

A Social Accounting Matrix for Scotland

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Abstract

Irrespective of the outcome of the September 2014 Scottish independence referendum, Scotland will require more and better economic data to manage its increased economic responsibilities. The 2012 Scotland Act and proposals by each major UK political party will further increase Scotland's fiscal powers. These powers require that future Scottish governments have more detailed knowledge of the flows of income and expenditure through the Scottish economy. This will allow it to better understand how the economy operates and – more critically – to model how the economy will respond to proposed changes in, for example, government expenditures and taxes. One extremely effective way to present and analyse such data is via a Social Accounting Matrix (SAM). Here we present a Scottish SAM for 2009 constructed in the Fraser of Allander Institute. We take the reader through the SAM's key elements and show how it can be used to better describe, analyse and model the Scottish economy.

1 Introduction

Table 1 shows an aggregate version of the Scottish SAM for 2009. This has been generated as part of a research programme jointly funded by the Scottish Government and the Economic and Social Research Council.¹ The SAM is here shown as a 12 x 12 matrix. It identifies all the incomes received and all the expenditures made within the Scottish economy for that year. It shows the accounts for production sectors; factors of production (labour and other value added); institutions (households, corporations and government); the capital account (savings and investment) and the external accounts (with the rest of the UK and the rest of the world). The figures are measured in £ million at 2009 basic prices.

First, some clarification is required. The figures in Table 1 do not cover activity on the continental shelf. That is to say, it does not include the incomes and taxes directly generated through the extraction of North Sea oil and gas. It is almost certain that a large proportion of this activity, and the associated tax revenues, would be attributed to Scotland under independence. However, in the present UK regional accounts these activities are dealt with separately. Second, for presentational purposes the industrial sectors have been aggregated to just four; Energy, Financial & Business Services, Manufacturing, and All Other Industries. In the full table there are 104 sectors.

¹ The funding covers fees and grants for two PhD students [ES/J500136/1].

Table 1: Aggregate 2009 Social Accounting Matrix for Scotland, 2009 basic prices (£million)

	1. Energy	2. Financial & Business	3. Manufacturing	4. All other Industries	5. Labour	6. Other Value Added	7. Households	8. Corporations	9. Government	10. Capital	11. RUK	12. ROW	Total:
Incomes →													
Expenditures ↓													
1. Energy (including renewables)	6,274	591	1,031	3,372	-	-	4,555	-	393	458	11,466	3,037	31,178
2. Financial & Business Services	736	4,117	538	4,187	-	-	2,973	-	29	213	10,374	2,161	25,328
3. Manufacturing	744	155	5,174	5,105	-	-	3,820	-	0	1,613	5,628	6,949	29,189
4. All other Industries	2,758	2,551	3,235	23,039	-	-	38,454	-	29,064	11,697	9,411	5,018	125,226
5. Labour	4,673	7,027	7,872	43,989	-	-	-	-	-	-	-	-	63,561
6. Other Value Added	6,998	6,566	3,162	21,715	-	-	-	-	-	-	-	-	38,442
7. Households	-	-	-	-	63,561	5,289	-	15,103	19,835	-	1,853	2,237	107,877
8. Corporations	-	-	-	-	-	29,456	6,401	-	5,722	-	7,784	4,144	53,507
9. Government	632	836	509	2,802	-	3,697	27,947	5,248	-	1,495	20,234	129	63,530
10. Capital	-	-	-	-	-	-	5,070	14,740	119	-	-	-	19,931
11. RUK	5,641	2,993	4,954	16,686	-	-	14,113	10,638	8,368	3,358	-	-	66,750
12. ROW	2,722	492	2,714	4,331	-	-	4,544	7,778	-	1,097	-	-	23,675
Total:	31,178	25,328	29,189	125,226	63,561	38,442	107,877	53,507	63,530	19,931	66,750	23,675	

Note: The fully disaggregated SAM can be accessed at: <https://www.strath.ac.uk/fraser/research/>

Accessing the SAM, the methodology and the Income and Expenditure Accounts:

The method used to compute the SAM was streamlined in such way that it allows other researchers to update and alter the SAM according to subsequent releases of Scottish Input-Output Tables.

