A regional agricultural SAM for Ireland 2007

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2014

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Abstract

The paper describes the construction of a regional agricultural Social Accounting Matrix (SAM) for Ireland for the year 2007. The SAM describes the full circular flow of money and goods in the Irish economy. The SAM includes 61 activities, 60 commodities, 40 factors of production, 7 households, 2 enterprises, government and investment/saving, 7 tax-related accounts, a trade and transport margin account and an external sector. Its construction starts from the Eurostat Supply and Use table for 2007. A prior unbalanced micro SAM with a regionalized agricultural sector is built with a variety of additional data sources. The final balanced SAM is estimated using the cross-entropy method.

Keywords: social accounting matrix, regional agriculture, cross-entropy method, supply-used table, Ireland

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1. Introduction

The purpose of this paper is the description of the technical aspects to develop a Social Accounting Matrix (SAM), with a regionalized agricultural sector, for Ireland for the year 2007. The matrix has been compiled to provide a suitable database to calibrate a Computable General Equilibrium (CGE) model to analyse agricultural policies in Ireland. For this reason, the paper focus is on the agricultural sector and on how to obtain a detailed representation of Irish agricultural activities and commodities.

The paper shows the different data sources used and the way data are organised to provide a set of first best estimates, the so called prior SAM. Data from different sources provide the initial estimates for the SAM. This matrix is usually neither complete nor consistent. This leads to a SAM that is not balanced i.e., the row and column totals do not equate. An important part of the development of a SAM is therefore the estimation of missing data that supplement the existing data in order that row and column totals of the SAM will equate.

In the next sections we will give a brief overview on the concept of SAM and the need of a new agricultural SAM for Ireland. Sections3 to 8 provide data sources and methodology to build different sub matrices. Section 9 provides the cross-entropy estimation method to obtain the complete and consistent SAM.

2. Overview of SAM and SAM for Ireland

A Social Accounting Matrix (SAM) is an economic database that collects the flow of resources associated with all transactions between economic agents in an economy during a period of time. A SAM is a square matrix which provides a comprehensive, complete and consistent picture of the economic transactions in an efficient way. Each cell shows the payment from the account of its column to the account of its row. Thus, the incomes of an account appear along its row and its expenditures along its column. For each account in the SAM, total revenue (row total) should be equal to total expenditure (column total).

Main theoretical developments in social accounting are due to Sir Richard Stone (1955). He integrated production accounts (in the form of input-output tables) into the national accounts to create an economy-wide database. This database included information about productive and non-productive institutions and markets, such as factor markets, capital markets, households, government, and the rest of the world. Table 1 represents a SAM which broadly follows the System of National Accounts.

A regional agricultural SAM for Ireland 2007

Table 1 Schematic Macro SAM

	Commodities	Margins	Activities	Value added	Households	Enterprises	Government	Savings	Rest of the World	Totals
Commodities		Marketing Margins	USE Matrix		Hhold Consumption		Government Expenditure	Investment Stock Changes	Exports	Commodity Demand
Margins	Marketing Margins									Margins Income
Activities	SUPPLY Matrix									Production
Value added			Factors Remuneration							Factors Income
Households				Factor Income		Distribution Enterprise Income	Transfers to Households		Remittances from RoW	Household Income
Enterprises				Factor Income			Transfers to Enterprise		Enterprise Income from RoW	Enterprise Income
Government	Commodity Taxes		Production Taxes	Factor Income	Hhold Income Tax	Ent Income Tax				Government Income
Investments					Hhold Savings	Enterprise Savings	Government Savings	Stock Changes	Capital Account	Savings
Rest of the World	Imports			Factor Payments to RoW			Transfers to RoW			RoW Income
Totals	Commodity SUpply	Margins Expenditure	Cost of Production	Factors Expenditure	Hhold Expenditure	Enterprise Expenditure	Government Expenditure	Investment	RoW Expenditure	

Due to its accounting consistency and comprehensiveness in recording data, the SAM is the preferred tool to calibrate computable general equilibrium (CGE) models. A SAM defines the base-year values for most endogenous variables as well as it helps to compute most of the structural parameters of the model.

As related to Ireland, several SAMs are currently available for this economy. Henry (1972), Henry (1980) and Henry (1986) are the first attempts to construct SAMs for Ireland for economic analysis. Subsequently, O'Toole and Matthews (2002) constructed a SAM for the year 1993 based on the Input-Output Table (IOTs) published for 1993, with particular emphasis on the agricultural and food processing sectors. A regional SAM for the Border, Midlands and Western region for 2000 was built by O'Herlihy (2004). Dixon (2006) produced a 2003 SAM for Ireland using the 1998 IOT and a type of RAS procedure. Wissema (2006) built a 1998 SAM for Ireland with a disaggregated energy sector. Finally, Miller et al., (2011a) built a SAM and an agricultural-food SAM (2011b) for the year 2005.

