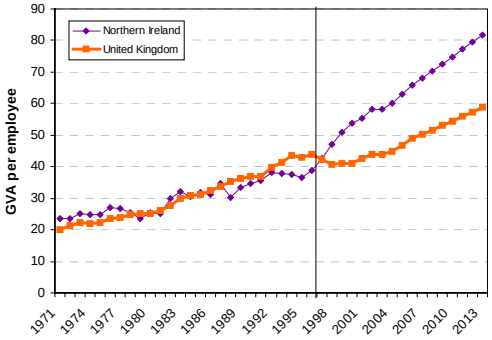
Employees in employment



GVA



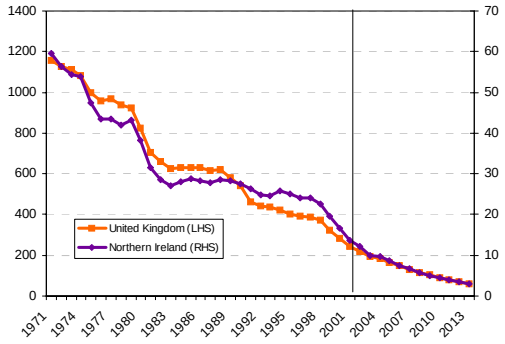
Productivity



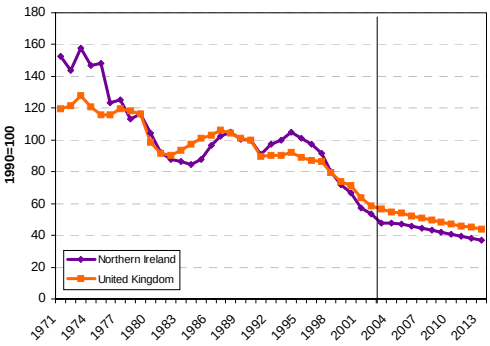
Source: NS, DETI, Regional Forecasts

Textiles

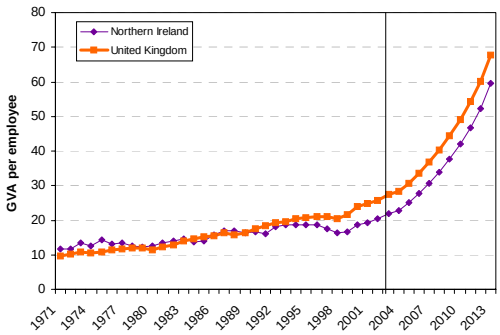
Employees in employment



GVA



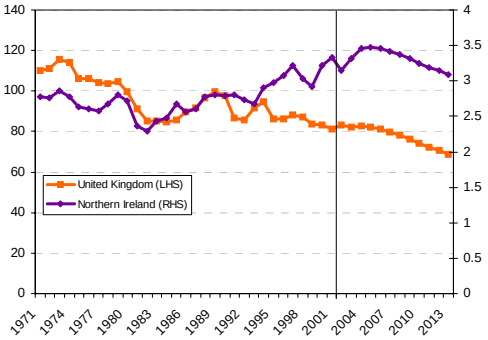
Productivity



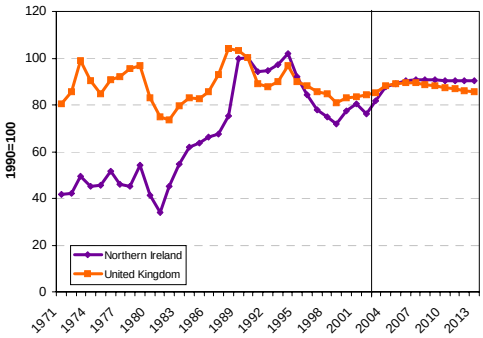
Source: NS, DETI, Regional Forecasts

Wood

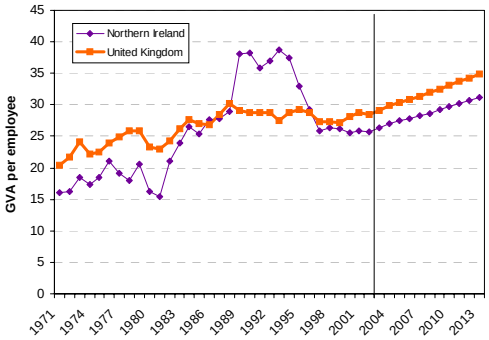
Employees in employment



GVA



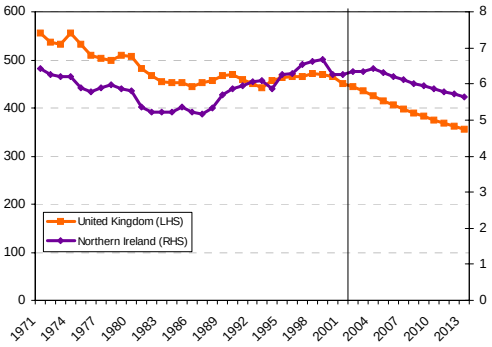
Productivity



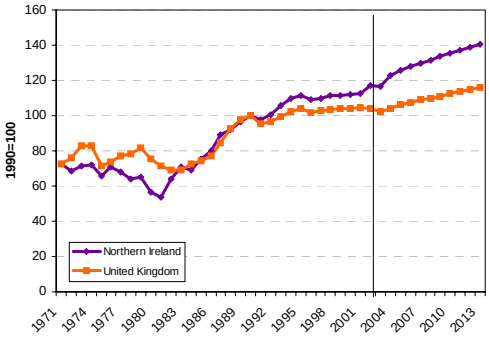
