

# Methodology Paper on the Production of Northern Ireland Broad Economy Exports Estimates with Experimental Estimates for 2011 and 2012

Damian Buchanan  
Northern Ireland Statistics & Research Agency  
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## 1.0 EXECUTIVE SUMMARY

- i) The Northern Ireland Executive's Economic Strategy referred to the need to improve the measurement of Northern Ireland's exports beyond that of the manufacturing sector.
- ii) This paper presents an overview of the work done to develop such a measure by estimating the value of goods and services sold outside Northern Ireland across most sectors of the local economy to provide a "Broad Economy Exports" measure.
- iii) This paper also seeks user views on the approach adopted to improve the measurement of exports and plans for future development, in line with the Code of Practice for Official Statistics.
- iv) Several measures of NI exports currently exist: HMRC's Regional Trade Statistics (RTS), relate to the export and import of goods, but provide no information on service exports or NI sales to Great Britain. NISRA carries out the Manufacturing Sales and Exports Survey (MSES) and the Exporting NI Services (ENIS) survey. The former measures goods and services and sales to Great Britain but, as the Economic Strategy noted, is restricted to the Manufacturing sector. The ENIS survey is restricted to those Service sectors that were thought most likely, on the basis of previous research, to have a high potential for tradable services (e.g. computer and related activity, management consultancy, technical services). It also measures goods and service exports from larger construction companies.

v) In addition, NISRA produces estimates of spending by tourists from outside the UK (another form of exports) and DARD provides estimates of the value of exports in the food and drinks sector. There are no sub UK estimates of the value of exports of financial services produced by ONS.

vi) Northern Ireland and Scotland have traditionally been considered better placed than other regions of the UK given that detailed surveys of local export activity have been carried out in some key sectors by NISRA and the Scottish government. However, the absence of a comprehensive exports measure in NI has meant that export targets in the Economic Strategy have tended to focus on the Manufacturing sector, with limited information available to set Service sector export targets.

vii) In order to address this NISRA added additional exports (and imports) questions to the existing Northern Ireland Annual Business Inquiry (ABI) which covers all industry sectors (apart from the financial sector and farm businesses). This new “Broad Economy Exports (BEE)” measure now provides a single comprehensive measure of business exports and external sales (including to Great Britain) of both goods and services. While these are experimental results (see below) they provide important additional information to help update the Executive’s Export Action Plan. Results for 2011 and 2012 are presented below.

viii) Previously published HMRC results for 2011<sup>1</sup> estimated the total value of the export of goods from Northern Ireland at £5.9 billion across all industry sectors (including trade in live animals). NISRA’s survey based approach estimated that there was an additional £0.5 billion related to the export of services in 2011. This combination of administrative (HMRC) sources which related to goods only and survey based (NISRA) estimates related to services indicated that the total value of business exports from NI was worth some £6.4 billion in 2011. When the value of spending by (non UK) tourists (£0.2 billion) is added the total estimated value of NI exports for 2011 was estimated to be £6.6 billion as measured on the old basis.

ix) The new Broad Economy measure estimates total business exports for 2011 at £8.7 billion, rising by 1.8% to £8.8 billion in 2012. The latter includes £5.4 billion (60.9%) of goods and services from the Manufacturing sector and an additional £3.5 billion (39.1%) of goods and services from other sectors of the NI economy<sup>2</sup> including £405 million in the construction sector. When (non-UK) tourism is added (£0.2 billion) the total value of NI exports in 2012 was estimated to be worth £9.1<sup>3</sup> billion. This figure excludes any estimates of exports in the financial services industry or exports directly from farms.

x) As such, the BEE estimate for 2011 includes an additional £2.3 billion of business exports which was not previously accounted for (£8.7 billion minus the combined HMRC and NISRA estimate of £6.4 billion). This is due to the fact that the new (BEE) measure provides estimates of NI trade in goods and services across a much wider range of sectors than was

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<sup>1</sup> 2011 is used as the reference year for comparisons as this was the last year the ENIS survey was conducted.

<sup>2</sup> Sub-totals do not add to £8.8 billion due to rounding.

<sup>3</sup> Sub-totals do not add to £9.1 billion due to rounding.

previously available. It has highlighted that there is considerable activity in the NI service sector related to the export of goods, particularly in the Wholesale sector.

xi.) The Construction sector had sales outside Northern Ireland worth £1.2 billion in 2012, of which £0.8 billion was to customers in GB.

xii.) There are several known limitations to the current findings, including some coverage issues relating to the finance sector and the export of live animals. Further development work relating to grossing procedures is also planned for Summer 2015.

xiii.) The new exports data will be incorporated into NISRA's ongoing work programme to develop key elements of an internationally standard set of Economic Accounts for Northern Ireland. This is expected to publish in spring 2015 and will set the value of exports in their wider economic context in Northern Ireland.

xiv) The Economic and Labour Market Statistics team are grateful for input already provided during several 'specialist user' meetings held at the end of 2014 on the proposed methodology. All users are invited to provide comments regarding the methodology and experimental results presented herein, and these can be provided to the Economic & Labour Market Statistics Branch, NISRA at [statistics@dfpni.gov.uk](mailto:statistics@dfpni.gov.uk). Following consideration of user feedback the methodology will be refined as necessary and results will be updated to include the period 2013. Estimates for the period 2011-13 will be published as an experimental series in Summer 2015.

## **2.0 INTRODUCTION**

### **2.1 Background and Context**

The Northern Ireland Executive's Programme for Government (PFG) 2011-2015 made the economy its top priority and identified growing the private sector (and exports) as one of the primary vehicles for delivering the vision of '*...a sustainable and growing private sector, with a highly skilled and flexible workforce operating in productive and innovative firms that are competitive in global markets*'. The Economic Strategy was subsequently published in 2012 with a further emphasis on export-led growth.

Northern Ireland has traditionally had a very good survey based measurement of its Manufacturing sector sales and as such is well placed compared to other regions of the UK in respect of the measurement of such exports. However there has been no single published source which provides the comprehensive statistical evidence required to measure exports across the whole economy. Relating to this, a paper published by DETI in March 2014 entitled 'Measuring Northern Ireland's Exports' indicated that a survey-based approach, rather than a HMRC based option, offered the greatest opportunities and utility for measuring the totality of Northern Ireland exports in the medium to long term.

Several sources of NI exports currently exist: HMRC Regional Trade Statistics (RTS), which relate to the export and import of goods; the annual NISRA Manufacturing Sales and Exports Survey (MSES); the Exporting NI Services Survey (ENIS), which referred mainly to trade in services and had limited coverage of the service sector; estimates of foreign tourism spending, and the DARD's estimates of food and drinks processing exports. The DETI publication 'Measuring Northern Ireland's Exports' looks in detail at the pros and cons of these individual sources and also how they could be used to produce two separate potential aggregate measures of NI exports.

However, in relation to the potential to combine different sources of export data, and following both internal assessment (NISRA) and external review (independent research commissioned by DETI and InterTradeIreland) of the differences between HMRC RTS and NISRA business surveys, it was concluded that any solution using both sources required micro level access to HMRC RTS data. In the absence of an appropriate legal gateway, this has not yet been possible.

This paper therefore summarises ongoing developmental work undertaken by NISRA's Economic and Labour Market Statistics Branch which has involved the expansion of the NIABI to include questions relating to export and import activity across the broad economy, the coverage of which is fully outlined in Appendix A. The approach to date has aligned the exports methodology with that used by the NIABI. Section 6 below outlines some identified shortcomings of the current approach. In particular, work is ongoing with the assistance of ONS under the Quality Improvement Fund (QIF) provided by the UK Statistics Authority, to look at the effect of changing the auxiliary variable for weighting purposes from selected employment to selected turnover for all financial variables collected in the NIABI, including exports and imports.

## **2.2 Developing the Coverage of the Northern Ireland Annual Business Inquiry**

Prior to survey reference year 2011, the NIABI and the NI MSES existed as separate surveys with sample sizes of approximately 5,000 and 3,500 respectively. However, in light of users' need for more detailed statistics (particularly in relation to geographical disaggregation and the growing requirement for a more comprehensive picture of NI exports activity) the NIABI and MSES surveys were merged and the sample boosted to approximately 9,000 in 2011. This was expanded to approximately 11,000 in survey reference years 2012 and 2013.

The NIABI gathers a broad range of financial and employment information covering two thirds of the economy (see Appendix A) and informs National and Regional Accounts.