In most of these SAM, the agricultural and food industry sector are represented as a single row and column as in the national datasets, particularly IOT and Supply and Use Tables (SUTs) provided by Eurostat. On the other hand, even when the agricultural sector is disaggregated in more details such as in O'Toole and Matthews (2002) and Miller et al. (2011b), the approach followed is always the typical IOT one. In this approach activities and commodities are often univocally linked and the supply matrix is a diagonal matrix.

The purpose of the new SAM developed in this paper is to represent the agricultural sector as a multiple output sector. In other words, following the typical approach of SUTs, a single activity is able to produce multiple outputs (commodities). This new SAM contains seven agricultural representative farmers, one for each Irish province, with a given amount of land. This approach should allow a better modelling of Common Agricultural Policy (CAP), given that the agents who receive the subsidies, the farmers, are explicitly represented in the database structure and can adapt their response to change in exogenous incentives. For a better description of the modelling approach see Ferrari et al., (2012).

3. The ESA95 Supply and use table for 2007

The input-output framework of the European System of Accounts (ESA 1995) consists of three types of tables: supply tables, use tables and symmetric input-output tables. Supply and use tables (SUTs) provide a detailed picture of the supply of goods and services by domestic production and imports and the use of goods and services for intermediate use and final consumption (household consumption, gross capital formation, exports). The use table shows how the components of value added (compensation of employees, other net taxes on production, operating surplus) are generated by industries in the domestic economy. SUTs give information on the production processes, the interdependencies in production, the use of goods and services and generation of income (Eurostat, 2008). Supply and use tables are matrices by

product and industry showing the production processes and transactions for particular products or industries. The supply and use tables also form the basis for deriving symmetric input-output tables by applying certain assumptions to the relationship between outputs and input. The tables provided by Eurostat are harmonised by Eurostat's standardised questionnaire, which distinguishes 59 products (classification CPA2008) and 59 industries (NACE rev 1) for all the tables up to 2007.

Given the focus of his work, the agricultural sector is our main objective, so we will give some illustrative figures related to this sector. All the other sectors will remain almost unchanged while the agricultural one will be disaggregated, as showed in sections below.

According to SUT provided by Eurostat (2011), the availability of the agriculture, hunting and related services product is 8,167 million of Euros (a composite goods of domestic and imports). Out of them, 5,728 (70.14%) is used as intermediate consumption by other activities, 1,664 (20.37%) as final consumption expenditure by households, -91 million as changes in inventories and 866 million (10.60%) as exports. Most of the intermediate consumption is bought by the agricultural sector itself (1,409 million) and from the sector manufacture of food products and beverages (3,947 million).

The domestic agricultural sector produces an output of 6,521 million (79.84%) of the total availability of the agricultural goods. The use table provides the cost structure of the domestic sectors. The agricultural sectors consumes 4,414 million of intermediate goods, pays 491 million as compensation of employees, receives 1,567 million of net subsidies on production (subsidies less tax on production) and pays 3,183 million of gross operating surplus.

The agricultural activity, in a typical Supply and Use framework is a multiproduct activity. Out of the domestic production of 6,521 million, 6,442 (98.78%) is sold as agricultural commodities, while other goods are produced by the agricultural activity (25 million of hotel and restaurant services, 23 of other business services, 5 of recreational, cultural and sporting services and 25 of other services).

The final composite agricultural good is made of the domestic production (6,442) and the 1,329 million of imports. This creates a total supply at basic prices of 7,771 million. The total supply at purchasers' prices is of 8,167 million, given that the agricultural commodities pay 848 million of trade and transportation margins and receive 452 million as net subsidies on products (subsidies less taxes on products).

Table 2 and Table 3 provide some figures on the whole Irish economy.

Table 2 Use Table 2007, Totals million €

	Total	Final consumption expenditure	Gross fixed capital formation	Changes in inventories	Exports FOB	Final uses at purchasers' prices	Total use at purchasers' prices
Total intermediate consumption/final use at purchasers' prices	235,467						
Compensation of employees	78,754						
Other net taxes on production	108						
Operating surplus, gross	87,480						
Value added at basic prices	166,342						
Output at basic prices	401,809						
Total		120,761	50,100	1,451	152,389	324,701	560,168

Source: Eurostat Supply Use bale for Ireland, 2007

Table 3 Supply Table 2007, Totals million €

Output at basic prices	Imports CIF	Total supply at basic prices	Trade and transport margins	Taxes less subsidies on products	Total supply at purchasers' prices
401,809	135,328	537,137	25,031	23,031	560,168

Source: Eurostat Supply Use bale for Ireland, 2007

4. The institutional SAM

The institutional part of the SAM represents the main difference between a SAM and a SUT or IOT. This sub matrix allows the closure of the economic circle. The income from value added generated by productive sectors is distributed to the institutions of the economy, which pay taxes and save. Moreover, all the transfers among these institutions are recorded in this sub matrix.

