

Research Bulletin 18/9 | Input-Output Tables and Multipliers

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Summary

In May 2018, NISRA's Economic Accounts Project published¹ detailed data on the supply and use of commodities, inter-industry flows and the structure of the economy for 2014 and 2015. This included the development of experimental Northern Ireland (NI) specific Input-Output tables, which provide a framework for modelling economic impacts and changes to the domestic economy. Furthermore, Input-Output tables allow the derivation of economic multipliers which can be used for economic planning, analysis and forecasting.

This article provides a brief overview of Supply and Use tables before focusing in on Input-Output tables and their multipliers. We will discuss how the information within Input-Output tables can be used to inform economic analysis, how to interpret the results of that analysis, and the limitations of this approach.

Introduction

Input-Output tables describe and quantify the interdependent relationship between inputs and outputs within an economy irrespective of whether the products have been produced by the primary industry or by other industries as their secondary output. The Input-Output tables show separately the consumption of domestically produced and imported goods and services, providing a theoretical framework for further analysis of the structure of the economy, its composition and the effect changes in demand will have on the economy.

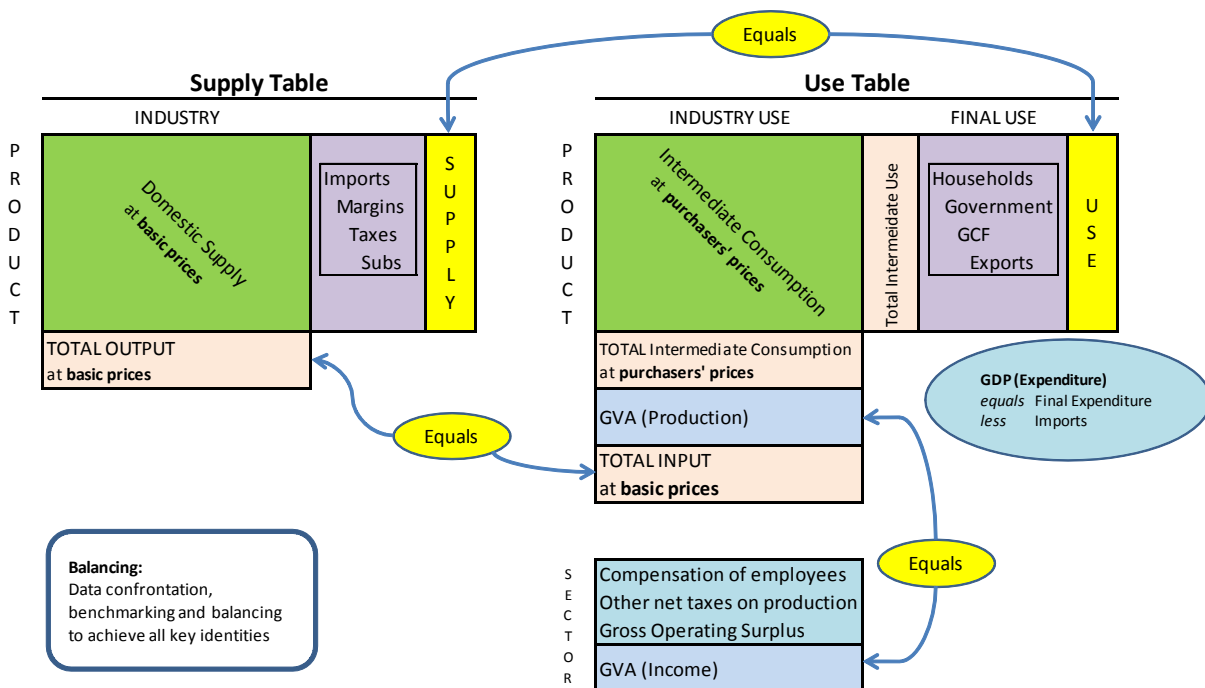
This means from a policy perspective, we can estimate the impact on the economy of an increase or decrease in spending in one sector and the subsequent impact on the NI economy over the reference period, which in this article is 2015. NISRA has published Gross Value Added (GVA) and output multipliers derived from the 2015 Input-Output tables at both the product and industry levels. NISRA has also developed (although not yet published) employment multipliers which are discussed later in this paper.