For the first time, and uniquely among the countries and regions of the UK, Northern Ireland now has a substantial database that links companies' exports, imports and external sales to Great Britain, with other aspects of individual company performance including total sales, gross value added, productivity and purchase costs. This will provide a reliable resource to inform

evidence based decision-making on how best to grow Northern Ireland export activity in line with the Economic Strategy.

The new information will also be used in NISRA's Supply Use Tables, which will provide a comprehensive overview of the structure and characteristics of the local economy, including the contribution that external sales and exports make.

Significantly the new methodology extends the measurement of exports of goods and services in the Service sector, with the total value of such activity now estimated at £2.8 billion. This is in addition to the estimated value of manufacturing exports (£5.4 billion), which is consistent with previously published estimates for 2012.

### **3.0 RESULTS**

The BEE results for survey reference years 2011 and 2012 are presented below. Users are reminded that all results remain experimental and are subject to future revision as the methodology is further refined during 2015/16.

#### **3.1 Reporting Period**

The data presented in this publication are consistent with 2012 (and revised 2011) results published by the ABI on 11 December 2013:

[http://www.detini.gov.uk/niabi\\_2012\\_publication\\_ru.pdf?rev=0](http://www.detini.gov.uk/niabi_2012_publication_ru.pdf?rev=0).

The latest ABI results were published on 10 December 2014 ([http://www.detini.gov.uk/index/what-we-do/deti-stats-index/business\\_statistics/stats-annual-business-inquiry.htm](http://www.detini.gov.uk/index/what-we-do/deti-stats-index/business_statistics/stats-annual-business-inquiry.htm)) and contain provisional 2013 and revised 2012 data. The revisions to the 2012 data will be reflected in the BEE in subsequent publications along with updates to provide a three year series from 2011-2013, based on the new approach.

#### **3.2 Definitions**

*Turnover* (also referred to as *total sales*) is defined as total sales and work done. This is calculated by adding the value of sales of goods produced, goods purchased and resold without further processing, work done and industrial and non-industrial services rendered.

*Internal Sales* are defined as all sales to Northern Ireland only.

*External Sales* are defined as all sales outside Northern Ireland (including sales to Great Britain).

*Exports* are defined as all sales outside the United Kingdom.

*The Rest of the EU (REU)* is composed of the following countries: Germany; France; Belgium; Luxembourg; Netherlands; Italy; Denmark; Portugal; Spain; Greece; Austria; Sweden; Finland,

Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Bulgaria, Slovakia and Slovenia (Croatia joined the EU in July 2013 and hence is not included in this reporting period).

*The Rest of World (ROW)* refers to all destinations outside the EU.

### **3.3 Quality Indicators**

Users are advised to take into account the quality indicators associated with the estimates when considering the significance of annual changes. These indicate that some results have quite large margins of statistical error associated with them. Users should exercise caution when interpreting the annual changes associated with such results.

#### **3.4.1 Main Messages**

The new experimental estimates show that:

- Total exports grew by 1.8%, from £8.7 billion in 2011 to £8.8 billion in 2012.
- In 2012, the largest proportion of exports by section were from:
  - Manufacturing (Section C) - 60.9%
  - Wholesale and Retail Trade (including the motor trade) (Section G) - 17.5%
  - Transport and Storage (Section H) - 4.7%
  - Construction (Section H) - 4.6%.
- Total external sales, including those to Great Britain, increased by 1.4% over the year from £20.1 billion in 2011 to £20.4 million in 2012.
- In 2012, 42.6% of all exports went to the Rest of The World, 37.4% to Republic of Ireland and 20.0% to the Rest of the EU.
- Exports represented 14.3% of total sales (£61.9 billion<sup>4</sup>) in 2012.
- External sales represented 32.9% of totals sales (£61.9 billion) in 2012.
- The Construction sector had sales outside Northern Ireland worth £1.2 billion in 2012, of which £0.8 billion was to customers in GB.

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<sup>4</sup> Unrevised estimates from the ABI, first published in December 2013.

### 3.4.2 New Findings in Context of Existing Information

Several measures of NI exports currently exist: HMRC’s Regional Trade Statistics (RTS), relate to the export and import of goods, but provide no information on service exports or NI sales to Great Britain. NISRA carries out the Manufacturing Sales and Exports Survey (MSES) and the Exporting NI Services (ENIS) survey. The former measures goods and services and sales to Great Britain but, as the Economic Strategy noted, is restricted to the Manufacturing sector. The ENIS survey is restricted to those Service sectors that were thought most likely, on the basis of previous research, to have a high potential for tradable services (e.g. computer and related activity, management consultancy, technical services). It also measures goods and service exports from larger construction companies.

The DETI publication ‘Measuring Northern Ireland’s Exports’ looked in detail at the pros and cons of these individual sources and also how they could be used to produce aggregate measures of NI exports.

Previously published HMRC results for 2011 estimated the total value of the export of goods from Northern Ireland at £5.9 billion across all industry sectors (including trade in live animals). NISRA’s survey based approach estimated that there was an additional £0.5 billion related to the export of services in 2011. This combination of administrative (HMRC) sources which related to goods only and survey based (NISRA) estimates related to services indicated that the total value of business exports from NI was worth some £6.4 billion in 2011. When the value of spending by (non UK) tourists (£0.2 billion) is added the total estimated value of NI exports for 2011 was estimated to be £6.6 billion as measured on the old basis. The values of exports for 2011 and 2012 estimated by each measure can be found in Table 1 below.

**Table 1. Old Exports estimates (2011) and New Broad Economy Exports measure (2011, 2012)**

	Old Basis (£ billions) (2011)	New Basis (£ billions) (2011)	New Basis (£ billions) (2012)
HMRC (goods)	5.9	-	-
Old NISRA ENIS survey	0.5	-	-
New Broad Economy Exports	-	8.7	8.8
<b>Total Business Exports</b>	<b>6.4</b>	<b>8.7</b>	<b>8.8</b>
<i>(plus Tourism)</i>	6.6	8.9	9.1

The new Broad Economy measure estimates total business exports for 2011 at £8.7 billion, rising by 1.8% to £8.8 billion in 2012. The latter includes £5.4 billion (60.9%) of goods and services from the Manufacturing sector and an additional £3.5 billion (39.1%) of goods and

services from other sectors of the NI economy. When (non-UK) tourism is added (£0.2 billion) the total value of NI exports in 2012 was estimated to be worth £9.1 billion. This figure excludes any estimates of exports in the financial services industry or exports directly from farms.

The BEE estimate for 2011 includes an additional £2.3 billion of business exports which was not previously accounted for (£8.7 billion minus the combined HMRC and NISRA estimate of £6.4 billion). One reason for this is that the new (BEE) measure provides estimates of NI trade in goods and services across a much wider range of sectors than was previously available. It has highlighted that there is considerable activity in the NI service sector related to the export of goods, particularly in the Wholesale sector.

The 'Exporting Northern Ireland Services' Survey (ENIS) is designed to collect only service exports in the services sector (with the exception of the construction sector, where both goods and service exports are collected); however some initial interrogation of the BEE goods/services breakdown indicates trade in goods within the services sector. In addition, ENIS is also restricted in its coverage to a very specific subset called the High Export Potential (HEP) group, plus construction and manufacturing services. The BEE indicates that export activity is much broader than the present remit of ENIS (see section 5.2.1 for further details).

This also confirms that the BEE captures substantial services exports that are not captured by HMRC (see section 5.2.2 for further details).