Source: NS, DETI, Regional Forecasts

Pulp, paper and printing

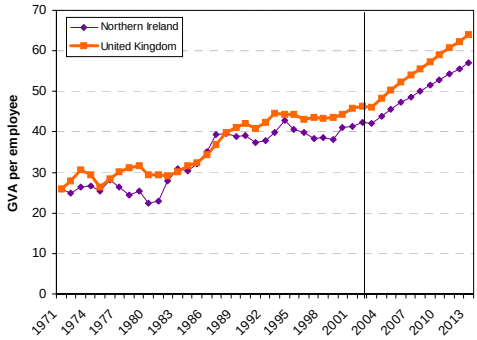
Employees in employment



GVA



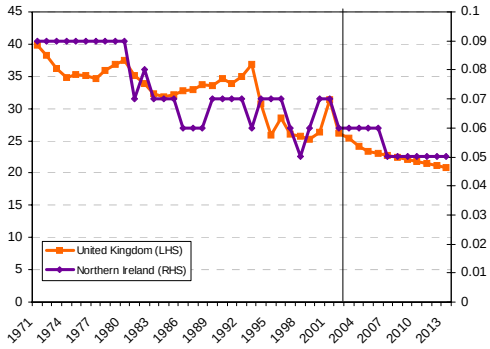
Productivity



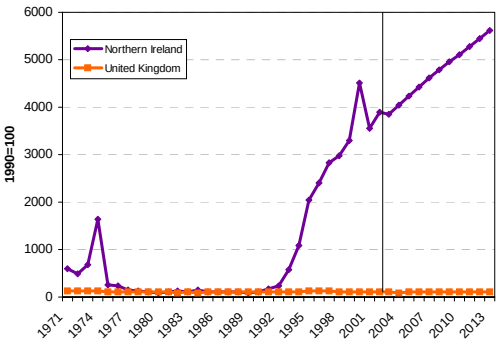
Source: NS, DETI, Regional Forecasts

Coke, oil and refining

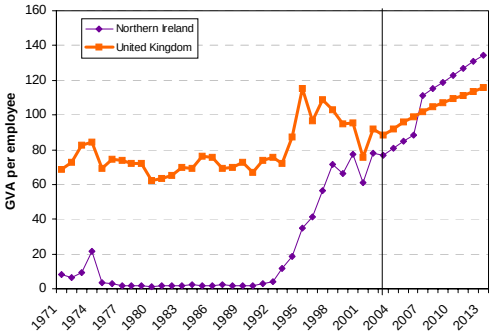
Employees in employment



GVA



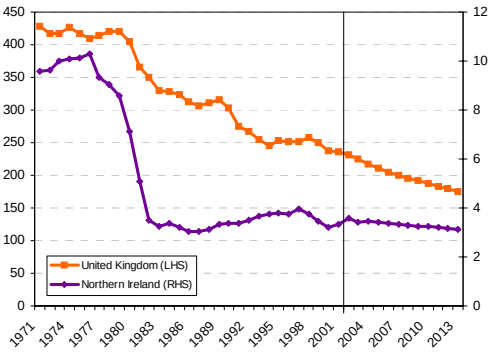
Productivity



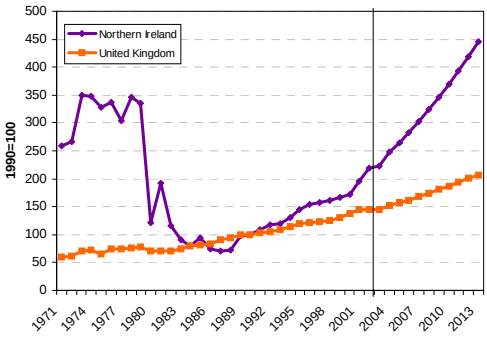
Source: NS, DETI, Regional Forecasts

Chemicals

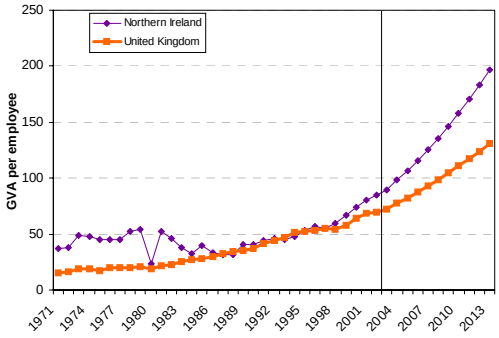
Employees in employment