It is important to note that these statistics are designated experimental, to reflect their status as new official statistics undergoing evaluation and are subject to revision. As a result users should adopt a cautious approach to their use. That said, the methodology is in line with the European System of Accounts 2010, thereby allowing comparison with other countries adhering to the same standard.

Overview of the Supply and Use framework

Supply and Use tablesⁱⁱ are the starting point for the production of the Input-Output Analytical tables. All other Input-Output analyses are derived from them. The Supply and Use tables provide a picture of the flows of products and services in the economy for a single year and are used to set the level of annual current Gross Domestic Product (GDP). They show the composition of uses and resources across institutional sectors and the inter-dependence of industries.

Figure 1: Supply and Use framework for a coherent picture of the economy



Interpretation of the Supply Table

The primary purpose of the Supply Table is to show the goods and services produced by each industry in NI along with the supply of goods and services including imports. The supply of products is presented in the rows while the columns show the industries responsible for the output of these products.

We can see from the excerpt of NI Supply 2015 table overleaf (the full Supply table can be found on the NISRA websiteⁱⁱⁱ) that £72,898m worth of goods and services were produced by NI businesses in 2015 (Domestic Supply). Of this, reading across the rows in the table, we can see that the total domestic value of chemicals and chemical products produced by Northern Ireland businesses was £492m (see column headed domestic supply). In addition chemicals and chemical products to the value of £1,186m and were imported in 2015. The total supply of this product equates to £2,283m (after you take into consideration the value of distributors' trading margins and Taxes (less subsidies) on products).

Table 1: Excerpt of NI Supply Table 2015

Product	Product Description	Domestic Supply	Imports from ROI	Imports from GB	Imports from ROW	Total Imports	Distributors' Trading Margins	Taxes (less subsidies) on products	Total Supply
...
CD	Coke & refined petroleum products	59	29	866	52	947	32	1,030	2,068
CE	Chemicals & chemical products	492	149	745	292	1,186	447	158	2,283
CF	Basic pharmaceutical products & preparations	689	43	307	136	486	238	58	1,472
...
	Total Supply at basic prices	72,898	2,383	17,564	4,669	24,616	(0)	5,547	103,062

Note: All in £ millions

Interpretation of the Use Table

Where the Supply Table presented the supply of goods and services for consumption in NI, the Use table shows the demand for goods and services by industries and final demand across the product rows.

The Use Table can be split into 3 main sections:

- **The intermediate use (section 1)**, which shows the inputs of products, both domestic and imported, used by NI industries in the production of their output;
- **The final use (section 2)**, which shows the purchases of each product by each category of final use (e.g. Household Final Consumption Expenditure (HHFCE), Non-Profit Institutions Serving Households (NPISH), Central Government (CG), Local Government (LG) and Exports); and
- **The primary inputs (section 3)**, these inputs do not flow through the other industries, they are employees' salaries, taxes less subsidies on production and gross operating surplus, which together constitute Gross Value Added.

Reading down the columns of the first section of the Use Table we can see the range of products used by each industry to produce goods and services. For example, in the excerpt of the NI Use Table, 2015^{iv} overleaf, the chemical and chemicals products industry purchased a total of £261m of goods and services to produce its own product. The main products purchased were chemicals and chemical products (£170m). Reading across the row we can see the destination of products and services. The table shows that £1,247m of chemicals and chemical products were used by industries in the production of their products. The main industry using these products was the rubber and plastics industry (£290m). In addition, £737m of chemicals and chemical products were used by the household sector and £302m of goods were exported^v.