The institutional part of the SAM contains two accounts for enterprises (financial and non-financial enterprises), an account for the government and one for the rest of the world. In this phase, the sub matrix comprises a single representative household. In the following sections, households will be disaggregated, following the agricultural disaggregation, into seven regional households.

Households, government and the rest of the world consume part of the domestic availability of goods for their final consumption (household and government) and as export (the rest of the world), while enterprises do not consume final goods. Data on final consumption (household and government consumption, gross capital formation and exports) come from the 2007 Eurostat SUT.

To complete the institutional sub matrix, an additional data source is needed. All the data necessary are stored in the Non-financial transactions (nasa_nf_tr) of the annual sector accounts (nasa) of Eurostat. The relevant enters of the database is the amount of money paid and received by each institution in terms of: property income (D4), social contributions and benefits (D.6), other current transfers (D7), adjustment for the change in net equity of households in pension funds reserves (D8). This data are collected from the Eurostat database and used to populate the sub matrix according to assumptions on bilateral relationships between institutions (Table 4). In addition, the same data source provides data on gross saving (B8G) by domestic institutions (Table 5), while savings of the rest of the world are calculated as a residual (exports minus imports minus net payments from the rest of the world).

Table 4 Non-financial transfer among institutions, 2007, million €

Property income	Households	Non-financial corporations	Financial corporations	Government	ROW
Households		826		314	
Financial corporations		2,896			
ROW		25,754			
Social contributions and benefits	**Households**	**Non-financial corporations**	**Financial corporations**	**Government**	**ROW**
Households				2,986	23
Financial corporations				3,286	
Other current transfers	**Households**	**Non-financial corporations**	**Financial corporations**	**Government**	**ROW**
Households		241	91	1,978	
ROW				2,314	
Adjustment for the change in net equity of households in pension funds reserves	**Households**	**Non-financial corporations**	**Financial corporations**	**Government**	**ROW**
Households			3,286		

Source: Eurostat Non-financial transactions (nasa_nf_tr) of the annual sector accounts (nasa), 2007

Table 5 Gross Savings by institutions, 2007, million €

Households	Non-financial corporations	Financial corporations	Government
7,445	17,006	8,715	7,830

The distribution of income of gross value added among institutions is again provided in the same database. According to this data, 55% of the Irish gross operating surplus is received by non-financial corporations, 12% by financial corporations, 5% by government and 28% by households. On the other hand, almost the whole income coming from compensation of employees (78,754) goes to households a part from 761 million, going to the rest of the world, as direct compensation for employees living abroad.

5. Taxation Instruments

The Eurostat supply and use able contains only two net tax instruments: net taxes on production and on products.

The net taxes on production for non-agricultural sectors are sufficient for the scope of our study. The net taxes on production on agricultural sectors coincide with figures paid by the European Commission as CAP payment to Ireland in 2007. For this reason, net taxes are considered as subsidises and we assume the agricultural sector is paying no tax on production. For the description of the CAP in Ireland see section 6.

As related to taxes on products, the goal is to have a better representation of tax instruments including: value added tax, import tax, other sales tax and subsidies.

The first distinction between tax and subsidies by sector is made with data coming from the Irish Central Statistical Office (CSO) The agricultural commodities are receiving subsidies form central government and paying tariffs on imports while are assumed to be exempted by sales and VAT taxation.

The Eurostat non-financial transactions (nasa_nf_tr) of the annual sector accounts (nasa) provides the control total for Value Added type taxes (VAT) (D.211) (14,057 million), for Taxes and duties on imports excluding VAT (D.212) (3,184 million) and for Taxes on products, except VAT and import taxes (D.214), (6,042 million).

To calculate the VAT tax, we use the 2007 VAT tax rate of 21% (Irish tax and Customs) and we applied it to the household final consumption of goods on which the VAT is paid. We assume that government is not paying VAT on his final consumption and VAT paid by enterprises for their intermediate consumption, gross capital formation and on exports is fully rebated.

To calculate the taxes on imports we employ the duty rate coming from the GTAP database version 8 for 2007 (Aguiar et al. (2012)), which has a comparable disaggregation of goods.

Eventually, other sales taxes have been computed as a residual.

Data to compile the current tax on income come from non-financial transactions (nasa_nf_tr) of the annual sector accounts (nasa). The whole economy pays 23,907 million as current taxes on income, wealth, etc. (D.5) to the government. Non-financial corporations pay 4,983, financial corporations pay 2,034 and households pay 16,890 million.