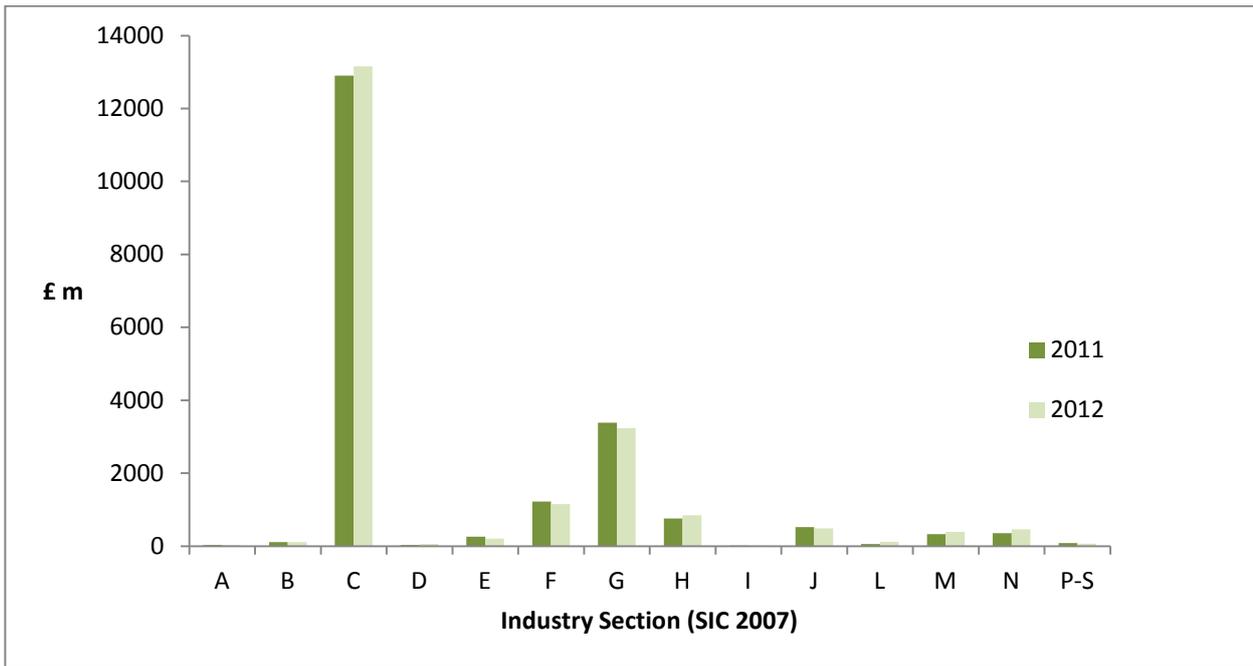
In relation to the export activity in Section G (Wholesale and Retail Trade) (in 2012, 17.5% of all exports were by businesses in this section), this is partly because some businesses in Section G have a manufacturing element and a wholesale/retail element but are classified as wholesale businesses, based on the IDBR classification (see Section 6.2). The BEE has a number of high turnover businesses that fit this profile, hence increasing sales in section G.

Figure 1 below shows external sales (in £ millions) split by industry section for 2011 and 2012 whilst Figure 2 shows exports sales (in £ millions) split by industry section.

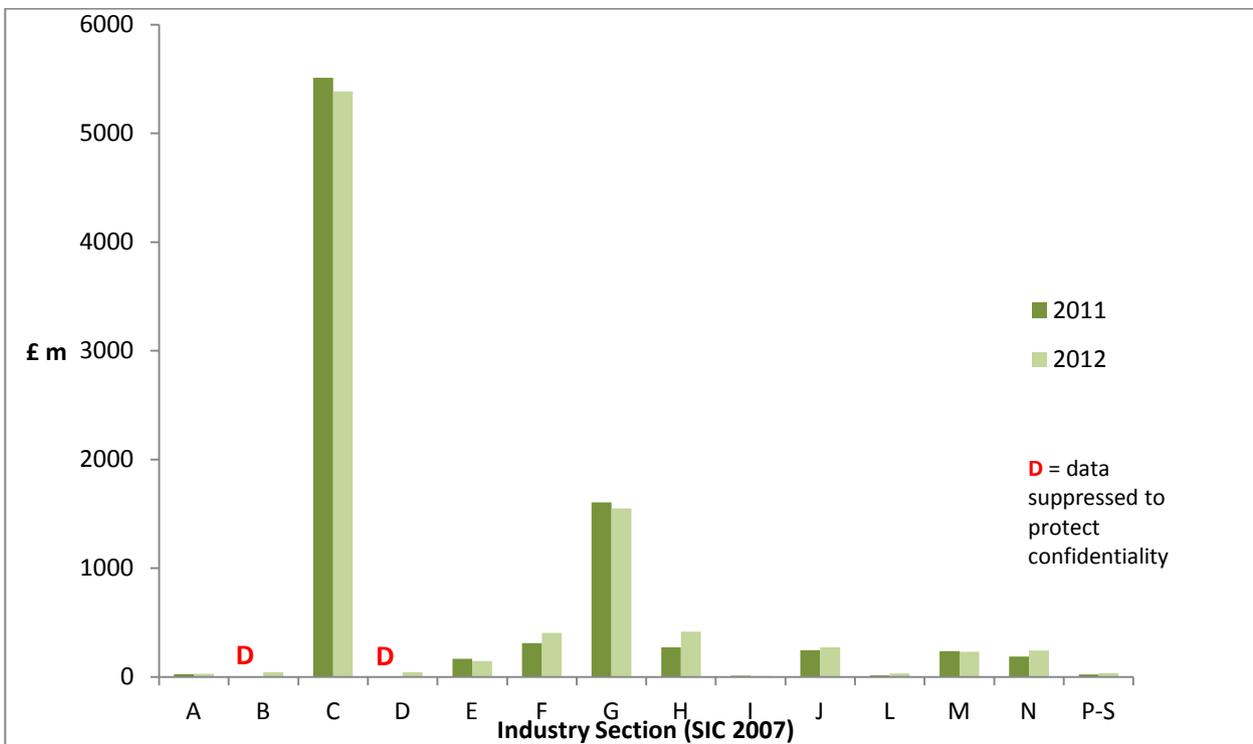
Table 2 in Section 3.5 presents a comprehensive breakdown of all sales disaggregated by industry section and broad destination. The table also presents quality indicators for the individual estimates.

Business activity is classified using the Standard Industrial Classification (SIC 2007) system.

**Figure 1. External Sales (£ millions) split by SIC 2007 industry section, 2011 and 2012**



**Figure 2. Exports Sales (£ millions) split by SIC 2007 industry section, 2011 and 2012**



### 3.5: Results by Industry

Table 2: BEE results by industry, 2011 and 2012

	CV ≤ 5%
	5% < CV ≤ 10%
	10% < CV ≤ 20%
	CV > 20%

	Standard Industrial Classification	Description	Total Sales (£m)	Northern Ireland (£m)	External Sales (£m)	Great Britain (£m)	Export Sales (£m)	of Republic Ireland (£m)	Rest of Europe (£m)	Rest of World (£m)
2011	A – S	Agriculture, fishing, production, construction, distribution and services	61,530	41,433	20,097	11,412	8,685	3,056	1,987	3,642
2012			61,945	41,570	20,374	11,534	8,840	3,305	1,768	3,766
%change			0.7%	0.3%	1.4%	1.1%	1.8%	8.1%	-11.0%	3.4%
2011	A (part)	Agriculture, forestry and fishing	100	64	37	11	25	11	*	*
2012			110	75	35	6	29	6	*	*
%change			9.9%	17.7%	-3.8%	-43.2%	14.0%	-47.9%	*	*
2011	B – E	Production Industries	19,420	6,109	13,310	7,558	5,752	1,409	1,433	2,910
2012			19,576	6,035	13,541	7,920	5,620	1,411	1,226	2,984
%change			0.8%	-1.2%	1.7%	4.8%	-2.3%	0.1%	-14.5%	2.5%
2011	B	Mining and quarrying	355	239	116	*	*	*	*	*
2012			325	214	111	67	44	39	*	*
%change			-8.5%	-10.4%	-4.8%	*	*	*	*	*
2011	C	Manufacturing	16,582	3,684	12,898	7,386	5,512	1,331	1,332	2,849
2012			16,834	3,675	13,159	7,774	5,385	1,317	1,141	2,928
%change			1.5%	-0.2%	2.0%	5.3%	-2.3%	-1.0%	-14.4%	2.8%
2011	D	Electricity, gas, steam and air conditioning supply	2,024	1,988	36	*	*	*	*	*
2012			2,018	1,958	60	15	45	41	*	*
%change			-0.3%	-1.5%	67.7%	*	*	*	*	*
2011	E	Water supply, sewerage, waste management and remediation activities	459	198	261	93	167	12	101	55
2012			399	188	211	64	147	14	85	48
%change			-13.1%	-5.4%	-18.9%	-30.9%	-12.3%	18.0%	-15.8%	-12.2%
2011	F	Construction	5,447	4,224	1,223	912	310	266	21	24
2012			5,099	3,941	1,158	752	405	327	39	39
%change			-6.4%	-6.7%	-5.3%	-17.5%	30.7%	22.9%	90.4%	66.4%