Table 2: Excerpt of NI Use Table 2015

Product	Product Description	INDUSTRY INTERMEDIATE USE (at purchasers' prices)						FINAL USE at purchasers' prices										
		CD Coke & refined petroleum products	CE Chemicals & chemical products	CG Rubber & plastic products	Total Intermediate Use	HHFCE	NPISH FFCE	CG FCE	LG FCE	Gross Capital Formation	Exports to ROI	External Sales to GB	Exports to ROW	Total Exports	Total Use			
...
CD	Coke & refined petroleum products	...	0	1	...	56	...	1,007	666	-	-	-	(1)	227	110	59	396	2,068
CE	Chemicals & chemical products	...	0	170	...	290	...	1,247	737	-	-	-	(2)	61	56	185	302	2,283
...
CG	Rubber & plastic products	...	0	8	...	252	...	2,072	136	-	-	-	(46)	194	665	246	1,105	3,266
...
	Total Intermediate Consumption at purchasers' prices	...	33	261	...	1,173	...	36,877	25,769	754	11,722	711	5,593	3,706	11,263	6,667	21,636	103,062
	Taxes less subsidies on production	...	1	1	...	7	...	610										
	Compensation of employees	...	3	105	...	397	...	19,381										
	Gross operating surplus	...	1	141	...	104	...	13,426										
	Mixed income	...	0	1	...	13	...	2,603										
	GVA (at basic prices)	...	5	249	...	521	...	36,021										
	TOTAL OUTPUT (INPUTS) at basic prices	...	38	510	...	1,695	...	72,898										

Note: All in £ millions

Input-Output Tables & Multipliers

The Supply-Use tables serve not only statistical but analytical purposes, especially when they are transformed into analytical Input-Output tables^{vi}. The analytical tables present a version of the Use Table in either an industry by industry or product by product format, as opposed to the product by industry basis of the Supply and Use tables. The representation of the Supply and Use tables in the Input-Output framework allows the interdependence of industries to be formally analysed as each industry is shown as intermediate purchasers of their own and other industries output. A key output from this analysis is the production of multipliers which help to analyse direct relationships within the economy.

A multiplier allows users to estimate the impact a small change in demand would have on the whole NI economy. The multiplier is calculated as the ratio of the total economic effect on the whole economy to the initial change. So, an output multiplier of 1.66 for example would indicate that if a sector in NI were to increase output by £100 million then ultimately total output for NI would increase by £166 million.

There are two main categories of multiplier - Type I & Type II, which between them cover three economic effects:

- **Direct effect:** This is the immediate effect caused directly by the change in final demand e.g. if there is an increase in final use for a particular product, we can assume that there will be an increase in the output of that product, as producers react to meet the increased demand;
- **Indirect effect:** This is the subsequent effect caused by the consequent changes in intermediate demand i.e. as producers increase their output, there will also be an increase in demand on their suppliers and so on down the supply chain; and
- **Induced effect:** This is the effect attributable to the ensuing change in compensation of employees and other incomes, which may cause further spending and hence further changes in final demand e.g. as a result of the direct and indirect effects the level of household income throughout the economy will increase as a result of increased employment. A proportion of this increased income will be re-spent on final goods and services.

Type I Multipliers cover direct and indirect effects only. These multipliers underestimate the effect on the economy as they do not estimate induced effects. Type II Multipliers cover induced effects as well, but due to data availability it has not been possible to produce robust Type II multipliers for NI.

Within the Type I category there are different multipliers that can be employed to measure the effect on different policy targets. Two of the more common are Output Multipliers and GVA Multipliers. Each sector has a unique multiplier because each has a different pattern of purchases from firms in and outside the region.

Product based Multipliers

The product multipliers demonstrate the effect on total GVA and Output caused by a one pound change in the demand for a specific product. Let's take the hypothetical example of an increase in demand of £5 million for 'CH - Basic metals and metal products'. The direct impact of an increase in demand will be a requirement to increase the total output of this product by £5 million to meet this additional final demand. To estimate the indirect effect on the industries that produce these products, we multiply the direct impact (£5m) by the Type 1 product output multiplier^{vii} for this product grouping (**1.25**) giving a **total of direct plus indirect impact in output of £6.25 million**.

The direct impact on total GVA caused by an increase of £5m in the GVA of products in the "Basic metals and metal products" group is an increase of £5m. To estimate the indirect effect on the industries that produce these products, we multiply the direct impact (£5m) by the GVA multiplier^{viii} for this product grouping (**1.28**) giving a **total of direct plus indirect impact in GVA of £6.40 million**. It should be noted that Type 1 Multipliers, such as GVA & Output, underestimate the effect on the economy as they do not estimate induced effects. NI Industry based multipliers for 2015 are also available^{ix}.