The fully disaggregated SAM, the Income and Expenditure Accounts and the underpinning methodology can be freely accessed at: <https://www.strath.ac.uk/fraser/research/>

Future releases of the SAM will include disaggregated labour (by education and gender), household (by type) and Government (central and local) accounts.

2 Reading the SAM

It is useful to see how the SAM is structured by working through one account. Let's take the Households account, which is shown in row and column 7. The row entries give the size and sources of Scottish household income. Total household income is £107,877 million, which implies a per capita income of just over £20,600. Not surprisingly, the most important source is wage payments, which account for £63,561 million, or almost 60%. The other major sources are non-wage income from production. These are the entries in the other value added and corporate columns. These include income from self-employment, dividends, private pensions and other corporate income going to households. Combined, the total comes to £20,392 million or just less than 20%. The final major source of household income is Government which contributes £19,835 million, just over 18%. This includes welfare payments and public pensions.

Where the row entries give the income sources, the column entries show how that income was used (i.e. spent). Note first that the total household expenditure of £107,877 million is equal to the total income. This is true for all the accounts: income and expenditure must balance. Of this total, £49,802 million, that is 46%, is spent on consuming Scottish goods. This is found by summing the first four entries in the household column (column 7). The biggest single element of Scottish household expenditure is labeled here "all other industries". The major expenditures in this category are Retail (excluding vehicles) £8,326 million, Imputed rent £6,342 million, Food & beverage services £3,198 million, Real estate £2,603 million, Wholesale (excluding vehicles) £2,556 million, and Education £2,442 million.

Of the other expenditures, £27,947 million, or just over a quarter, goes to the Government, primarily in taxes. These include both direct and indirect taxes, such as income tax and VAT. The payments to the rest of the UK and the rest of the world (RUK and ROW) are almost all imports to consumption. These are goods or services produced outwith Scotland but purchased by consumers here. The value of consumer imports is a little over one third the value of the consumption of Scottish produced goods with the rest of the UK (RUK) supplying just over three quarters. The payments to the capital account are savings and to corporations are payments for shares and for private pensions.

3 Industries

Each account has the same broad characteristics as those shown in the discussion of households above. That is to say, the rows show income sources and the columns expenditure, and the corresponding rows and columns balance. The first four rows and columns contain information for the accounts for individual sectors. Three industries important for the Scottish economy are separately identified here and all other industries aggregated together. This is simply for illustrative purposes; as we state earlier, in the full table there are 104 separate industries. The first four rows of Table 1 show the income sources for these industries. These indicate to whom the sectors' outputs are sold. For the first three sectors, Energy, Financial and Business Services, and Manufacturing, exports are the major market. In all cases the RUK and rest of the world (ROW) combined sales provide more than 40% of the industry's revenue, and for Financial & Business Services this is almost 50%. Note also the particular importance of exports to the rest of the UK for the Energy and the Financial & Business Services sectors. These are sectors which might be adversely affected under independence if this leads to a reduction in RUK trade.

The block of transactions in the 4 x 4 square at the top right hand corner of the SAM details the sales from industries to themselves and other sectors. These are the sales and purchases of intermediate inputs required for production. For example Financial & Business Services purchases £591 million from the Energy sector in order to light and heat its offices. Similarly Manufacturing sells £744 million of its output to the Energy sector as intermediate inputs. Sales of intermediate goods and services are a significant share of the total sales of individual industries. For the three industries separately identified here, intermediate sales make up over 35% of total sales and for "All other industries" the share is just over 25%. Note that in all the industries there are large own-industry sales: that is to say transactions between firms within the same industry. An example would be an electricity distribution company in the Energy sector that purchases its electrical energy from an electricity generating company.

For the other elements of demand, note that over 50% of the sales of the "All other industries" sector is to government and household consumption demand. This is not surprising since this will include such large sectors such as Education, Health and Personal Services.