**Table 1 (continued): BEE results by industry, 2011 and 2012**

	Standard Industrial Classification	Description	Total Sales (£m)	Northern Ireland (£m)	External Sales (£m)	Great Britain (£m)	Export Sales (£m)	of Republic Ireland (£m)	Rest of Europe (£m)	Rest of World (£m)
2011	G – S	Distribution and service industries	36,563	31,035	5,528	2,930	2,598	1,371	525	702
2012			37,159	31,519	5,641	2,855	2,785	1,562	490	733
%change			1.6%	1.6%	2.0%	-2.5%	7.2%	14.0%	-6.7%	4.4%
2011	G	Wholesale and retail trade; repair of motor vehicles and motor cycles	23,875	20,493	3,382	1,777	1,605	986	294	325
2012			24,133	20,898	3,235	1,685	1,549	944	246	359
%change			1.1%	2.0%	-4.4%	-5.2%	-3.5%	-4.3%	-16.4%	10.6%
2011	H – S	Other service Industries	12,688	10,542	2,145	1,153	993	385	231	377
2012			13,026	10,620	2,406	1,170	1,236	619	244	373
%change			2.7%	0.7%	12.2%	1.5%	24.5%	60.6%	5.7%	-0.9%
2011	H	Transport and storage	2,967	2,204	763	489	274	136	89	49
2012			3,254	2,405	849	434	415	277	90	48
%change			9.7%	9.1%	11.3%	-11.3%	51.5%	103.1%	1.4%	-1.0%
2011	I	Accommodation and food service activities	1,255	1,235	20	10	10	9	1	0
2012			1,314	1,295	19	10	9	7	*	*
%change			4.7%	4.9%	-8.2%	-1.0%	-14.9%	-15.1%	*	*
2011	J	Information and communication	1,432	904	527	280	247	82	20	145
2012			1,446	954	492	219	273	103	21	150
%change			1.0%	5.5%	-6.8%	-22.0%	10.5%	24.9%	2.1%	3.5%
2011	L	Real estate activities	892	830	62	48	14	11	*	*
2012			891	769	123	92	31	26	3	1
%change			-0.1%	-7.4%	97.6%	93.3%	111.7%	132.0%	*	*
2011	M	Professional, scientific and technical activities	1,743	1,415	328	92	237	67	46	123
2012			1,754	1,362	392	161	231	76	51	104
%change			0.6%	-3.7%	19.4%	76.1%	-2.5%	13.0%	9.7%	-15.6%

**Table 1 (continued): BEE results by industry, 2011 and 2012**

	Standard Industrial Classification	Description	Total Sales (£m)	Northern Ireland (£m)	External Sales (£m)	Great Britain (£m)	Export Sales (£m)	of Republic Ireland (£m)	Rest of Europe (£m)	Rest of World (£m)
2011	N	Administrative and support service activities	1,773	1,413	360	172	189	68	*	*
2012			1,700	1,238	462	218	244	113	*	*
%change			-4.1%	-12.4%	28.2%	27.1%	29.2%	65.6%	*	*
2011	P - S	Others	2,625	2,541	84	63	22	11	3	7
2012			2,667	2,597	70	37	34	17	3	14
%change			1.6%	2.2%	-16.5%	-41.7%	57.1%	48.4%	-0.5%	97.2%

\* = Cells have been suppressed to protect confidentiality

### Coefficient of Variation

The coefficient of variation (CV) measures the variability of the values in the table above by expressing the standard error as a percentage of the parameter estimate. Unlike confidence intervals, which measure variability by providing the range of values between which the mean value for a predetermined percentage of all possible samples would fall, the coefficient of variation expresses variability as an easily comparable percentage. As the coefficient of variation is not measured in any specific unit, it facilitates comparison between surveys measuring different underlying variables. A larger coefficient of variation implies a larger variability.

$$\text{Coefficient of Variation} = \frac{\text{Standard Error}}{|\text{Parameter Estimate}|}$$

Standard Error: In statistics, sample estimates such as means and medians deviate from the actual population mean and median; and this deviation is the standard error. Standard error is a statistical term that measures the accuracy with which a sample represents a population and is essentially an indicator of the reliability of the estimate.

Parameter Estimate: The parameter estimate refers to the individual value for each of the variables in the table above. For example the 2012 parameter estimate for turnover in Section A is £110 million.

## 4.0 METHODOLOGY

A detailed description of the current NIABI methodology can be found in Appendix A. The BEE utilises this same methodology but also includes some additional processing to incorporate the sales destination data. This additional processing is described below.

### 4.1 Rationale

The exports destination data is collected through the NIABI and one of the core rules for each return is that total sales (ie ABI turnover) must equal the sum of sales to each of the individual destinations. So at an individual record level:

$$total\ sales = \sum sales\ to\ individual\ destination$$

It is therefore logical to require that this rule should also hold at weighted population level and that the sum of population level sales to all destinations for  $i$  cases should sum to total turnover in the population.

$$total\ weighted\ sales = \sum_i sales\ to\ individual\ destination \times weight$$

Thus by adopting this approach, the population sum of destination sales must be constrained to ABI total turnover and this can only be achieved by ensuring that the BEE replicates the ABI processes, including:

- Creation and treatment of outliers
- Creation of imputed values for businesses in the census element who have failed to respond to the survey
- Creation of weighting factors.

### 4.2 Summing of Destination Data

The section above details the requirement that total sales must equal the sum of sales to each of the individual destinations. Where returns fail to sum in this respect, they are queried with the individual businesses; however there remain instances where, at an individual record level, the sum of destinations does not equal total turnover. The following is the list of processes used to address the most common issues.

#### **4.2.1 Deriving Destination Data for Imputed Returns**

Where any business in the census component has not made a return in the current year, that business will have an individual estimate created. This is achieved by applying a growth rate, derived from the median per head annual change of other similar businesses, to the previous year's return.

However, a consequence of this process is that the imputation calculation for each destination is treated independently and for any single imputed record, the outcome destination values will not sum to imputed turnover as required.

To address this, the imputed value of turnover is accepted and the imputed destination values are disregarded. Destination values are instead derived by applying the apportionment of sales in the previous year to the current year imputed turnover.

#### **4.2.2 Deriving Destination Data for Returns with Missing Destination Data**

Where a return is made with turnover provided but destination data missing, the approach above is used, where an apportionment of sales can be derived from previous returns. If a previous apportionment cannot be calculated, the sales pattern in other similar businesses is used.

#### **4.2.3 Sum of Destination Data Provided is Less Than Total Turnover**

The broad destination groups "Rest of EU (Excluding Ireland)" and "Rest of World" each have a catch-all "other" category included in the list of constituent countries. This can be used by respondents to list any sales that they cannot attribute to a particular country within each group.

Where a return has a shortfall in either the REU or ROW group, the outstanding amount is attributed to the "other REU" or "other ROW" category, as appropriate.

#### **4.2.4 Sum of Destination Data Provided is Greater Than Total Turnover**

Where a return is made with turnover provided but the sum of the destination data is greater than total sales, the total turnover figure is assumed correct. The destination values are derived by calculating each destination as a proportion of the sum of destinations. This split is then applied to the total turnover figure.

The above list of processes is not exhaustive but will usually address the vast majority of issues. As a last resort, and in the absence of any other information, an individual estimate is created and all sales are considered to be internal sales (i.e: all sales are attributed to Northern Ireland).

### 4.3 Weighting Returned Data to Population Level Results – Grossing Procedures

Valid sample returns are weighted to ensure they reflect the business population that are reported on.

The final weight ( $w$ ) that is applied to each return is produced based on a design ' $a$ ' weight and a calibration ' $g$ ' weight.

Let  $y_i$  = the value of the characteristic (e.g.: turnover) for the  $i$ th sampled business

$w_i$  = the weight for the  $i$ th sampled business

$\bar{Y}$  = the desired population total

$\hat{Y}$  = the estimate of  $\bar{Y}$

Then:

$$\hat{Y} = \sum_i w_i y_i$$

The weight  $w_i$  is commonly split into three parts:

$$\hat{Y} = \sum_i a_i g_i o_i y_i$$

where  $a_i$  = the  $a$ -weight for business  $i$

$g_i$  = the  $g$ -weight for business  $i$

$o_i$  = the outlier weight for business  $i$  (For NIABI, this can be ignored and considered to have value = 1)

- The design or ' $a$ ' weight is a simple expansion estimator (i.e:  $\frac{N}{n}$ ) for similar groups in the population. So, for example, each SIC or size band could have the same  $a$  weight;

- The calibration 'g' weight is based on auxiliary data and acts as a control on the  $a$  weight to ensure that the final weight  $w$  is not skewed, based on over- or under-sampling businesses of a certain characteristic.

For example, suppose the  $a$  strata are created based on 2 digit SIC groups. If one third of businesses respond, it follows that the responders have  $a$  weights of 3 (ie:  $N/n = 3/1 = 3$ ).

Furthermore, if the businesses that responded accounted for, say, 80% of the IDBR selected employment for that  $a$  group, weighting results by 3 is likely to produce employment and related variables of  $3 \times 80\% = 240\%$  of the true value.