GVA



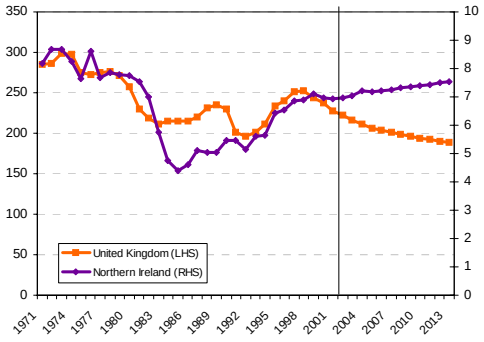
Productivity



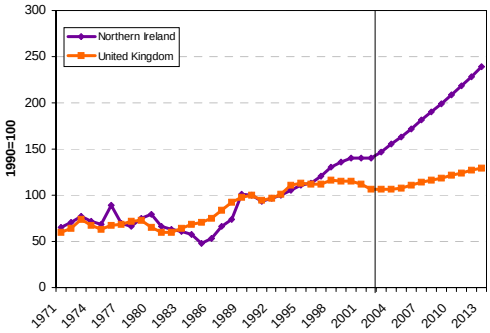
Source: NS, DETI, Regional Forecasts

Rubber and plastic

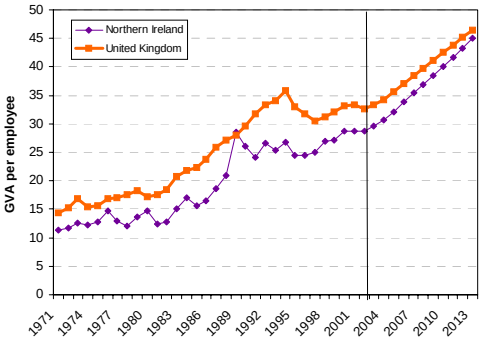
Employees in employment



GVA



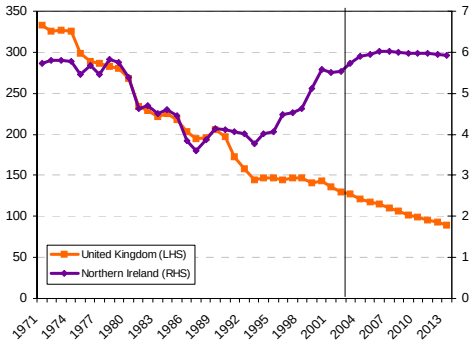
Productivity



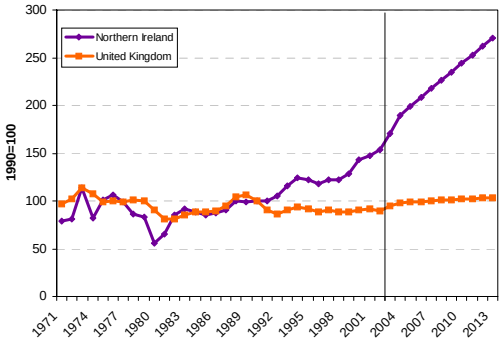
Source: NS, DETI, Regional Forecasts

Other mineral products

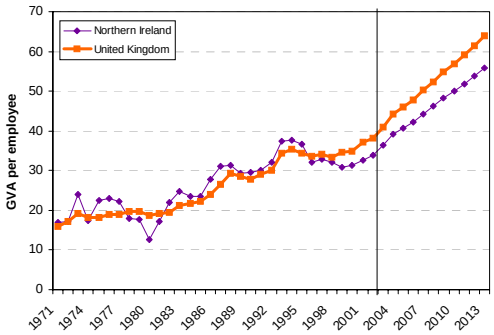
Employees in employment



GVA



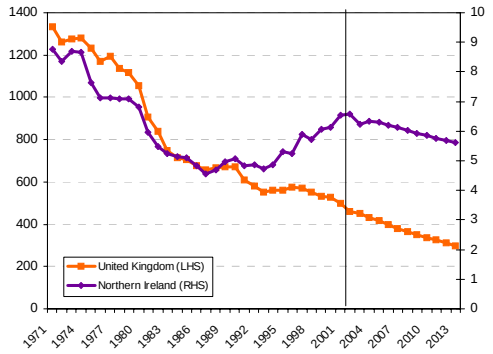
Productivity



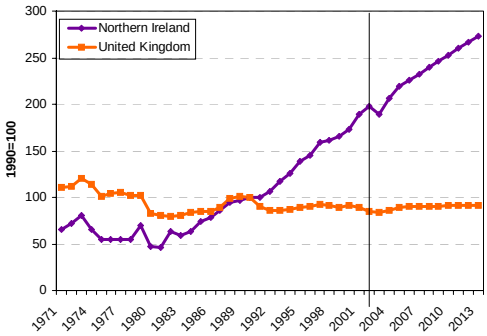