The first four columns of the SAM show the purchases of the same four industrial sectors. Essentially these reveal the differing cost structures of these industries. We know already that the first four entries in each of these columns give the intermediate purchases in that sector. So in the first column, the £744 million sold by the Manufacturing sector to the Energy sector is here seen as a purchase (and therefore a cost) to the Energy sector. The last two elements in each of these four columns also report intermediate expenditures, in this case on imports from the RUK and ROW. The Energy and Manufacturing sectors have a high level of intermediates. In particular, both of these sectors import intermediates, primarily from the RUK, to a value of over 25% of their total output.

The entries in the industry columns which are central to the economic well-being of the country are those that show the value added that is produced in these sectors. When summed, they equal Scotland's gross domestic product, GDP. In the SAM these are divided into payments to labour and other value

added, which comprises essentially profits and rents. By summing the totals for these entries, we can calculate the Scottish GDP for 2009 as £102,002 million. A little over 60% goes to labour and just under 40% to profits and rents. The three sectors separately identified together generate over 35% of Scottish GDP, with Financial & Business Services being the biggest contributor at just over 13%. The wage share of GDP has become an important issue in discussions about changes in income inequality since 1970, highlighted most recently in the work of Thomas Piketty (2014). It is clear that both the Energy and Financial & Business Service sectors have a relatively low share of wage income to their total value added.

4 Factors of Production: Labour and Other Value Added

The accounts for labour and other value added are given in rows and columns 5 and 6 of the SAM. These accounts are relatively straightforward. As we have already seen, the incomes to these accounts come solely from production sectors. This implies that the rows 5 and 6 only have positive entries for the first four elements. Columns 5 and 6 show how this income is distributed. Wage income is straightforward. The whole £63,561 million is transferred to households. Over three quarters of the income in the Other Value Added account is transferred to Corporations. The remainder is split between the Household and the Government accounts. These reflect income earned by resources owned directly by households or the Government.

5 Institutions: Households, Corporations and Government

We have already looked in detail at the Household accounts. The Corporate account is shown in row and column 8. In many ways this is the most problematic set of accounts because it is the one in which we have least reliable information. The total income is £53,507 million. Over a half of this income, £29,456 comes from Other Value Added. A further 22% is derived outwith Scotland. We have no direct means of attributing this combined figure between the two external sources, RUK and ROW, but we have divided the total up in a way that is consistent with the balancing of the Table as a whole. A further 22% comes from Households and Government. The expenditure by corporations is made up of four main parts. The first is the payments of taxes (plus some interest and dividends) to Government; this is primarily corporation tax and non-domestic rates and amounts to £5,722 million and makes up just over 10% of corporate income. The remaining three elements to Households, the Capital Account and the External (RUK and ROW) accounts each comprises around 30% of Corporation expenditure. The payments to Households are capital gains, interest payments, dividends, pensions etc., payments to the Capital account are savings and the payments to the External accounts are to individuals and institutions located outwith Scotland.

The Government Account is shown in row and column 9. It covers the three levels of Government operating in Scotland: UK, Scottish and local government. In the income row the entries from the individual Industries, Households, Corporate, Capital and the ROW accounts are primarily tax payments. The income from Other Value Added is from productive activities owned by the Government. The large entry from RUK is almost all a transfer from the central Government to meet the net cost of the Barnett formula funding of Scottish Government expenditure and to finance the UK budget deficit. Government

income is used for the purchase of goods and services and to make transfer payments. The top four entries in the Government expenditure column are the purchases of Scottish goods and services. This totals £29,486 million and, as we have commented already, is spent almost wholly on the 'All Other Industries' sector. The entry of £19,835 in the Households row is primarily welfare payments and pensions. These are expenditures mainly met at present from the UK Government which would become the Scottish Government's responsibility under independence. The large transfer to RUK is to the UK Government to cover expenditure on centrally produced services such as defense and foreign affairs and to pay interest on the UK public debt. There is a small addition to saving.