The final weight  $w$  is such that:

$$w_i = a_i g_i$$

Also, the sum of (the control variable X weight) equals the sum of that calibration groups control variable. In the NIABI, the control variable is IDBR selected employment.

A more detailed mathematical description of the weighting can be found in Appendix B.

## 5.0 VALIDATION OF RESULTS AGAINST OTHER SOURCES

### 5.1 Measuring the Impact of Producing Results Utilising NIABI Methodology

The impact of producing results using the NIABI methodology can be measured directly by comparing the published results for manufacturing exports from the MSES with the manufacturing exports estimated by the BEE. Table 3 and Figure 3 below compares broad destination results from the 2012/13 MSES (revised) with manufacturing exports from the 2012 BEE (provisional).

Overall, the two methodologies produce broadly similar estimates. The BEE gives a total sales figure of £16.8 billion compared to the MSES figure of £17.4 billion. This is a difference of £520 million or 3.0%. The sales to each of the broad destinations are all lower in BEE compared to MSES. The greatest percentage difference between the two measures is in the level of Rest of European Union sales. However, it should be noted that the comparison presented below is not a direct like-for-like comparison. The 2012 MSES data presented is the latest revised data available while, due to the development time involved, the BEE is based on provisional 2012 data. The revisions to the previously published 2012 MSES data resulted in an increase of £416 million in total manufacturing sales and thus account for the vast majority of the difference between the two measures.

The revisions to the 2012 data will be included in subsequent BEE publications along with the further refinement work anticipated through the QIF.

**Table 3. Comparison of Manufacturing Sales and Exports as measured by Manufacturing Sales and Exports Survey (revised 2012) and Broad Economy Exports (provisional 2012)**  
Measure

	MSES /£m	BEE 95% CI Lower	BEE /£m	BEE 95% CI Upper	Coefficient of Variation	Difference (BEE - MSES) / £m	% difference
Turnover	17,354	16,624	16,834	17,044	0.6	-520	-3.0
NI Sales	3,758	3,553	3,675	3,798	1.7	-83	-2.2
GB Sales	7,975	7,656	7,774	7,892	0.8	-201	-2.5
ROI Sales	1,413	1,248	1,317	1,386	2.7	-96	-6.8
REU Sales	1,264	1,092	1,141	1,189	2.2	-124	-9.8
ROW Sales	2,944	2,861	2,928	2,994	1.2	-17	-0.6
External Sales	13,596	12,987	13,159	13,331	0.7	-437	-3.2
Exports	5,621	5,269	5,385	5,502	1.1	-236	-4.2

**Figure 3. Comparison of Manufacturing Sales and Exports as measured by Manufacturing Sales and Exports Survey (2012 revised) and Broad Economy Exports (2012 provisional) Measure**

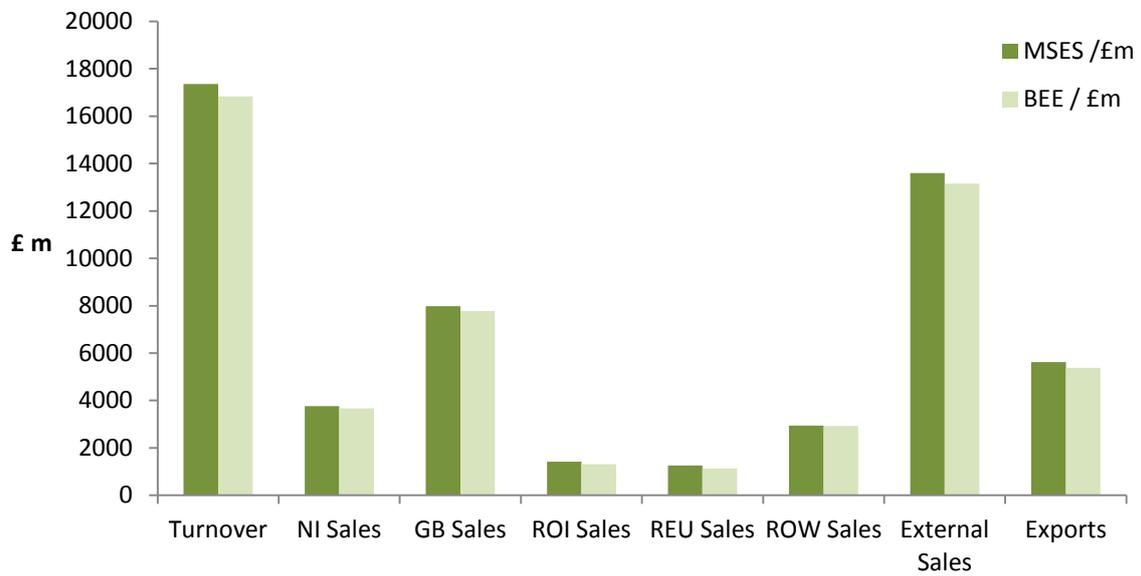


Table 4 below compares two digit SIC results from the 2012/13 MSES (revised) with manufacturing exports from the 2012 BEE (provisional). As with the broad destination level data, the two methodologies produce broadly similar estimates. Again, the MSES revisions account for the vast majority of the difference between the two measures.

**Table 4. Comparison of Manufacturing Sales and Exports as measured by Manufacturing Sales and Exports Survey (Revised 2012) and Broad Economy Exports (2012 provisional) Measure**

SIC 2007 Division	Industrial Sector	MSES /£m	BEE 95% CI Lower	BEE Estimate /£m	BEE 95% CI Upper	Coefficient of Variation	Difference (BEE - MSES) / £m	% difference
SIC 10-33	All Manufacturing	17,354	16,624	16,834	17,044	0.6	-520	-3.0
SIC 10-12	Food, Beverages & tobacco	9,244	8,644	8,790	8,936	1.7	-455	-11.3
SIC 13	Textiles	169	145	162	179	5.3	-7	-4.1
SIC 14	Wearing apparel	161	80	113	145	14.6	-48	-30.0
SIC 15	Manufacture of leather & related products	*	*	*	*	*	*	*
SIC 16	Wood & of products of wood & cork	297	282	308	335	4.4	11	3.7
SIC 17	Paper & paper products	253	192	197	203	1.4	-56	-22.1
SIC 18	Printing & reproduction of recorded media	158	125	142	159	6.1	-16	-10.2
SIC 19	Coke & refined petroleum products	*	*	*	*	*	*	*
SIC 20	Chemicals & chemical products	281	196	217	238	4.9	-64	-22.8
SIC 21	Pharmaceutical	292	317	323	330	1.0	31	10.7
SIC 22	Rubber & plastics	730	701	741	782	2.8	12	1.6
SIC 23	Non-metallic minerals	488	425	451	476	2.9	-37	-7.6
SIC 24	Basic metals	83	75	99	123	12.5	15	18.3
SIC 25	Fabricated metal products	802	797	880	962	4.8	78	9.7
SIC 26	Computer, electronic & optical	602	547	598	649	4.4	-4	-0.6
SIC 27	Electrical equipment	942	924	944	965	1.1	2	0.2
SIC 28	Machinery & equipment n.e.c.	1,038	958	1,016	1,073	2.9	-22	-2.2
SIC 29	Motor vehicles & trailers	454	396	412	429	2.1	-42	-9.2
SIC 30	Other transport equipment	938	916	937	958	1.1	-1	-0.1
SIC 31	Furniture	223	218	243	268	5.3	20	9.1
SIC 32	Other manufacturing	114	75	154	234	26.3	41	35.9
SIC 33	Repair & installation of equipment	61	45	64	83	15.2	3	5.7

\* = Cells have been suppressed to protect confidentiality

## 5.2 Comparing BEE exports with other sources

The experimental results from the BEE were compared against the findings from other data sources to assess if they were consistent and, if not, to try to identify reasons for the differences.

### 5.2.1 Broad Economy Exports and Exporting Northern Ireland Services

The Exporting Northern Ireland Services Study is designed to measure tradable services. The annual publication brings together service sector export information for:

1. Construction
2. Manufacturing
3. A “High Export Potential” group, which includes a range of service industries which have been deemed on the basis of earlier research to have a high potential to trade in services.

The basis of the questionnaire mirrors the ONS International Trade in Services Survey (ITIS) which the NI data also feeds into.

The latest published ENIS results are for the 2011 survey reference period and are presented in Table 5 below.

