Conceptual Challenges for the Integration of Agricultural Sector and General Equilibrium Models: the databases of CAPRI and GTAP

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Abstract

When comparing recent projects on the integration of CAPRI and GTAP (Global Trade Analysis Project, Hertel 1997) modelling systems, broadly three conceptual approaches may be distinguished: First, the sequential implementation of scenarios, where one model`s outcome serves as input for subsequent model runs (Scenar2020, European Commission 2006) without paying systematic attention to mutual compatibility in overlapping result areas. Second, the systematic combined application such as developed within the SEAMLESS project (Jansson et al. 2009) or by Britz & Hertel 2009 and discussed in last two papers of the session. And third, the direct combination of CAPRI and economy-wide data from EuroStat to generate a database compatible with GTAP, but with a higher degree of detail for the agricultural sector (AgroSAM Project, Mueller et al 2009). The latter project revealed some profound structural deviations between CAPRI and GTAP databases, originating mainly from the underlying statistics. Among the most prominent deviations are the treatment of non-marketed outputs, the classification of agricultural and processed commodities, the relation between outputs and producing sectors, domestic price transformation processes, and the accounting for indirect taxes.

This paper summarizes the main findings from the AgroSAM project. It starts with a description of the CAPRI database and European "Economic Accounts for Agriculture" (EAA, EuroStat 1997), and the. The link to economy-wide Supply- and Use-Tables within the "European System of National Accounts" (ESA) is established by transforming the CAPRI data into agricultural accounting matrices in ESA format. This paper concludes with an outline of the implications of the transformations from original CAPRI data to GTAP-IOTs. It is argued that a clear understanding of the conceptual differences between the respective databases is a prerequisite for the integration of both modelling systems.

1 Integration of CAPRI and GTAP Modelling Systems

When comparing recent projects on the integration of CAPRI and GTAP (Global Trade Analysis Project, Hertel 1997) modelling systems, broadly three conceptual approaches may be distinguished: First, the sequential implementation of scenarios, where one model`s outcome serves as input for subsequent model runs (Scenar2020, European Commission 2006) without paying systematic attention to mutual compatibility in overlapping result areas. Second, the systematic combined application such as developed within the SEAMLESS project (Jansson et al. 2009) or by Britz & Hertel 2009 and discussed in last two papers of the session. And third, the direct combination of CAPRI and economy-wide data from EuroStat to generate a database compatible with GTAP, but with a higher degree of detail for the agricultural sector (AgroSAM Project, Mueller et al 2009). The latter project revealed some profound structural deviations between CAPRI and GTAP databases, originating mainly from the underlying statistics. However, integrated policy impact assessment at Pan-European or global scale requires consolidated databases to feed partial or general equilibrium models. A key data set for economic analysis are Social Accounting Matrices (SAM, see Pyatt and Round 1985) which represent the monetary flows between productive sectors and institutions and, thus, may serve a large variety of quantitative tools, especially Computable General Equilibrium (CGE) models. However, the datasets underlying the SAMs, namely national Supply- and Use Tables (SUT) or symmetric Input-Output tables (IOT), are typically highly aggregated by sectors and commodities and, thus, provide little detail for sub-sector specific analysis. The agricultural sector is e.g. often represented as one row and column only in the national datasets.

This coarse representation is one reason for the limited application of CGEs for analysis of the Common Agricultural Policy. The AgroSAM project hosted at the Institute for Prospective Technological Studies of the European Commission (IPTS) addressed this issue by combining national SUT for the EU Member States with the highly disaggregated information on the agricultural sector provided by the database of the "Common Agricultural Policy Regional Impact" modelling system (CAPRI) (Britz and Witzke, 2008). One of the main challenges for AgroSAM was overcoming definitional and structural differences between the SUT based on the European System of National Accounts (ESA95) and the CAPRI database which is mainly structured according to the Economic Accounts for Agriculture (EAA). As such, the AgroSAM project is one example for constructing large-scale data bases for impact assessment where different data sources are combined and consolidated.

The steps to compile, adjust, and balance the used datasets started with the compilation of macroeconomic indicators which served as control totals at the subsequent stages. Subsequently, SAMs were compiled according to the ESA95 classification scheme by re-arranging SUT and data on monetary flows between institutional sectors and balancing them based on and subject to the intermediate results from the previous step. These balanced SAMs are then used, together with detailed agricultural sector data from the CAPRI database, to compile a prior dataset, which was again balanced with a second cross-entropy procedure.