6 The Capital Account (Saving and Investment)

This account identifies the £19,931 million expenditure on real investment in Scotland and its financing. The entries along the Capital account row are savings. These are made by Corporations, Households and the Government sectors, with Households generating just over 25% and the Corporate sector just under 75%. The Capital (investment) expenditure primarily goes on Scottish produced goods and services, concentrated in the All other Industries classification (e.g. sectors such as Construction are heavily involved in investment). Imports of capital goods make up £4,455 million, which is just over 20% of the total, primarily from RUK. There are also tax payments made to the Government.

7 The External Account

The external account incorporates all trade and income flows between Scotland and RUK and Scotland and ROW. These are shown in the final two rows and columns of the SAM. The income entries along the rows from the Industrial and Capital sectors represent exports from RUK and ROW of intermediate and investment goods and services to be used in Scottish production. Similarly the entries in the Households account are for imports of consumer products, although there is a small of transfer payments incorporated too. However, the entries from Corporations and Government are all transfer payments of various types.

8 Economic Interaction

Up until now we have been looking at the SAM as a set of accounts. Organising the information in this way provides a strong discipline and framework for analysis. The accounts require data to be assembled with a high degree of consistency and the accounts must balance. This imposes necessary constraints not required when data is generated in different ways and for different purposes and never brought directly into contact with one another. Constructing the SAM can also indicate areas where our knowledge is weak. We discuss this briefly later. The consistency of the data means that it is a valuable source for simple data comparisons of the type we have made in the previous sections.

However, another advantage of the matrix formulation of the SAM is that it helps trace the complex set of impacts within the economic system which accompany expenditure changes. For example, imagine an increase in the export demand from the RUK for the output of the Energy sector, where the Energy output rises to meet that demand. This increases the income in the Energy account. The sector will then

spend the additional income on intermediate inputs, labour and imports required to produce the increased output. Profit payments will also rise. These expenditures increase the income in the accompanying accounts. For example, in so far as there is an increase in employment or wage rates, this will increase household income, which will generate subsequent consumption expenditure, stimulating further demand expansion and so on. Again, increased expenditure on domestic intermediate goods will directly increase the output of other sectors and additional value added, including wages. We can visually trace the financial flows as expenditure from one account becomes income in a second account, which is subsequently spent to become income in a third account, etc. etc.

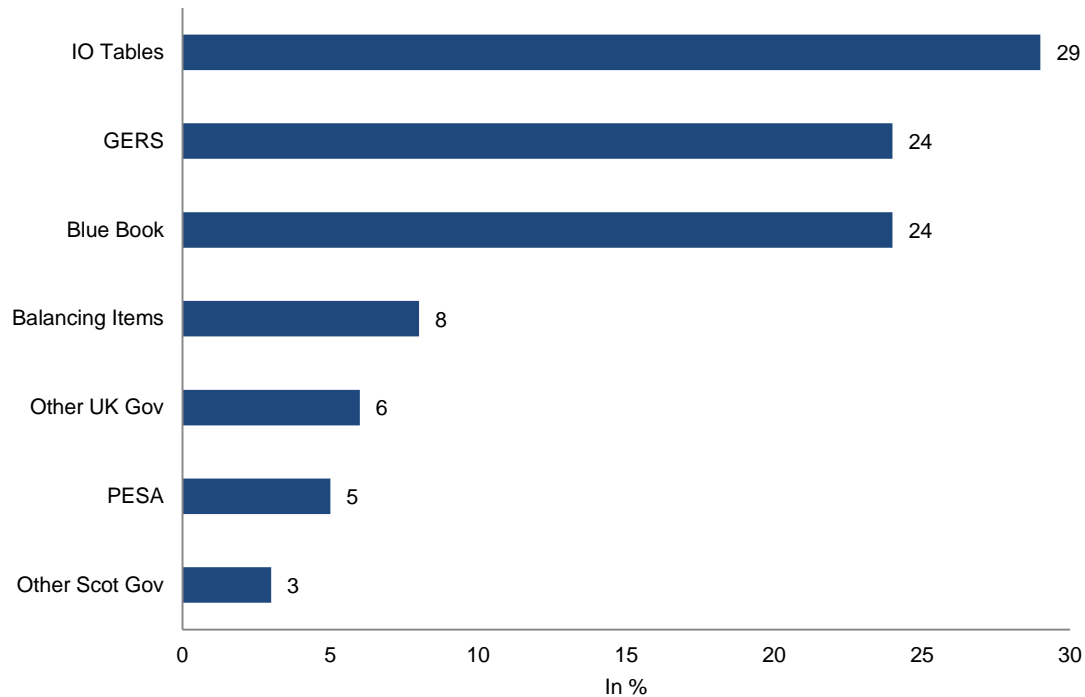
If we assume that all these expenditure increases have an impact that applies linearly (so that an increase in income in any account generates a linear expansion in all the expenditures from that account), then we can construct a sophisticated SAM multiplier model (Miller and Blaire, 2009). This will predict the increase in total output from some external expenditure increase, for example from an increase in Energy exports. It will also show the way in which the impact from a change in activity is spread across sectors and institutions. Such demand-driven models, usually of a less sophisticated form than this, are extensively used in economic impact analysis.