Source: NS, DETI, Regional Forecasts

Metals

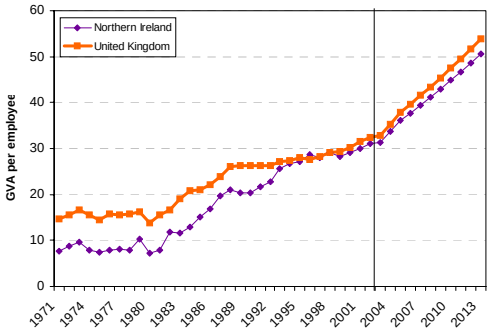
Employees in employment



GVA



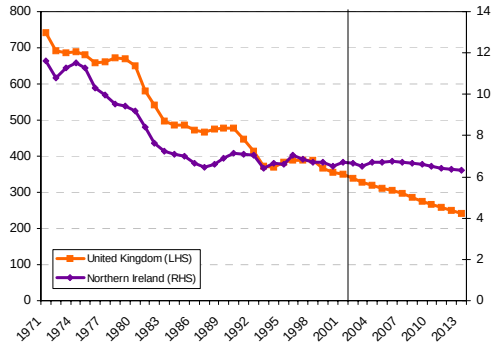
Productivity



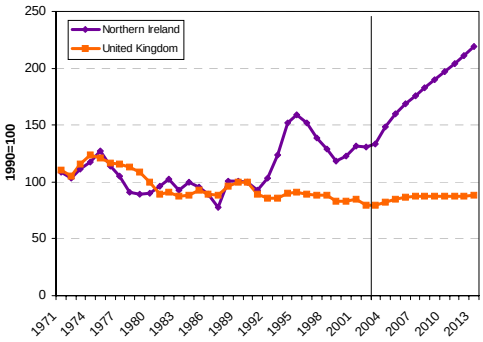
Source: NS, DETI, Regional Forecasts

Machinery and equipment

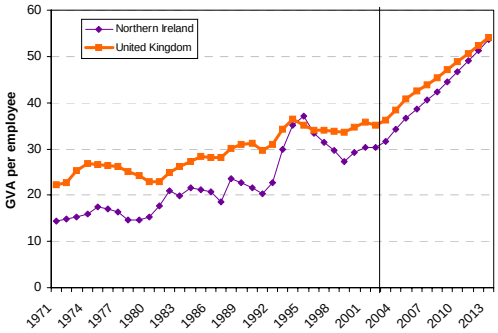
Employees in employment



GVA



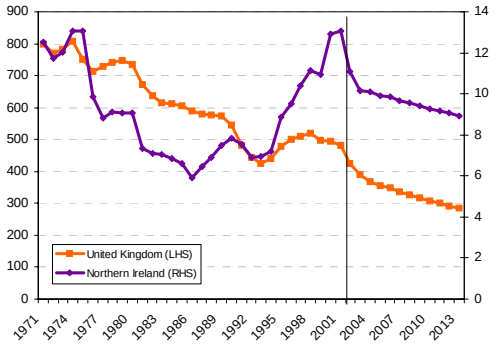
Productivity



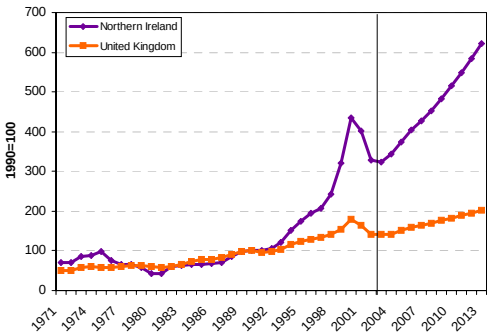
Source: NS, DETI, Regional Forecasts

Electrical and optical

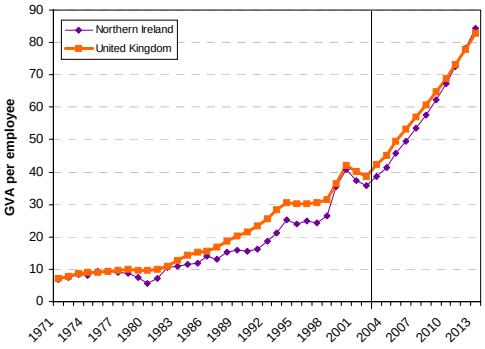
Employees in employment



GVA