All tax accounts enter as income into the government account.

6. The CAP in Ireland

The SAM considers total agricultural domestic support of 1,892.93 million euros, which corresponds to about 98% of all CAP payments in Ireland.

When introducing the Single Payment Scheme (SPS), Member States had three main options for calculating the value of payment entitlements, either (i) on the basis of the payments received by the individual farmer during a reference period (historical model) resulting in different aid per hectare; (ii) taking all payments received in a region and divide them by the number of eligible hectares (regional model) resulting in a flat rate, or (iii) a mixture between these two models (hybrid model) that can be either static or dynamic (with the latter approximating both elements towards a flatter rate).

With the 2003 CAP reform, Ireland fully decoupled Irish direct payments using the historical model. This latter model possesses the ability to almost freeze the past distribution of support whereas a regional model shuffles it within a determined territory.

We assume that the distribution of decoupled payments – SFPs – received by each farm in 2007 approximates the distribution of coupled payments received in 2004, one year before the implementation of decoupling in 2005. This assumption is required to integrate in our database the bulk of SFP which are the highest share of domestic support in Ireland. Total subsidies to Irish agriculture amounted about 2 billion euros in 2007, with SFPs representing two third of these payments.

SFPs are calculated as the sum of the eligible payments that were linked to production in 2004 (2005 financial year) with the 2007 financial envelope (2008 financial year). Bovine support gathers previous suckler cow premium, special beef premium, slaughter premium, extensification premium, and cattle head premium. Other domestic support measures are the payments to cereals (common wheat, barley and other cereals) and to sheep and goats.

The 2003 CAP reform introduced a reduction in the intervention price of milk products, compensated by direct payments. In Ireland, the premiums have been decoupled from 2005; ahead of the scheduled implementation date of 2007. Table 6 shows the methodology used to estimate SFP amount which result from milk premium decoupling. Special attention has been devoted to the changes of support and additional payment as agreed in CAP legislation, and to the modulation rate of 5% applied in 2007. Interventions in agricultural markets for 2007 gather storage measures, operational funds for producer organisations, promotion measures, school milk support - included within raw milk support – and some coupled payments for protein and energy crops. Their amount is 10.62 million euros.

Table 6 Estimation SFPs granted to milk production in Ireland, 2007, million €

Item	2004	2007
Rate of support (EC regulation 1782/2003 – article 95) (€/t)	8.15	24.49
Milk premium (FEOGA 2005 FY – 05030110) (M€)	42.3	
SFP extrapolation from milk premium (M€)		127.2
Additional payment (EC regulation 1782/2003 – article 95) (M€)	19.20	57.76
Total milk SFPs (M€)		184.96
Total milk SFPs with modulation rate of 5%* (M€)		175.71

* Without considering any 5,000 euros franchise
Source: own elaboration

Export refunds amount to 16.54 million euros. By contrast, SFPs amount for 1,274.3 million euros. As a result, the share of subsidies over production varies significantly according to the activity. Bovine cattle appear as the most supported activity with subsidies representing about 100% of the value of production (Table 7).

Table 7 Share of subsidies over production in Ireland, 2007, %

Product	share	Product	share
Wheat	31.30	Fodder crops	30.46
Barley	35.06	Raw milk	14.98
Other cereals	33.11	Bovine cattle	99.72
Rape seed	5.35	Swine	6.39
Other oil plants	5.23	Raw milk sheep, goats	5.34
Other starch	9.82	Sheep and goats	32.32
Potatoes	5.46	Eggs	0.09
Vegetables, fruit	6.06	Poultry	0.00
Other crops	13.37	Other animals	0.00

* Without considering any 5,000 euros franchise
Source: own elaboration

On rural development support – i.e. second pillar of the CAP – we use data from Irish Department of Agriculture and Food. National and European subsidies are taken into account. Support to LFAs amounts to 253.83 million euros in 2007. It has been redistributed according to production type within LFAs as provided by Eurostat. Most of this area-based compensatory allowance scheme benefits fodder crops.

Rural Environment Protection Scheme (REPS) amounts to 311.75 million euros in 2007. This amount has been redistributed homogeneously to primary activities according to their production level. This assumption was necessary because of the lack of information on REPS distribution. The same distribution methodology has been used to distribute the installation aid for young farmers, which amounts to 5.79 million euros. Last, diseases eradication schemes where taken into account, with bovine cattle receiving 19.52 million euros; sheep and goats receiving 0.58 million euros. As a whole, our analysis considers a total support of 1,892.93 million euros which corresponds to about 98 % of all CAP payments in Ireland. Table 8 summarizes this breakdown.