However, the SAM data base can also be used to construct even more powerful models which will simulate changes in prices, outputs for individual sectors and also give overall changes in economic activity in terms of employment, GDP and the price level. Such Computable General Equilibrium (CGE) models can deal with both demand and supply-side changes. The Scottish Government and HMRC use such a model to consider changes in taxes, such as corporation tax, and fuel duty (HMRC, 2013/2014; Scottish Government, 2011). Similar CGE modeling for Scotland has been employed at the Fraser of Allander Institute on topics such as the impact of the tourism stimulus associated with the Commonwealth Games and the effect of energy efficiency improvements (Allen et al, 2014; Lecca et al, 2014).

9 Data

A Scottish SAM brings together several powerful and independently produced data sets to better illustrate and model the overall structure of (and interdependencies within) the Scottish economy. Figure 1 gives a broad overview of the main data sources used. At the very heart of the SAM are the Scottish Input-Output Tables (Scottish Government, 2014). This is the information that is included here in the first four rows and columns of the SAM. It presents the accounts of the industrial sectors presented in a matrix form. The full SAM for Scotland includes the full 104 sectors.

The Input-Output Tables themselves are often used to quantify the demand-side impact of expenditure changes. SAM modeling improves this in particular by modeling household consumption in more detail. This Input-Output information is produced by the Scottish Government and is regularly up-dated, though with a time lag because the data required for its construction only become gradually available (Scottish Government, 2014). The commitment of the Scottish Government (and previously the Scottish Executive and the Scottish Office) to produce these Input-Output tables is a major benefit in being able to analyse the Scottish economy. No other UK region has such an official data source.

Figure 1: Shares of data sources in Income and Expenditure Accounts

The construction of the SAM's Government accounts benefit from the Scottish Government publication, "Government Expenditure and Revenue Scotland", often referred to as 'GERS'. This is an annual publication which uses both UK and Scottish Government finance statistics in order to capture all public sector expenditures and receipts in Scotland. This source provides, amongst other things, household and corporate tax payments as well as total public spending (Scottish Government, 2013). The third most important data source we have used to construct the SAM are the UK National Accounts, known as the ONS 'Blue Book'. This is an annual UK National Statistics publication. The Blue Book is constructed using financial statistics from both UK and international governmental sources. It provides a detailed sectoral breakdown of the UK economy as well as its economic activities with the rest of the world (ROW). The Blue Book data are used for a wide variety of SAM entries, with Scotland being allocated a share of the UK figure (ONS, 2013). The fourth largest single source of data for the SAM is the annual HM Treasury Public Expenditure Statistical Analysis (PESA) publication (HMRC, 2012).