The structure of the final AgroSAMs was largely determined by the available data and the desired compatibility with the classifications used in prominent modelling systems, namely the "Global Trade Analysis Project" (GTAP)[1] and the "Common Agricultural Policy Regional Impact" (CAPRI)[2] models. The Complete and Consistent Database of CAPRI (COCO, see Britz and Witzke (2008)), which is shared also by the CAPSIM modelling system, distinguishes 50+ agricultural production activities and output commodities, 30+ agricultural inputs, and 20+ processed commodities. This representation of the agricultural sector determined the upper limit for the level of disaggregation in the target AgroSAMs, as more detailed datasets with the same country-coverage were not available for this study. Apart from this, the CAPRI database is constantly maintained and updated, and the underlying expert knowledge ensures the quality of the included information.

The dominant role of GTAP in the context of policy analyses on global scale suggests that a set of AgroSAMs for the EU27 Member States should be compatible with the GTAP classification scheme, such that the creation of datasets usable in the GTAP framework, namely symmetric IOT at basic prices, is possible without extensive additional work. Therefore, the GTAP classification scheme, which distinguishes 12 raw agricultural products and 8 processed food commodities, was set as the lower limit for the level of detail for the agricultural sector. This included the requirement that the target classification of the AgroSAMs can be mapped into the GTAP classification by simple summation (many-to-one mapping). As the latter requirement was not necessarily fulfilled by the standard classification schemes in which the underlying SUT were provided, a "Modified Agro-industrial Classification" (MAC) was formulated, which followed in general the commodity classification of the "Combined Nomenclature" (CN) and the "Commodities Produced by Activities" (CPA) used by EuroStat, but lies within the bounds given by CAPRI and GTAP.

2 CAPRI and the Economic Accounts for Agriculture (EAA)

The agricultural sector models CAPRI and CAPSIM are both based on a common database which was developed at the University of Bonn as the successor of the formerly used SPEL database. This database builds upon the meta-database of the NewCRONOS domain manager of EuroStat (sub-domains: ZPA1, COSA, PRAG). Although the raw data is processed to meet the demand for completeness and consistency (Britz and Witzke (2008)), it still follows the general accounting principles of the EAA. The differences in accounting create serious difficulties when attempting to combine the data with data in ESA95 format (e.g. SUT) as the distinction between an agricultural commodity and a processed commodity is not done in the same way. For instance, wine is considered as an agricultural commodity in EAA but as a processed output of the "beverage industry" in the ESA95 framework (EuroStat 1997). Furthermore, it is unclear how "feed cereals" should be mapped into the targeted AgroSAM format: either as non-marketed on-farm consumption or as demand of the agricultural sector for products of the "animal feed" industry, which in turn would demand cereals as intermediate input. The mapping of farm and market balances is also not straightforward. For instance, seed use, internal use and losses on farm are not considered in the ESA framework.

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[1] https://www.gtap.agecon.purdue.edu/

[2] URL: http://www.capri-model.org/

The main data sources for the construction of CAPRI are presented in the following Table 1.