Table 8: Breakdown of CAP payments by activity in Ireland, 2007, million €

	Export refunds	Coupled support	SFPs	LFA support	Environmental support (REPS)	Disease era-diction scheme	Aid for young farmers
Other wheat			37.76	1.60	7.78		0.14
Barley			75.03	3.21	13.19		0.23
Other cereals			12.14	0.44	2.31		0.04
Rape seed				0.00	0.20		0.00
Other oil plants				0.00	2.63		0.05
Other starch and protein plants		0.10		0.03	0.15		0.00
Potatoes				0.25	9.11		0.16
Other crops		0.20		0.07	8.98		0.16
Vegetables, fruit, and nuts		2.90			20.33		0.36
Fodder crops		0.10		25.33	45.74		0.80
Raw milk from bovine		5.40	179.13		95.46		1.67
Bovine cattle, slaughtered		0.00	866.98		47.07	19.52	0.82
Swine, slaughtered		0.10			24.73		0.43
Raw milk from sheep and goats					9.77		0.17
Sheep, goats, equines, slaughtered			103.25		19.24	0.58	0.34
Eggs							0.07
Poultry, slaughtered							0.28
Dairy products		1.50					
Other food products	7.84						
Vegetable oils and fats							
Dairy products	4.30						
Meat of bovine animals	2.80						
Meat of sheep, goats, and equines	1.60						
TOTAL	**16.54**	**10.62**	**1,274.3**	**253.83**	**311.75**	**20.10**	**5.79**

Source: own elaboration, data from EAGF/EAGGF, Irish Department of Agriculture and Food, and Eurostat

7. The regionalized agricultural sector

The activity "Agriculture, hunting and related service activities" has been disaggregated following the administrative division of Ireland at Nomenclature of territorial units for statistics (NUTS) 3 (which represent small regions), as represented in Figure 1. Seven agricultural activities have been individuated: Border (1), West (2), Midland (3), Dublin plus Mid-East (4+5), South-East (6), South-West (7) and Mid-West (8). Border, Midland and West are part of the Border, Midland and Western NUTS-2 Region while all other regions are part of the Southern and Eastern NUTS-2 Region.

Border, Midland and Western occupies a total area of 33,252.3 Km^2 (Eurostat, demo_r_d3area), in 2007 had a population of 1,166,500 and a GDP per capita in Purchasing Power Standard (PPS) per inhabitant of 25,300 € (Table 9). The Southern and Eastern region occupies an area of 36,544.83 Km^2 (Eurostat, demo_r_d3area), had a population 3,190,400 and GDP per capita (PPS per inhabitant) of 40,800 € (Table 9).

Table 9 Gross domestic product (GDP) at current market prices ad population by NUTS 3 regions, 2007

	GDP Millions of euro	GDP Euro per inhabitant	Euro per inhabitant in % of the EU average	GDP Millions of PPS	GDP PPS per inhabitant	PPS per inhabitant in % of the EU average	Population
Ireland	**188,729**	**43,200**	**173**	**159,902**	**36,600**	**146**	**4,312,526**
Border, Midland and Western (NUTS2)	**34,778**	**29,800**	**119**	**29,465**	**25,300**	**101**	**1,153,796**
Border (NUTS3)	14,374	29,700	119	12,179	25,200	101	478,334
Midland (NUTS3)	7,496	28,600	114	6,351	24,200	97	258,571
West (NUTS3)	12,907	30,600	123	10,936	26,000	104	416,891
Southern and Eastern (NUTS2)	**153,952**	**48,100**	**192**	**130,436**	**40,800**	**163**	**3,158,730**
Dublin (NUTS3)	75,032	61,300	245	63,571	51,900	208	1,202,865
Mid-East (NUTS3)	17,372	35,000	140	14,718	29,600	119	493,435
Mid-West (NUTS3)	13,768	37,600	150	11,665	31,900	127	362,604
South-East (NUTS3)	15,506	32,600	130	13,137	27,600	111	471,437
South-West (NUTS3)	32,274	50,700	203	27,344	42,900	172	628,389

Source: EUROSTAT, nama_r_e3gdp for GDP and demo_r_pjanaggr3 for population

Figure 1 Republic of Ireland, NUTS 3 regions

1 Border, 2 West, 3 Midlands, 4 Mid-East, 5 Dublin, 6 South-East, 7 South-West, 8 Mid-West

Ireland Agricultural Regional Statistics (Central Statistics Office) (2008b) are the source for the regional disaggregation of the national agricultural activity and commodity. Regional statistics provide data on regional production of different livestock, livestock products milk, others livestock products and crops in values (Table 10). For each region, subsidies on production, compensation of employees and operating surplus are provided. These data can enter directly the prior agricultural regionalized SAM. In addition, CSO provides value for intermediate consumption of agricultural activities in each region. A mapping between the CSO aggregation of intermediate inputs and the inputs provided by the SUT is necessary to insert these data into the SAM.