In addition to the above, there are various other UK and Scottish Government publications used to help construct the SAM. The breakdown of sources is given in Figure 1. In Figure 1 we note that there are some sources that are given as "Balancing Items". In the SAM, as we have stressed already, in each account total income and total expenditure must balance. The use of all income going into an account must be identified. However, the data that are being used to identify the income and expenditure flows come from different sources. Also there are some income/expenditure flows where we have no direct information and no easy estimate. For example, some of the flows around the corporate account are of

this nature as are the financial relationships between Scotland and the rest of the UK. In many of the accounts, we have set one or sometimes two entries as residual entries to take the level required to balance that account. This is not ideal as any errors in the estimation of the other flows in the account end up in this residual. Ideally we would like to have good estimates for all entries and the table balanced by a mixture of manual and algorithmic procedures.

10 Summary

We have shown in simplified form the development of a SAM for 2009 as a new and powerful tool to help analyse and model the Scottish economy. We have taken the reader through each of the major 'Accounts' of the SAM (Industries, Households, Government, Capital etc.) to better demonstrate the relationship between income and expenditures in these accounts. We have shown that the SAM is capable of describing the flows of income and expenditure in the Scottish economy and can form the basis for more sophisticated modeling of the impact of changes in income and expenditure across the economy as whole. A key benefit of extending the Input-Output system to a SAM stems from the added ability of modelling households in more detail. When examining the income effects of an external policy shock on households, IO models allow for analysing different effects on household income. SAM-based multiplier models, however, can additionally detail distributional effects on households. The main utility, however, of a SAM is that it provides a comprehensive and consistent record of the interrelationships of an economy at the level of individual production sectors, factors and institutions. Thereby, the SAM makes available an internally consistent statistical foundation, or benchmark, for the creation of plausible economic models (e.g. Computable General Equilibrium models) which simulate changes to the economy. The SAM is built from four primary Scottish and UK economic data sets. Notwithstanding this, research areas remain to be addressed to help minimise any remaining residual entries (Balancing Items) and to improve the Scottish SAM as the basis for robust economic analyses for future Scottish Government's. Given the importance of the SAM to Scottish policy analysis we have made the SAM publicly available, and streamlined the compilation process to ease the process of updating it when new Input-Output Tables are released. The Sam, the Income and Expenditure Accounts and the undergirding method are freely available from: <http://www.strath.ac.uk/fraser/research>. More detailed versions of the SAM are currently being developed. Upcoming releases of the SAM will include disaggregate Labour, Government and Household accounts.

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References

- Allan, G.J., Lecca, P. and Swales, J.K. (2014) "The impacts of temporary and anticipated tourism spending", Strathclyde Discussion Papers in Economics, 14-06
- HMRC (2012) Public Expenditure Statistical Analyses. Retrieved 25/05/2013, from: <https://www.gov.uk/government/collections/public-expenditure-statistical-analyses-pesa>
- HMRC (2013) HMRC's CGE model documentation. Retrieved 09/06/2014, from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/263652/CGE_model_doc_131204_new.pdf
- HMRC (2014) Analysis of the dynamic effects of fuel duty reductions. Retrieved 09/06/2014, from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/303233/Analysis_of_the_dynamic_effects_of_fuel_duty_reductions.pdf
- Lecca, P.G. McGregor, J.K. Swales, K. Turner, 2014. The added value from a general equilibrium analysis of increased efficiency in household energy use. *Ecological Economics*, vol. 100, pp51-62.
- Miller, R. E., and Blair, P. D. (2009). *Input-Output Analysis: Foundations and Extensions*, 2nd edition, Cambridge University Press.
- ONS (2013) United Kingdom National Accounts - Blue Book 2011. Retrieved 25/05/2013, from: <http://www.ons.gov.uk/ons/rel/naa1-rd/united-kingdom-national-accounts/2011-edition/index.html>
- Piketty, T. (2014) *Capital in the 21st century*. Harvard University Press.
- Scottish Government (2011) The impact of a reduction in corporation tax on the Scottish economy. Retrieved 01/06/2014, from: <http://www.scotland.gov.uk/Resource/0038/00388940.pdf>
- Scottish Government (2013) Government Expenditure and Revenue Scotland 2011-12. Retrieved 25/05/2013, from: <http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/GERS>
- Scottish Government (2014) Input Output Tables for Scotland. Retrieved 09/06/2014, from: <http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/input-output>