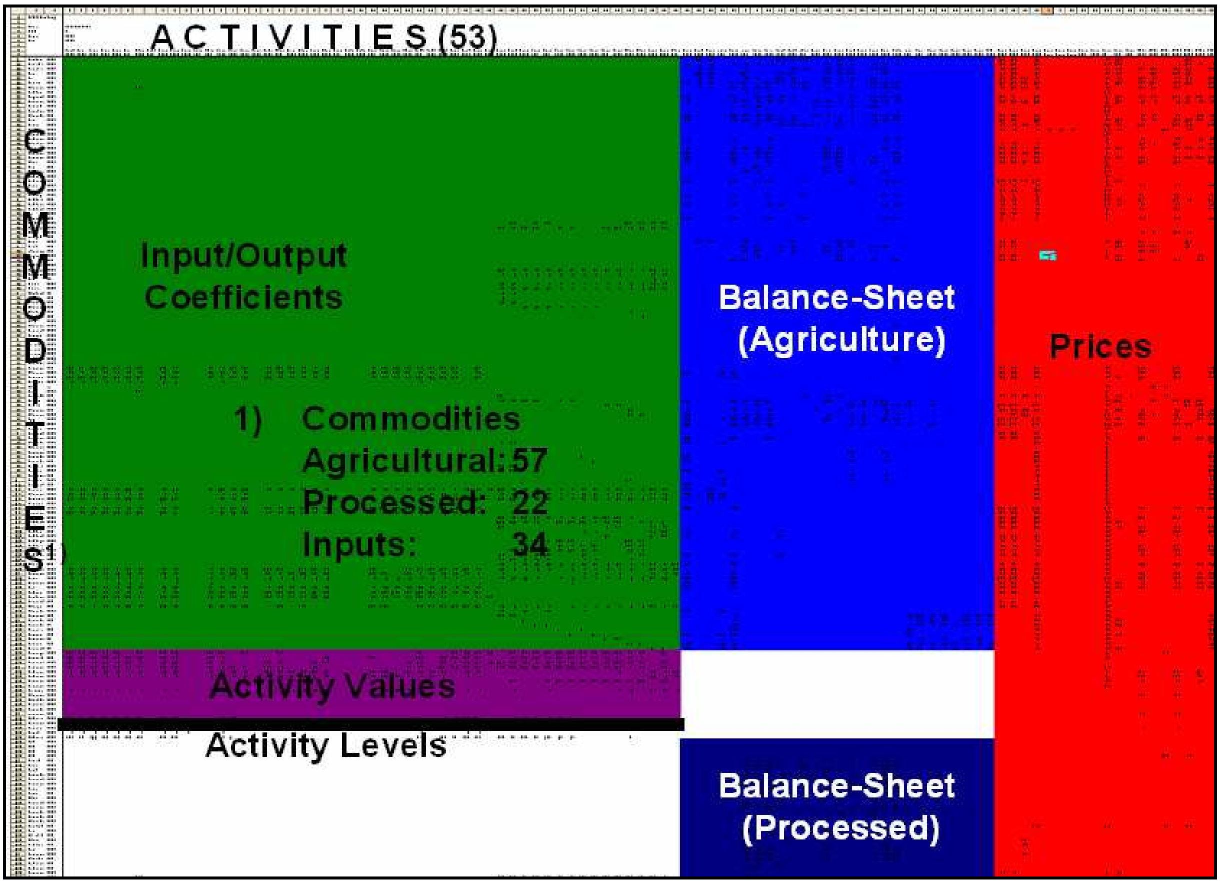
Table 1 Data items and their main sources in CAPRI

Data items	Source
Activity levels	Land use statistics, herd size statistics, slaughtering statistics, statistics on import and export of live animals
Production	Farm and market balance statistics, crop production statistics, slaughtering statistics, statistics on import and export of live animals
Farm and market balance positions	Farm and market balance statistics
Sectoral revenues and costs	Economic Accounts for Agriculture (EAA)
Prices	Derived from production and EAA
Output coefficients	Derived from production and activity levels, engineering knowledge
Input coefficients	Different types of estimators, engineering functions
Activity specific income indicators	Derived from input and output coefficients and prices
Policy data	Various sources (Official Journal of the EU)

Source: EuroStat (http://epp.eurostat.cec.eu.int), several bio-physical econometric studies and European Commission (http://publications.eu.int/general/oj_en.html).

For the purposes of the AgroSAM project, the CAPRI database was also too detailed and included several elements which are conceptually challenging with respect to their transformation into a SAM format (e.g. data on manure production/use, fertilizer consumption, set-aside, milk quotas, as well as activity and commodity premiums). This has to do with the fact that (1) CAPRI does not strictly follow the "activity from/to commodity" accounting structure of ESA95 and (2) does not include other sectors of the economy (e.g. processing of agricultural products like dairies are presented as end-of-pipe products, with no corresponding industrial activities to pay for). However, the CAPRI database includes algorithms for data consistency and completeness, which are key issues for future versions of the AgroSAM project (see Britz and Witzke (2008), pp.15-30).