Table 10 Value for Output, Input and Income in Agriculture by Region, 2007, million €

	Dublin + Mid East	Border	Midland	West	Mid-West	South-East	South-West
Cattle	127.2	207	174.4	215.4	222	261.2	296.2
Pigs	14.8	86.1	40.8	10	17.3	58.2	64.9
Sheep	26.9	35.9	13.8	49.5	5.4	29.8	23.2
Other Livestock	54.1	111.2	21.1	45.4	52.9	75.8	40.9
Milk	137.7	171	121.8	82.3	238.4	362.8	553.4
Other Products	3	25.5	2.2	2.5	1.4	2.4	6.3
All Crops	310.8	248.9	150.7	183.1	138.3	337.3	263.1
Root Crops	46.1	27.4	1.3	1.2	2.3	14.3	11.3
Forage Plants	105.8	133	105.4	136.3	120.1	190.6	173.1
Vegetables	56	57.3	11.1	21.1	3.2	22.1	23
Fresh Fruit	5.7	1.5	1.8	0.6	0.5	20.8	2.1
Turf	1	4.3	5.7	15.3	3.4	0.4	2.8
Other Crops	32.7	3.9	2.9	5.3	1.5	3.5	12.9
Subsidies on Products	-3.4	-5.8	-3.9	-3.9	-5.2	-7.9	-10.4
Agricultural Output (Basic Prices)	725.6	923.6	547.3	616.4	695.3	1179.2	1284.8
Intermediate Consumption	459.3	705.5	459.1	508.9	487.1	777.6	825.3
Feeding stuffs	72.8	253.2	106.1	107	130.7	168.3	186.7
Fertilizers	38.8	44.1	38.8	40	40.7	75.5	82.2
Financial Intermediation Services	18	18.3	13.5	6.3	9.2	18.7	24
Seeds	37.2	11.4	6.6	9.1	4.9	16.7	19.9
Maintenance and Repairs	33.9	55.1	42.9	52.8	43.4	74.2	91
Other Goods	0	0	0	0	0	0	0
Services	0	0	0	0	0	0	0
Other Goods and Services	37	55	48.6	47.4	43.7	64.7	74.2
Crop Protection Products	11.7	4.9	6.1	2.6	3.2	14.6	7.8
Veterinary Expenses	18.5	31.1	22.7	34.5	27.6	41.5	49.7
Energy and Lubricants	33	58	43.8	43.1	41.1	56.3	72.6
Forage Plants	104	130.7	103.6	134	118	187.4	170.1
Contract Work	54.5	43.8	26.6	32.1	24.6	59.6	47.1
Gross Value Added (Basic Prices)	266.3	218.1	88.3	107.6	208.1	401.7	459.6

Subsidies on Production	-154	-302.1	-192.5	-338.7	-220.9	-312.3	-327.2
Compensation of Employees	112.7	81.9	28.7	32.8	34.8	81.9	75.8
Operating Surplus	198.3	321	165.3	360.1	331.1	508.7	562.4

Source: CSO, Agricultural regional Accounts

The SAM has been further extended by disaggregating the agricultural factor markets (land, labour and capital) within each region. With data from Agricultural Regional Statistics CSO (2008b), the area farmed (Table 11) in each region has been allocated to three different types of land (pasture, crops and rough grazing). Pasture is more than 80% of arable land at national and regional level. Nationally, crop land accounts for around 8%, with greater variability among regions (around 20% in Mid East and South-East, around 2% in West and Mid-West regions).

The average national price for different types of land is provided by Eurostat land prices and rents (land prices and rents - annual data (apri_ap_aland)). The price to rent a hectare of agricultural land for crop is reported to be 184.6€, while the value of renting a hectare of pasture o grazing crop is reported to be 60% lower at 73.84€.

The variation around the average price, to take into account differences among region are calculated from the Land Sales Survey (Ganly, 2010). According to this survey, prices in Mid East and South-East are higher than the average national price (1.5 and 1.2 time the average), in Midland, Mid-West and South-West prices are around 80% the national average, and in West region less than 70% of the average.

The combination of these three data sources provide us the possibility to calculate the volume and the value (volume time price) of land cultivated in 2007 in each Irish region (Table 12).