**Table 5. Export of Northern Ireland Services - Value of known services (2011)**

Sector	Value of Service Exports (£m)
High Export Potential	247.0
Construction	183.8
Manufacturing	64.7
TOTAL	495.4

Table 2 above shows that BEE estimated the total value of exports by companies in the services industries (sections G – S) as £2.6 billion in 2011. There is a substantial difference when this value is compared to the ENIS estimate of £495 million, however there are reasons for this:

- The High Export Potential (HEP) group reported in the ENIS is a very specific subset of businesses in the services sector. The BEE suggests that exporting by businesses in the service sector is more widespread than previously thought.

- The BEE presents all exports (ie: goods and services) sold by a business, whereas the ENIS presents only services exports by businesses in the services sector, with the exception of construction companies, where both goods and services are collected.

It should be noted that the BEE does collect information on the broad destination of sales, split by goods and services and this has received some initial analysis. As part of the future development of the BEE, the methodology to analyse and validate this data will be further developed. Splitting out the services element of exports would then allow a more informed like-for-like comparison with ENIS.

### 5.2.2 Broad Economy Exports and Regional Trade Statistics, HMRC

As outlined above, the latest exports data from the Regional Trade Statistics (RTS) series produced by HMRC show that exports from Northern Ireland in 2011 were worth £5.9 billion and £5.6 billion in 2012.

This is substantially lower than the 2012 £8.8 billion estimate from the BEE. Again, identified reasons for this difference include:

- The HMRC estimates are based on customs declarations, employ regional allocation for London based large businesses and include exports not covered by the BEE (e.g. live animals). As such the results are not directly comparable with the BEE.
- HMRC does not receive information in respect of goods that move wholly within the UK, nor in intangibles and services such as banking or tourism.
- Not all trade can be assigned to one of the nine English Regions, Wales, Scotland and Northern Ireland. This unassigned figure accounts for about 12 per cent of the total HMRC trade figure.

Further information on the RTS series can be found here:

<https://www.uktradeinfo.com/Statistics/RTS/Pages/aboutRTS.aspx>

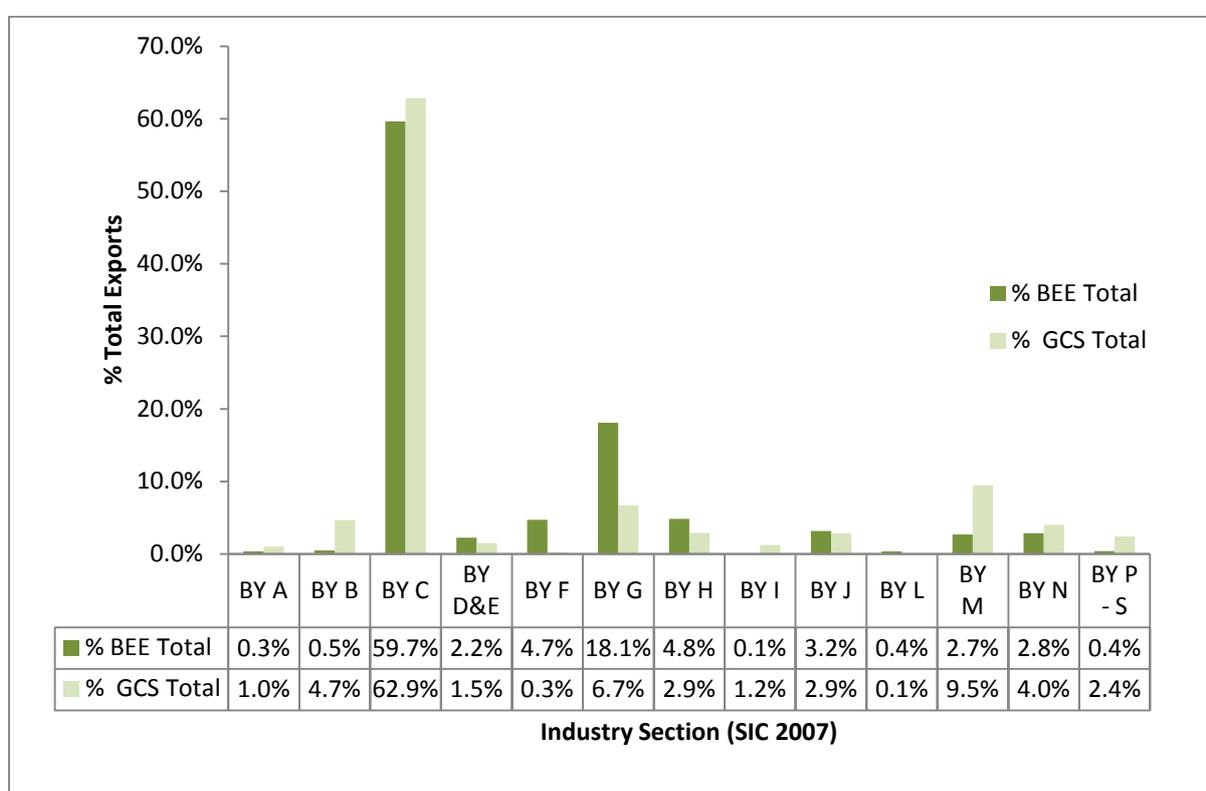
As noted in section 5.2.1, the BEE collects exports data split by goods and services. While this data has not yet received enough quality assurance to be published, tentative comparisons of the goods element of the BEE with the RTS data show very good concordance. This also verifies that the BEE captures substantial services exports that are not captured by HMRC.

### 5.2.3 Broad Economy Exports vs Findings from Scotland’s Global Connections Survey

The Global Connections Survey (GCS) is an annual survey of businesses in Scotland collecting information on exports and international connections of companies in Scotland. The survey covers all sectors of the Scottish economy, but does exclude exports of oil and gas from the UK continental shelf.

Comparing the surveys facilitates the comparison of the exports profile of Scotland and NI so that activity across industry sections can be evaluated. Figure 4 below illustrates this comparison.

**Figure 4. Broad Economy Exports vs Global Connections Survey – Proportion of exports by sector (2012)**



As expected, the pattern of exports is broadly similar. Perhaps the two most notable differences in profile occur in sections G (Wholesale and retail trade; repair of motor vehicles and motor cycles) and M (Professional, scientific and technical activities). The higher proportion of exports in G in NI is likely explained by two factors:

- Some businesses in Section G have a manufacturing element and a wholesale/retail element but are classified as wholesale businesses, based on the IDBR classification

(see Section 6.2). The BEE has a number of high turnover businesses that fit this profile, hence increasing sales in G.

- NI's land border with a country outside of the UK means that trade to the Republic of Ireland is classed as exports. Table 1 shows that just under two thirds of all exports in section G in 2012 were to Ireland.

The larger proportion of GCS exports in M compared to BEE may be contributed to by the range of professional and technical activities of businesses associated with the oil and gas extraction from the UK continental shelf.

Further information on the Global Connection Survey can be found here:

<http://www.gov.scot/Topics/Statistics/Browse/Economy/Exports/GCSIntroduction>

#### 5.2.4 Exports as a proportion of Gross Value Added (GVA)

As noted there are no directly comparable measures of the value of exports of both goods and services between countries and regions of the UK. However, NI exports measured on the new basis represented 27% of NI GVA (£32.4 billion) in 2012, the same as for the UK (when HMRC and ONS estimates of goods and services respectively are combined).

The NI figure was higher than Scottish<sup>5</sup> exports' share of GVA (23%), though this is likely because of the ease with which Northern Ireland can export to the Republic of Ireland.

**Table 6. Total Exports (Goods and Services) as % of GVA**

Region	Total Exports (Goods and Services) as % of GVA
Northern Ireland (BEE)	27%
Scotland (Global Connections survey)	22%
UK (HMRC and ITIS)	27%

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<sup>5</sup> Based on the Scottish Global Connections Survey estimates for 2012.

## **6.0 LIMITATIONS OF THE METHODOLOGY**

### **6.1 Limitations in Coverage**

The enhanced coverage of the BEE reflects the coverage of the ABI and still does not address certain gaps in the economy. In line with the ABI and also the ONS Annual Business Survey, BEE does not cover exports from the financial services sector due to ongoing volatility of the estimates. NISRA is continuing to investigate options as to how NI data might be accessed or UK data regionalised.

The other main areas that are excluded are Public Administration and Defence (section O) while Agriculture, Forestry and Fishing (section A) excludes farming (groups 01.1, 01.2, 01.3, 01.4 and 01.5). In relation to the latter, DARD publishes separate estimates of the value of the Food and Drink Processing sector, including exports. There are also some exports in the HMRC Trade data, which the new NISRA measure may not be capturing (e.g. the export of live animals). NISRA will continue to work with DARD colleagues to ensure there is appropriate coverage of such exports.