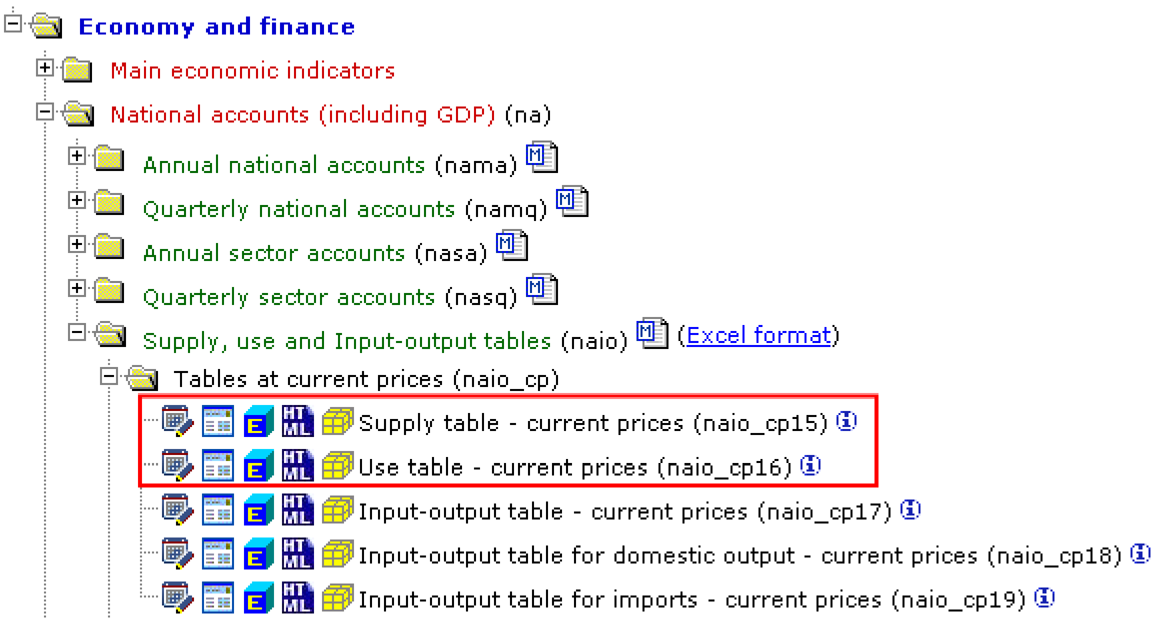
Figure 1 Structure of the CAPRI Database



3 GTAP, Input-Output Tables, and the European System of National Accounts (ESA)

A fundamental question for the construction of social accounting matrices is whether they should be based on SUT or symmetric IOT. Although IOT are often preferred for the compilation of SAMs, and the GTAP database is no exception, they do not provide the same amount of information as SUT, particularly as they do not anymore include information on multi-commodity technologies. The CAPRI database does feature multi-commodity technologies, and it therefore seemed appropriate to start out with an SUT framework to integrate the CAPRI database. SUT are provided by EuroStat in the so-called NAIO domain (National Accounts – Input-Output tables) as shown in the screenshot of Figure 2.

Figure 2 Supply, Use and Input-output Tables: NAIO



Source: Screenshot from EuroStat homepage: URL:
http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136173,0_45570701&_dad=portal&_schema=PORTAL

Among the first steps during the construction of the AgroSAM database was the compilation of a comprehensive set of SAMs according to the ESA95 classification used by EuroStat. These SAMs distinguish 59 productive sectors and commodities and will be noted as ESASAM in the following. The stylized structure of the ESASAM is mainly shaped by the structure of the main input datasets, namely the SUT (NAIO datasets).

Table 2 Target Structure of SAMs and Correspondence to NAIO datasets

		NACE3	CPA3	FCTR	TRD	TNF	DIN	ROW	SIA	
Activities	**NACE3**		**p1**							REVENUES
Commodities	**CPA3**	**p2**			**p118_r**		**p3**	**p6**	**p5**	
Primary factors	**FCTR**	**d1**								
Trade and transport margins	**TRD**		**p118_p**							
Direct and indirect taxes, transfers	**TNF**	**d29_m_d39**	**d211, d212, d214, d31**	**Taxes and transfers**						
Domestic institutions	**DIN**									
Rest of the world	**ROW**		**p7**							
Saving-Investment account	**SIA**									
		EXPENDITURES								

Domestic intermediate demand and domestic production by activity were computed as:

(1) $$\begin{aligned} ESASAM_{C,A} &= naio\_cp16_{CPA3,NACE3} \\ ESASAM_{A,C} &= naio\_cp15_{CPA3,NACE3} \end{aligned}$$

Where:

ESASAM:	SAM based on ESA data
naio_cp16:	ESA95 use table in current prices
naio_cp15:	ESA95 supply table
CPA3:	CPA commodity accounts (at 3-digit level)
NACE3:	NACE activity accounts (at 3-digit level)
C:	ESASAM commodity account (corresponds with CPA3)
A:	ESASAM activity account (corresponds with NACE3)

Payments of domestic activities to primary factors are provided by the use tables, from which only "compensation of employees" (d1 in ESA notation) and "operating surplus, gross" (b2g_b3g) are used for the ESASAMs. "Consumption of fixed capital" (k1) and "net operating surplus" (b2n_b3n) are not distinguished at this stage, mainly due to the limited information available for the disaggregated agricultural sub-sectors.

(2) $$ESASAM_{FCTR,NACE3} = naio\_cp16_{FCTR,NACE3}$$

Where:

FCTR:	Index for primary factors:
d1	Compensation of employees
b2g_b3g	Operating surplus, gross

Taxes and subsidies on production are only available as net-values in NAIO:

(3) $$ESASAM_{\text{"T\_d29\_m\_d39"},NACE3} = naio\_cp16_{\text{"d29\_m\_d39"},NACE3}$$

Where:

T_d29_m_d39:	Other net taxes on production (in ESASAM format)
d29_m_d39:	Other net taxes on production (in SUT format)

Trade margins on commodities are computed in a similar manner, while taxes on commodities are taken from the estimation outlined in section **Fehler! Verweisquelle konnte nicht gefunden werden.**.

(4) $$\begin{aligned} ESASAM_{\text{"T\_p118"},C} &= naio\_cp15_{CPA3,\text{"p118"}} \\ ESASAM_{\text{"T\_d21\_m\_d31"},C} &= naio\_cp15_{CPA3,\text{"d21\_m\_d31"}} \end{aligned}$$

Where:

p118:	Trade and transport margins (in ESA format)
d21_m_d31:	Taxes less subsidies on products (in ESA format)
T_p118:	Trade and transport margins (in ESASAM format)
T_d21_m_d31:	Taxes less subsidies on products (in ESASAM format)

Imports and exports in NAIO were distinguished by the direction of trade to and from either MS or third countries. This distinction is maintained here, as it can serve as a benchmark for the trade-balances at a later stage.

$$(5)\quad \begin{aligned} ESASAM_{XINS,C} &= naio\_cp15_{CPA3,XINS} \\ ESASAM_{C,XINS} &= naio\_cp16_{CPA3,XINS} \end{aligned}$$

Where:

M:	Imports
E:	Exports
XINS:	Index for external institutions (trade partners):
I_s21	European Union
I_s22	Third countries and international organisations
I_s2	Rest of the world

Domestic demand for commodities was derived similarly:

$$(6)\quad ESASAM_{C,DINS} = naio\_cp16_{CPA3,DINS}$$

Where:

DINS:	Index for domestic institutions (in ESASAM format):
I_s11_s12:	Financial and non-financial corporations
I_s13:	General government
I_s14_s15:	Households
I_s15:	Non-profit institutions serving households
I_s14_S15:	Households; non-profit institutions serving households
I_p51:	Gross fixed capital formation
I_p52_p53:	Changes in inventories
I_p5:	Gross capital formation

With the computation of domestic consumption, the accounts for activities and commodities are closed. It remains to derive the monetary flows between institutions, like taxes, transfer payments, distribution of factor incomes, and so on, which is described in detail in Mueller et al (2009).

4 Combining ESA and CAPRI Datasets

The objective of estimating a reliable, balanced social accounting matrix with disaggregated agricultural and food industry sectors depends largely on the reliability of the a priori information drawn from the various sources. The compilation of the prior SAM should hence be carried out in a careful and transparent manner. Particularly challenging is to perform in a transparent way the necessary re-arrangement of entries in the parent datasets, in order to achieve the required compatibility of formats and contents. GAMS code was developed and adjusted whenever new challenges occurred in the process of including more countries, years or datasets. In general, a four-step procedure was followed:

1. Re-arrange the CAPRI data into the SAM format (agricultural accounting matrix AAM)
2. Merge ESASAM and AAM into an unbalanced PriorSAM
3. Balance activity and commodity account totals
4. Balance the PriorSAM

Table 3 provides an overview on the sources used to obtain a priori information for the AgroSAM. Since the food-industry sector is not covered exhaustively either in ESA or in CAPRI[3], here it is necessary to incorporate other sources of information as well, like the database on Products of the European Community (PRODCOM).