Although unpublished, NISRA has also produced experimental employment multipliers, further detail on employment multipliers is available on request. If for instance, a company in the 'Pharmaceuticals' industry intends to employ an additional 500 people on a full-time basis and say for example the 'CF – Basic Pharmaceutical products and preparations' Type I employment multiplier is **1.50**. It is estimated the **total employment impact (direct plus indirect) on the economy is 750 full-time equivalent jobs**.

Limitations of Input-Output Tables

As evidenced in this article, Input-Output tables are a useful tool, which provides a framework for modelling economic impact and changes to the domestic economy. However the Input-Output tables are based on a strict set of assumptions, which for the purposes of estimating any subsequent economic impacts, are assumed to remain constant.

The overarching assumption is that interdependency between input and outputs over the relevant period remains constant. Referring back to the previous product multiplier example, an increase in demand of £5m for 'Basic metals and metal products' resulting in a total direct plus indirect impact of £6.25m, is based on the structure and composition of the economy in 2015. This estimate makes a number of assumptions. Including:

- **Responsive Supply Chain** – relevant industries in the supply chain will vary their own production to meet the variance in demand for their outputs within the relevant time period;
- **Fixed Price Supply Chain** - it is assumed there will be no price adjustment or supply constraints;
- **Industry Homogeneity** - any additional increase/decrease in production for an industry/product classification is based on the characteristics of all production within that classification;

- **Fixed Production patterns** – assumes input proportions are fixed in the production process;
- **Local Supply Conditions** – does not make an adjustment for local industries who may purchase inputs from outside the region; and
- **No Inter-Regional feedback effects** – makes no adjustment for demand in NI production as a result of changes in demand outside NI.

As a result of these assumptions, which reflect the nature of Input-Output tables, Input-Output modelling is not particularly well suited to estimating very large scale changes to the economy or aspects of the economy experiencing significant or rapid changes from the reference year, for example industries in new or emerging areas (or in sudden decline) or in industries which implement new production methods.

Conclusion

The purpose of this article is to provide a brief overview of the outputs of NISRA's Economic Accounts Project, in particular Input-Output tables and their multipliers. Notably, the Input-Output tables provide a framework allowing the modelling of economic impacts to NI based on the composition and structure of the economy in 2015. This may be of particular interest to policy colleagues, as it allows the straightforward quantification of the economic impact to NI as a result of variances in demand across industries and products. Furthermore, as the methodology is in line with the European System of Accounts 2010, it is possible to compare NI with other countries or regions adhering to the same standard.

This article identified some of the limitations to the impact of Input-Output tables and the statistics are designated experimental, reflecting their status as new official statistics undergoing evaluation and are subject to revision. Nevertheless, this type of economic analysis, if used responsibly, is a very powerful addition to the policy toolkit. The Input-Output tables for NI is a new and exciting area for NISRA, we are keen to engage and happy to advise any policy colleagues interested in learning more about the outputs of the Economic Accounts Project and their application.

The Supply and Use tables for 2016 (and subsequent Input-Output tables) are due to be published in Spring 2019.

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- i <https://www.nisra.gov.uk/publications/ni-economic-accounts-project-2014-and-2015-experimental-results>
- ii More detail on the key outputs from the Economic Accounts project, including a methodology guide and results bulletin, is available here - <https://www.nisra.gov.uk/publications/ni-economic-accounts-project-2014-and-2015-experimental-results>
- iii NI Supply 2015 sheet can be found here - <https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/NI-Supply-Use-Tables-Multipliers-2015.xlsx>
- iv NI Use 2015 sheet can be found here - <https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/NI-Supply-Use-Tables-Multipliers-2015.xlsx>
- v Each of the components of the Supply and Use Tables are based on detailed analysis of a wide range of data sources covering the whole of the Northern Ireland economy. Where direct estimates for NI are not available UK datasets are used to estimate NI values. The range of data sources can be accessed here <https://www.nisra.gov.uk/publications/ni-economic-accounts-project-2014-and-2015-experimental-results>
- vi Further discussion on this transformation process is available here - <https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/NI-Economics-Accounts-Project-Methodology-guide-2014-2015.pdf>
- vii NI Product based Multipliers are available here - <https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/NI-Supply-Use-Tables-Multipliers-2015.xlsx>
- viii As above.
- ix NI Industry based Multipliers are available here - <https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/NI-Supply-Use-Tables-Multipliers-2015.xlsx>.