Local authority and central Government bodies in Education (section P) and Human Health and Social Work Activities (section Q) have also been excluded from this publication, as has 86.2 (Medical and Dental Practice Activities) within section Q. Please see Appendix A, sections A3 and A4 for further details.

### **6.2 “Head Office” Effect**

The information provided in this publication is based on reporting unit (i.e. head office) information which means that all trade activity is coded based on the classification and location of the reporting unit. This means, however, that businesses with cross -sectoral activity must be classified within one sector. For example, a business may have both a manufacturing (Sector C) and wholesale (part of Sector G) element to its structure. In this case, the business is classified based on the rules used by the Inter-Departmental Business Register (IDBR), according to the activity of the majority of employees. So in this example, if the majority of employees are in the wholesale arm, the business is classified as Wholesale and all sales and exports are coded as coming from a wholesale unit.

In the interrogation of the BEE results, it was found that this was a particular issue for manufacturing activity being classified under Sector G (wholesale and retail).

### **6.3 Classification of Businesses**

The 2012 NIABI sampled approximately 11,000 businesses in Northern Ireland from a population of approximately 49,000 businesses in the IDBR sample frame. The IDBR consists

of companies, partnerships, sole proprietors, public authorities, central government departments, local authorities and non-profit making bodies in the UK. Businesses not registered for either Pay As You Earn or VAT are excluded from the frame.

The NIABI is reliant on the IDBR receiving accurate and timely updates and providing a true reflection of the Northern Ireland business population. In the course of validating the BEE output, the classification of a number of individual businesses has been queried. This validation of classification is continuing on an ongoing basis and any changes will be reflected in subsequent analyses.

Additional information about the IDBR and the characteristics of the businesses covered by the IDBR is available at the link: [http://www.detini.gov.uk/index/what-we-do/deti-stats-index/business\\_statistics/stats-inter-dept-bus-register.htm](http://www.detini.gov.uk/index/what-we-do/deti-stats-index/business_statistics/stats-inter-dept-bus-register.htm)

#### **6.4 The use of auxiliary variables in GES for weighting exports data**

The weighting used to gross the BEE individual records to population level is identical to that used by the NIABI. This is the only way to ensure that the common variables are consistent at population level, that is, the total value of turnover in NIABI equals the total value of external sales which was previously not possible using the MSES approach. When calibrating returns to population level, there should be a strong correlation between the outcome variable and the calibration variable. However, it is possible that using the auxiliary variable of selected employment in GES, as currently used in NIABI, might not be the most suitable variable for weighting returned exports values to population level or indeed for weighting the financial variables within the NIABI. Work is ongoing under QIF to assess the use of selected turnover for grossing the NIABI financial variables.

Some statistical analysis has been carried out for the purposes of informing this paper, to assess the relationship between exports (outcome variable) and selected employment (calibration variable) compared with selected turnover. A Spearman's Rank correlation analysis showed a moderate, positive monotonic correlation between exports and selected employment ( $r_s = 0.297$ ,  $n = 7,523$ ,  $p < 0.001$ ); and also a moderate, positive monotonic correlation ( $r_s = 0.396$ ,  $n = 7,523$ ,  $p < 0.001$ ) between exports (outcome variable) and selected turnover (calibration variable). The latter coefficient, whilst smaller than desirable, is an improvement over the use of selected employment.

One of the proposed future developments in the BEE will be in relation to replacing selected employment with selected turnover as a calibration variable for all financial variables within the NIABI should the findings of the ongoing QIF endorse this approach.

The turnover approach will also be similar to that used in the Scottish Index of Manufactured Exports (IME) (<http://www.scotland.gov.uk/Resource/0042/00428407.pdf>).

In the IME, sampled export sales (stratified by industry group and number of employees) are weighted to form an estimate for the entire population of companies, using the Inter-Departmental Business Register (IDBR) as the sampling frame and IDBR turnover as an auxiliary data source.

## 7.0 FURTHER DEVELOPMENTS

This paper provides detailed descriptions of the methodology and analysis procedures, including the underlying statistical and mathematical concepts. Prior to publication, the methodology and key findings were presented to a group of special users to take initial informed views on the broad findings. While some areas for further investigation were suggested, no major issues in relation to the work's underlying assumptions or top level findings were identified.

All users are invited to provide comments regarding the methodology and experimental results presented herein, and these can be provided to the Economic & Labour Market Statistics Branch, NISRA at [statistics@dfpni.gov.uk](mailto:statistics@dfpni.gov.uk).

NISRA is planning to publish a summary of users' views and its proposed response. This is in line with the requirement of the Code of Practice to investigate and document such views and provide transparent priority setting.

In 2014, NISRA successfully bid for a Quality Improvement Fund (QIF). As part of this bid, a methodology expert from the Office for National Statistics (ONS) is assisting NISRA in further refinements to the methodology for the NIABI and BEE measure. One of the areas to be examined is the effect of changing the auxiliary variable for weighting purposes from selected employment to selected turnover for all financial variables collected in the NIABI, including exports and imports.

NISRA will take on board user feedback and subsequently publish a three year series covering the period 2011 to 2014 at the end of June 2015. This updated series will also incorporate developments from the QIF bid.

Other areas for potential development, subject to user need, include:

- Splitting sales into goods and services
- Data for sales to individual countries
- Analysis of trade by business size
- Imports data

The new exports data will be incorporated into NISRA's ongoing work programme to develop key elements of an internationally standard set of Economic Accounts for Northern Ireland. This is expected to publish in spring 2015 and will set the value of exports in their wider economic context in Northern Ireland.

## **APPENDIX A: NORTHERN IRELAND ANNUAL BUSINESS INQUIRY BACKGROUND AND METHODOLOGY**

### **A.1 About the Northern Ireland Annual Business Inquiry**

The Northern Ireland Annual Business Inquiry (NIABI) collects both financial and employment information from businesses and other establishments and covers about two thirds of the economy. This includes the Production, Construction, Distribution and Service industries in Northern Ireland but excludes public sector activity for the most part. The Coverage of the survey is detailed at section A.4 below.

The 2012 NIABI sampled just under 11,000 businesses in Northern Ireland from a population of approximately 49,000 businesses in the sample frame: the Inter-Departmental Business Register (IDBR). The IDBR consists of companies, partnerships, sole proprietors, public authorities, central government departments, local authorities and non-profit making bodies in the UK. The NIABI is reliant on the IDBR receiving accurate and timely updates and providing a true reflection of the Northern Ireland business population. Businesses not registered for either Pay As You Earn or VAT are excluded from the frame. Additional information about the IDBR and the characteristics of the businesses covered by the IDBR is available at the link:

[http://www.detini.gov.uk/facts\\_and\\_figures\\_edition\\_15.pdf](http://www.detini.gov.uk/facts_and_figures_edition_15.pdf)

### **A.2 Survey reference period**

For survey reference period 2012, businesses were asked to make returns for the calendar year 2012. Where this was not possible, returns for business years ending between 6 April 2012 and 5 April 2013 were accepted. Similar procedures operated in previous years. Returns covering fewer than twelve months were accepted for businesses which had started or ceased trading during the year. Estimates were made for those firms providing returns for more than six months while firms providing less than six months were treated as closures in the results process.

### **A.3 NIABI sample**

Following user feedback and consultation with the Statistics Advisory Committee and the DFP official statistics user group, the NIABI sample size was boosted from approximately 5,000 in the 2010 survey reference year to approximately 9,000 in 2011. The sample was further boosted to just under 11,000 in 2012 and 2013.

To maximise survey precision, the Neyman allocation approach to sampling is utilised. Neyman allocation is a sample allocation method that may be used with stratified samples. The purpose of the method is to maximize survey precision, given a fixed sample size. The survey universe is stratified by 2 digit SIC code and employee size band, and all businesses with 50+ employees, or 20+ employees and more than one local unit, are fully enumerated. The current NIABI sample design includes all Manufacturing businesses with 6 or more employees. Businesses falling below the threshold of complete enumeration are selected on a stratified random basis. In addition, certain companies of special interest to policymakers and government agencies (for example, certain Invest NI clients) are added to the sample.

#### **A.4 Standard Industrial Classification and the coverage of the NIABI**

NIABI results are classified according to the Standard Industrial Classification of Economic Activities (SIC) system. The UK is required by European legislation to have a system of classification consistent with the European Union's Industrial classification system. A review of the system was completed in 2007 and implemented in 2008. UK SIC 2007 is divided into 21 sections, each denoted by a single letter from A to U. Below this, further levels of detail are provided at division (denoted by 2 digits), groups (three digits), classes (four digits) and subclasses (five digits).