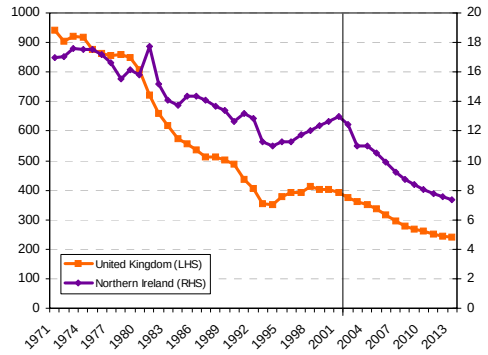
Productivity



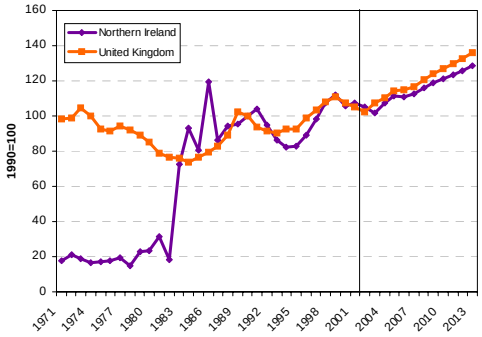
Source: NS, DETI, Regional Forecasts

Transport and equipment

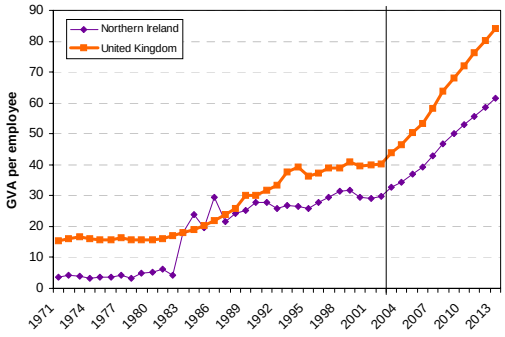
Employees in employment



GVA



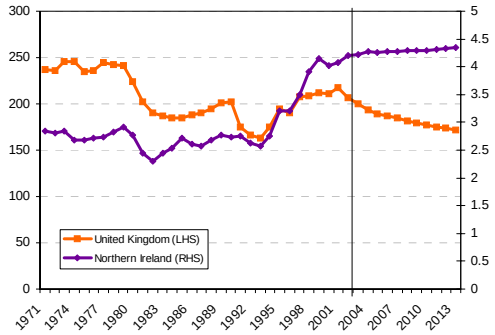
Productivity



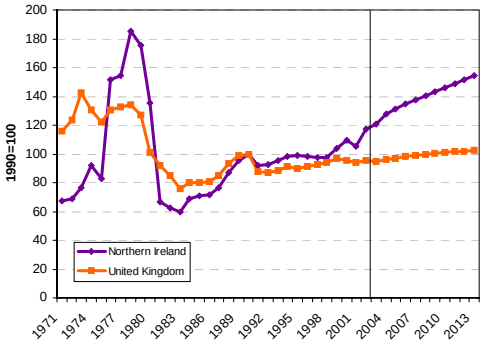
Source: NS, DETI, Regional Forecasts

Other manufacturing

Employees in employment



GVA



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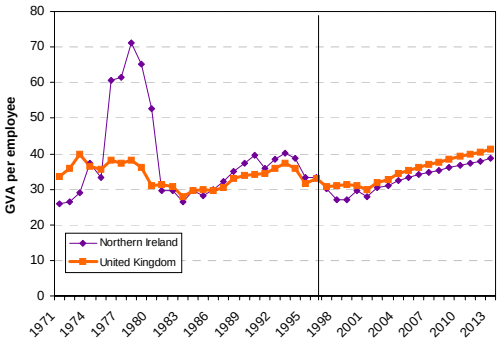

Source: NS, DETI, Regional Forecasts

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