Table 3 Sources of prior information for the Agricultural and Food processing Industries in the AgroSAMs

Description	Code	Preferred source	Second best source
Domestic output by sectors	**D**	CAPRI	EAA/AGRI_IS/PRODCOM
Intermediate demand	**I**	CAPRI	Qualitative Prior/Estimate
Domestic final consumption	**C**	CAPRI	EAA/AGRI_IS
Exports	**E**	CAPRI	EAA/AGRI_IS/TRADEX
Domestic factor payments (value added)	**Fd**	ESA/CAPRI	
Factor revenues from abroad	**Fe**	ESA	
Trade margins	**H**	ESA	
Taxes and subsidies on production	**Ta**	CAPRI	Estimate
Taxes and subsidies on products	**Tc**	ESA	Estimate
Direct taxes paid by institutions	**Ti**	ESA	
Distribution of factor income across institutions	**F**	ESA	
Distribution of taxes and transfers across institutions	**T**	ESA	
Imports	**M**	CAPRI	EAA/AGR_IS/TRADEX
Savings of institutions	**S**	ESA	
Total domestic production value	**VX**	CAPRI/ESA	AGR_IS
Total domestic absorption	**VQ**	CAPRI/ESA	AGR_IS

The CAPRI database builds upon the meta-database of the NewCRONOS domain manager of EUROSTAT (sub-domains: ZPA1, COSA, PRAG). Although the raw data is processed to meet the demand for completeness and consistency (Britz and Witzke (2008)), it still follows the general accounting principles of the EAA. This "data massaging" property creates serious difficulties when attempting to combine the data with data in ESA95 format (e.g. SUT) as the distinction between an agricultural commodity and a processed commodity is not done in the same way. For instance, wine is considered as an agricultural commodity in EAA but as a processed output of the "beverage industry" in the ESA95 framework (EuroStat 1997). Furthermore, it is unclear how "feed cereals" should be mapped into the AgroSAM format: either as non-marketed on-farm consumption or as demand of the agricultural sector for products of the "animal feed" industry, which in turn would demand cereals as intermediate

[3] This might change in the near future, since the CAPRI Model is currently improving processing functions for dairies, oilseeds and biofuels in its market module, information which will most likely be fed into the base year database and used in the construction of a future PriorSAM.

input. The mapping of farm and market balances is also not straightforward. For instance, seed use, internal use and losses on farm are not considered in the ESA framework.

The first step in utilizing the CAPRI dataset was to transform it into an agricultural accounting matrix (AAM) to facilitate the mapping of CAPRI and MAC accounts at a later stage. The AAM distinguishes strictly between activity and commodity accounts and agricultural, processing, and other industrial activities. As a consequence, it was necessary to introduce activity accounts not included in the CAPRI database. The commodity 'beef' for instance is produced by the cattle sectors, which is not consistent with the concept of the ESA accounts. In there, the transformation of live cattle into beef ready for human consumption or further processing is an activity within the food and beverage industry complex (ESA code da15) rather than belonging to agriculture. The same applies for pork, poultry meat, and wine.

An important feature in this context is that basically two agricultural accounting matrices were created: One in value terms (AAMV) and one in quantity terms (AAMQ). AAMQ is basically a balance sheet for CAPRI commodities, arranged in SAM format, but with empty accounts for activity expenditures and consequently only with balanced commodity accounts. AAMV is the corresponding matrix with filled activity accounts and quantities on the commodity markets measured at basic prices obtained from CAPRI (Unit Value at Basic Prices, UVAB). This treatment of the available data allows controlling the estimates for prices and quantities at a later stage and prevents the creation of un-plausible values, which can occur when using only value-data for the SAM estimation. An outline of the operations to obtain the AAM from the CAPRI dataset is also displayed in Table 4.