The SIC 2007 sections covered by the NIABI are as follows and this also equates to the definition of 'Broad Economy' used throughout this paper:

- A. Agriculture (support activities), forestry and fishing
- B. Mining and quarrying
- C. Manufacturing
- D. Electricity, gas, steam and air conditioning supply
- E. Water supply, sewerage, waste management and remediation activities
- F. Construction
- G. Wholesale and retail trade; repair of motor vehicles and motor cycles (Distribution industries)
- H. Transport and storage
- I. Accommodation and food service activities
- J. Information and communication
- L. Real estate activities

- M. Professional, scientific and technical activities
- N. Administrative and support service activities
- P. Education (excludes local authority and central government bodies)
- Q. Human health and social work activities (excludes local authority and central government, and medical and dental practice activities (group 86.2))
- R. Arts, entertainment and recreation
- S. Other service activities

*Production Industries* are comprised of sections B – E.

*Service Industries* are comprised of sections H, I, J, L, M, N, P, Q, R and S.

Following a decision in 2013 by the Office for National Statistics to discontinue the publication of figures covering Insurance & Re-insurance industries (within Sector K) due to ongoing volatility of the estimates, the NIABI publication also excludes estimates for this sector. The other main areas that are *excluded* are: Public Administration and Defence (section O) while Agriculture, Forestry and Fishing (section A) excludes farming (groups 01.1, 01.2, 01.3, 01.4 and 01.5). Local authority and central Government bodies in Education (section P) and Human Health and Social Work Activities (section Q) have also been excluded from this publication, as has 86.2 (Medical and Dental Practice Activities) within section Q.

#### **A.5 Data collection, validation and calculation of NIABI results**

Around 11,000 forms were issued from Economic and Labour Market Statistics Branch, DFP, in March 2013 (NIABI Survey reference year 2012) and the returned forms were subjected to a range of validation and congruency checks. The 2012 response rate was 74.6%.

Extensive data validation was carried out on the returned forms ensuring internal consistency within the form, checking data fell within expected limits or by contacting the company for clarification where appropriate. For non-returns above a selected employment threshold, data were imputed using a methodology which takes account of previous returned data and the performance of other similar businesses. This information is then grossed up to the reporting unit population, to ensure that results are representative of the sampled population.

Please note that the information presented throughout this publication is based on reporting unit information, and not local unit information. Reporting and local unit definitions can be found at: [http://www.detini.gov.uk/stats\\_bus\\_register\\_3.doc](http://www.detini.gov.uk/stats_bus_register_3.doc)

Also, to better meet user needs, and in consultation with ONS Methodology Consultancy Service, DFP produced these results using Statistics Canada's Generalized Estimation System (GES). This allows DFP to produce estimates, with an associated measure of their quality. For more detail of the estimation methodology please consult: [http://www.detini.gov.uk/review\\_of\\_the\\_abi\\_-\\_quality\\_improvement\\_fund\\_project.pdf](http://www.detini.gov.uk/review_of_the_abi_-_quality_improvement_fund_project.pdf)

Users are advised to take into account the quality indicators associated with the estimates when considering the significance of annual changes. These indicate that some results have quite large margins of statistical error associated with them. Users should exercise caution when interpreting the annual changes associated with such results.

Ongoing development of the methodology will be informed by user feedback, both in terms of the usefulness and reliability of the estimates and their comparability with other sources. Any comments should be sent to [statistics@dfpni.gov.uk](mailto:statistics@dfpni.gov.uk).

## APPENDIX B: *a* and *g* Weight Calculations

A more detailed description of the mathematics used in the calculation of *a* and *g* weights is presented below.

### B.1 Weighting Returned Data to Population Level Results

Valid sample returns are weighted to ensure they reflect the business population that are reported on.

The final weight (*w*) that is applied to each return is produced based on a design '*a*' weight and a calibration '*g*' weight.

Let  $y_i$  = the value of the characteristic (e.g.: turnover) for the *i*th sampled business

$w_i$  = the weight for the *i*th sampled business

$\bar{Y}$  = the desired population total

$\hat{Y}$  = the estimate of  $\bar{Y}$

Then:

$$\hat{Y} = \sum_i w_i y_i$$

The weight  $w_i$  is commonly split into three parts:

$$\hat{Y} = \sum_i a_i g_i o_i y_i$$

where  $a_i$  = the *a*-weight for business *i*

$g_i$  = the *g*-weight for business *i*

$o_i$  = the outlier weight for business *i* (For NIABI, this can be ignored and considered to have value = 1)

Hence:

$$\hat{Y} = \sum_i a_i g_i y_i$$

Therefore the weights  $a_i$  and  $g_i$  must be derived for each element  $i$ .

The  $a$  weights can be easily calculated however the derivation of the  $g$  weights is complex and is done using the Generalised Estimation System (GES). GES is a SAS-based application, developed by Statistics Canada. Further detail relating to the methodological principles of the Generalised Estimation System (GES) are available at:

[http://www.researchgate.net/profile/M\\_Hidiroglou/publication/240115239\\_Methodological\\_Principles\\_for\\_a\\_Generalized\\_Estimation\\_System\\_at\\_Statistics\\_Canada/links/Of3175359c38579606000000.pdf](http://www.researchgate.net/profile/M_Hidiroglou/publication/240115239_Methodological_Principles_for_a_Generalized_Estimation_System_at_Statistics_Canada/links/Of3175359c38579606000000.pdf)

## B.2 Design $a$ weights

The design weight for each element  $i$  in stratum  $h$  is calculated as follows:

$$a_i = \frac{N_h}{n_h} \quad \text{for } i \in s_h$$

where:

$N_h$  = number of elements in population stratum  $h$

$n_h$  = number of elements in sample stratum  $h$

## B.2 Calibration $g$ weights

Calibration weights are calculated based on the auxiliary data within each of the calibration groups. The groups form mutually exclusive and exhaustive partitions of the population. The Auxiliary data for the elements consists of the following information within each calibration group  $p$ :

$$x_i \quad \text{for } i \in s_p$$

$$X_p = \sum_{i \in U_p} x_i$$

where:

$x_i$  = vector of auxiliary variable for element  $i$

$S_p$  = sample of elements in calibration group  $p$

$X_p$  = Vector of auxiliary variable totals for calibration group  $p$

$U_p$  = Population of elements in calibration group  $p$

The calibration weights are obtained as the solution to the following problem within each calibration group

$$\begin{aligned} & \text{Min} \sum_{i \in S_p} \frac{g_i(w_i - a_i)^2}{a_i} \quad \text{with respect to } w_i \\ & \text{subject to} \sum_{i \in S_p} w_i x_i = X_p \quad \text{and } l_i \leq w_i \leq u_i \end{aligned}$$

where:

$g_i$  = value of g-weight for element  $i$ .

$a_i$  = design weight for element  $i$ .

In order to obtain a valid solution to this problem, the constraint set given by the calibration equations and the bounds must define a feasible region. This means that the calibration equations must be consistent and the specified bounds cannot be too restrictive.

In general, there is no explicit formula for the calibration weights. They are obtained by an iterative non-linear programming algorithm. The calibration weights obtained by solving the calibration problem are then used to produce the calibration factors.

## **APPENDIX C: NOTES**

### **C.1 Status of figures in current bulletin**

This bulletin contains detailed experimental results for the Broad Economy Exports measure for 2011 and 2012. It is normal practice to revise the data from the previous year based on ongoing data validation and clarification of responses from individual businesses. These experimental figures will also be subject to revision based on:

- user feedback
- ongoing work to further develop the survey methodology
- additional information provided by individual businesses

### **C.2 Disclosure**

The NIABI is the instrument through which the Broad Economy Exports data is collected. The NIABI is conducted under the Statistics of Trade and Employment (Northern Ireland) Order 1988 and great care is taken to avoid disclosing information about individual enterprises (in line with the stipulations in Article 7 of the Order). Figures which would be likely to disclose particulars relating to an enterprise are not published (i.e. they are suppressed) unless prior written consent for their publication has been obtained directly from the business. The Northern Ireland Statistics & Research Agency Economic & Labour Market Statistics confidentiality statement can be accessed at the following link:

[http://www.detini.gov.uk/data\\_confidentiality\\_statement\\_principle\\_5\\_of\\_the\\_code\\_of\\_practice\\_for\\_official\\_statistics\\_-2.pdf](http://www.detini.gov.uk/data_confidentiality_statement_principle_5_of_the_code_of_practice_for_official_statistics_-2.pdf)

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