Table 11, Area Farmed in June by Region, type of Land Use, 2007, thousand hectares

	IRELAND	Dublin + Mid East	Border	Midland	West	Mid-West	South-East	South-West
Pasture	3441.7	302.1	547.5	374.2	626.5	477.9	524.5	589
Crops	379.4	93.3	37.4	34.8	11.9	15.6	122.3	64.1
Rough grazing	454.8	15.1	119.2	14.5	115.4	40.9	25.8	124.1

Source: CSO, Agricultural regional Accounts

Table 12, Value of Area Farmed in June by Region, Type of Land Use, 2007, million €

	IRELAND	Dublin + Mid East	Border	Midland	West	Mid-West	South-East	South-West
Pasture	254.14	34.95	37.26	23.91	31.62	29.43	50.14	36.28
Crops	28.01	26.99	6.36	5.56	1.50	2.40	29.23	9.87
Rough grazing	33.58	1.75	8.11	0.93	5.82	2.52	2.47	7.64

Source: Authors' elaboration

The labour market has been segmented into four labour types: farm holders, other family workers and regular non-family workers. The regular on famer workers have been further subdivided into two regions, following the NUTS2 subdivision. This segments the market into two regionalized markets, the model will then choose whether to allow migration between segments or not.

Data for labour market come from the 2007 Farm Structure Survey by the Central Statistics Office (2008a) (Table 13). This source contains information on the number of workers involved in agricultural divided by type of workers. Numbers of workers do not enter directly into the SAM which takes into account only values. Nevertheless, figure on physical quantities (in this case number of workers as well as hectares in the case of land) may be subsequently used in the model to calibrate differential in labour productivity of different type of workers in different regions.

To calculate the value to assign to family works in household, we calculate the average wage of regular workers in agricultural by diving the value of compensation of employees by number of regular workers. The literature, e.g. Elhorst (1994), highlights that implicit wages of on-farm family labour are significantly below off-farm wages. Therefore, we assume that value of family workers is 20% of the average wage rate.

Table 13 Family and regular non-family workers by region, 2007, thousands of persons

		IRELAND	Border	Midland	West	Dublin Mid East	Mid-West	South East	South West
Family workers	Total	227	43.7	21.3	52.7	16.9	26.3	28.1	38
	Holder	126.4	25.8	11.9	29.6	9.1	14.5	14.9	20.6
	Spouse	41.5	7.1	3.7	9.7	3	5	5.3	7.6
	Other family workers	59.1	10.8	5.7	13.4	4.8	6.8	7.9	9.8
Regular non-family workers		15.2	2.4	1.3	2.3	2.3	1.6	2.6	2.6
Total		242.3	46.1	22.6	55	19.2	28	30.7	40.6

Source: National Farm Survey Report 2007

In the agricultural activities, the original entry for gross operating surplus in now subdivided into six entries: three entries for value paid to land types, one entry for the value of worker of farm holders, one for value of other family workers and one for the value of capital. Once the values of land types and family workers are computed, the value of capital is calculated as a residual.

While the agricultural activity has been regionalized, the commodity "Products of agriculture, hunting and related services" has been disaggregated into eight main agricultural products: cattle, sheep, pigs, milk, other livestock products, cereals, forage and other crops. The supply table is constructed using total from agricultural activities (Table 14). The supply table gives the idea of multi-output agricultural farms. Given the amount of land available, farmers can utilize intermediate inputs, capital and labour to produce different mixes of outputs.

Table 14 Prior Agricultural Supply Table, 2007, million €

	Cattle	Sheep	Pigs	Milk	Other Livestock	Cereals	Foreage	Other Crops
Agriculture Dublin + Mid East	127.2	14.8	26.9	137.7	57.1	63.4	105.8	141.5
Agriculture Border	207	86.1	35.9	171	136.7	21.7	133	94.4
Agriculture Midland	174.4	40.8	13.8	121.8	23.3	22.5	105.4	22.8
Agriculture West	215.4	10	49.5	82.3	47.9	3.3	136.3	43.5
Agriculture Mid-West	222	17.3	5.4	238.4	54.3	7.3	120.1	10.9
Agriculture South-East	261.2	58.2	29.8	362.8	78.2	85.6	190.6	61.1
Agriculture South-West	296.2	64.9	23.2	553.4	47.2	38	173.1	52.1

Source: Authors' elaboration on CSO

The allocation of total imports and exports is performed with data from Eurostat trade statistics. The rest of final demand allocation (household consumption and stock variation) is performed with shares coming from the GTAP database version 8.1 for 2007 (Aguiar, McDougall, & Narayanan, 2012). The procedure to allocate intermediate consumption is twofold. Intermediate consumption of agricultural commodities by agricultural activities is allocated following data from Ireland Agricultural Regional Statistics, computing the share of cereal, forage and other crops used as intermediate consumption in each region. Intermediate consumption of agricultural commodities by non-agricultural activities is allocated as share of total agricultural production of the control total given by the original SUT.

The trade and transportation margins are allocated proportionally according to the final value of production of each commodity.

8. The household regionalization

To obtain a better distribution between primary factors and institutions, the representative households has been split into seven regional household, according the same regional subdivision at NUTS3 adopted for the agricultural activities. To achieve this goal we adopt a procedure which relies on share, whenever we lack raw data. Once the prior SAM is achieved with a single representative household, we disaggregate the households using both raw data and shares coming from the CSO (2007) database "Estimates of Household Income by County and Region, statistical indicator and Year", (Table 15).

Table 15 Estimates of Household Income by Region, 2007, million €, %

Share and million €	Midland	Border	West	Mid-East	Mid-West	South-East	South-West
Compensation of Employees	30,731	7,061	6,322	10,110	5,960	7,478	10,397
Current Taxes on Income	9,825	1,879	1,814	3,134	1,719	2,124	3,064
Net Interest and Dividends	38.51%	9.12%	8.42%	12.72%	7.72%	9.91%	13.60%
Social Benefits and Other Current Transfers	33.59%	11.78%	10.00%	9.40%	8.98%	11.50%	14.75%
Total Household Income	37.61%	9.57%	8.68%	12.16%	7.93%	10.23%	13.81%

Source: Authors' elaboration on CSO

Income from agricultural production factors (land, capital and labour) is already regionalized, so it has to be allocated to the corresponding regional households. Income from compensation of employees of non-agricultural sectors is disaggregated using data provided by CSO on compensation of employees by region in million. For capital we use the share of income, for transfer from financial and non-financial corporations the share of net interest and dividends, for transfers from the government the share of social benefits and other current transfers.

On the consumption side, the total household income shares are used to disaggregate consumption by commodities. The current taxes on income in million are to disaggregate the direct tax account while the savings are calculated as residuals.

9. Cross-Entropy and the final SAM

The final Ireland SAM contains 182 rows and columns: 61 commodities and 60 activities, 40 production factors, 7 tax instruments, 11 institutions, 2 savings-investments account and one account for trade and transportation margins.

The final balanced SAM has been estimated employing the cross-entropy (CE) methodology developed by Golan et al. (1994) and Robinson et al. (2011). This method allows creating a complete and consistent matrix, starting from the prior SAM built with the data reported above. The SAM estimation philosophy is Bayesian and iterative. It starts with all available information to estimate a new consistent and balanced SAM.

This version of cross entropy (CE) technique estimates the cells of a consistent SAM assuming that the initial data are inconsistent and measured with error. In this program, the CE minimand only includes probability weights for the various error support sets. The SAM coefficients are not treated as analogous to probabilities. The approach allows specification of a prior estimate of the standard error of: (1) cell entries, expressed either as values or column coefficients, (2) column sums, (3) various macro aggregates, and (4) macro aggregates from a standard macro-SAM aggregated from the micro-SAM, or from a user-defined aggregate SAM. The errors on cell entries can be specified as additive or multiplicative. Fixed constraints are achieved by setting standard errors to zero. The estimation procedure minimizes the cross-entropy measure of the distance between prior coefficients and the new estimated coefficients, given a choice of constraints imposed on the basis of prior knowledge.

In order to build a Sam which is as close as possible to the original Supply and Use table provided by Eurostat, the estimation procedure has been constrained to use macro control totals specified in a standard macro-SAM derived from Eurostat SUT. A standard error of zero, i.e. the corresponding macro control total is imposed exactly, with no error, is imposed for the sum of the regional agricultural activities that should be exactly equal to the initial value of the agricultural sectors provided by the SUT. The same holds for the aggregation of the eight agricultural commodities whose sum should be exactly equal to the value provided in the original SUT under the agricultural commodity.

In the final results the forage commodity has the biggest percentage change from the prior value, while other agricultural commodities are close to their original values. Within the agricultural activities, the final result highlight that better data on the disaggregation of the agricultural operating surplus into capital, land and family work would certainly improve the estimation procedure. On the other hand, all the non-agricultural commodities and activities remain almost unchanged compared to the prior SAM.

The final version macro SAM estimated by the CE procedure is provide in Table 16.

Table 16 – Ireland Macro SAM, 2007, billion €

	Comm odities	Margins	Acti vities	Value added	House holds	Enter prises	Govern ment	Savings	Rest of the World	Totals
Commodities		25.031	245.956		88.515		29.715	50.094	145.888	585.199
Margins	25.031									25.031
Activities	393.786									393.786
Value added		147.722								147.722
Households			103.592			4.381	5.189		0.023	113.186
Enterprises			40.636				3.584		-10.695	33.525
Government	21.681		0.108	2.731	17.272	6.728			-2.133	46.387
Investments					7.399	22.415	7.899		12.381	50.094
Rest of the World	144.701			0.762						145.463
Totals	585.199	25.031	393.786	147.722	113.186	33.525	46.387	50.094	145.463	

Source: Authors' elaboration

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