Table 4 Summary of operations from CAPRI Database to AAM

			Activities		Σ	Commodities		Σ	Institutions				
			A_AGR	A_NAG					I_GVT	I_HHD	I_STC	I_FCF	I_RoW
Activities	Agriculture	A_AGR	$\sum_C[LOSF_C - SEDF_C - INTF_C] \cdot ASHR_{C,A}$			$LEVL_A \cdot IO_{A,C} - LOSF_C - SEDF_C - INTF_C$		$LEVL_A$ $TOOU_A$					
	Non-agriculture	A_NAG					$MAPR_C \cdot ASHR_{C,A}$	.					
	Total	Σ				$NETF_C$, MAPR							
Commodities	Agriculture	C_AGR	$LEVL_A \cdot IO_{C,A}$,	$NETF_C$ / $ASHR_{C,A}$	$INDM_C + PRCM_C + FEDM_C + SEDM_C$					$HCOM_C$	$STCM_C$		$EXPT_C$
	Non-agriculture (including processed commodities)	C_NAG	$LEVL_A \cdot IO_{C,A}$										
	Total	Σ	$LEVL_A \cdot TOIN_A$										
Factors	Labour	F_LAB	$LEVL_A \cdot WAGE_A$										
	Capital	F_CAP											
	Total	Σ	$LEVL_A * GVAP_A$										
	Trade	T_TRD				$-LOSM_C – SADM_C$							
	Taxes	T_TAX	$LEVL_A * PRME_A$										
…	…	…											
	Rest of the	I_RoW				$IMPT_C$							
		Total	$LEVL_A * TOOU_A$										

4.1 Activity Accounts of the Agricultural Sector

For the agricultural sector, the procedure of re-arranging the CAPRI data is in general straightforward. In the following, the CAPRI notation is used whenever possible to allow the comparison of the computations with the CAPRI documentation (Britz and Witzke (2008)). Starting with the activity accounts, the first step is the derivation of an aggregate output value of each agricultural activity:

$$(7)\quad AAMV_{'Total',A} = ALV_A = TOOU_A \cdot LEVL_A \qquad \forall A \in Agriculture$$

Where:

AAMV:	Agricultural accounting matrix in value terms based on CAPRI data
ALV:	Total value of activity level
TOOU:	Total output value per activity level at producer prices (CAPRI)
LEVL:	Activity level (CAPRI)
A:	Index for activities (here only agriculture)

Taxes paid (or received as negative taxes i.e. subsidies) by each activity equal the CAP premiums per activity as indicated by CAPRI times the activity level:

$$(8)\quad AAMV_{'T\_PRME',A} = TXA_A = -PRME_A \cdot LEVL_A \qquad \forall A \in Agriculture$$

Where:

TXA:	Value of tax or subsidy received or paid by activity
PRME:	CAP premium effectively paid (CAPRI)

The rate for activity-related taxes is here computed as the share of taxes paid (or subsidies received) in the total output value of the activities, $ta_A = \dfrac{TXA_A}{ALV_A} \qquad \forall A \in Agriculture$.

Value added at basic prices can also be taken directly from CAPRI:

$$(9)\quad \sum_F AAMV_{F,A} = VAD_A = GVAB_A \cdot LEVL_A \qquad \forall A \in Agriculture$$

Where:

VAD:	Value-added per activity
GVAB:	Gross value-added per activity level at basic prices (CAPRI)
F:	Fixed factors (here: labour and capital)

A wage indicator is also provided in the CAPRI database, but the exact unit in which they are measured is not explained in the documentation (Britz and Witzke 2008). Furthermore, it is not clear whether this information was processed by the consistency algorithm of CAPRI. However, in the absence of other data, WAGE was used as an instrument for the distribution of the corresponding entry in the ESASAM.

$$(10)\quad AAMV_{'F\_LAB',A} = LAB_A = \frac{WAGE_A \cdot LEVL_A}{\sum_A WAGE_A \cdot LEVL_A} \cdot LAB^{ESA}_{Agriculture} \qquad \forall A \in Agriculture$$

Aggregate input demand from agricultural activities is expressed as input demand per unit of activity level times the activity level.

(11) $$\sum_{C} AAMV_{C,A} = IDA_{A} = TOIN_{A} \cdot LEVL_{A} \qquad \forall A \in Agriculture$$

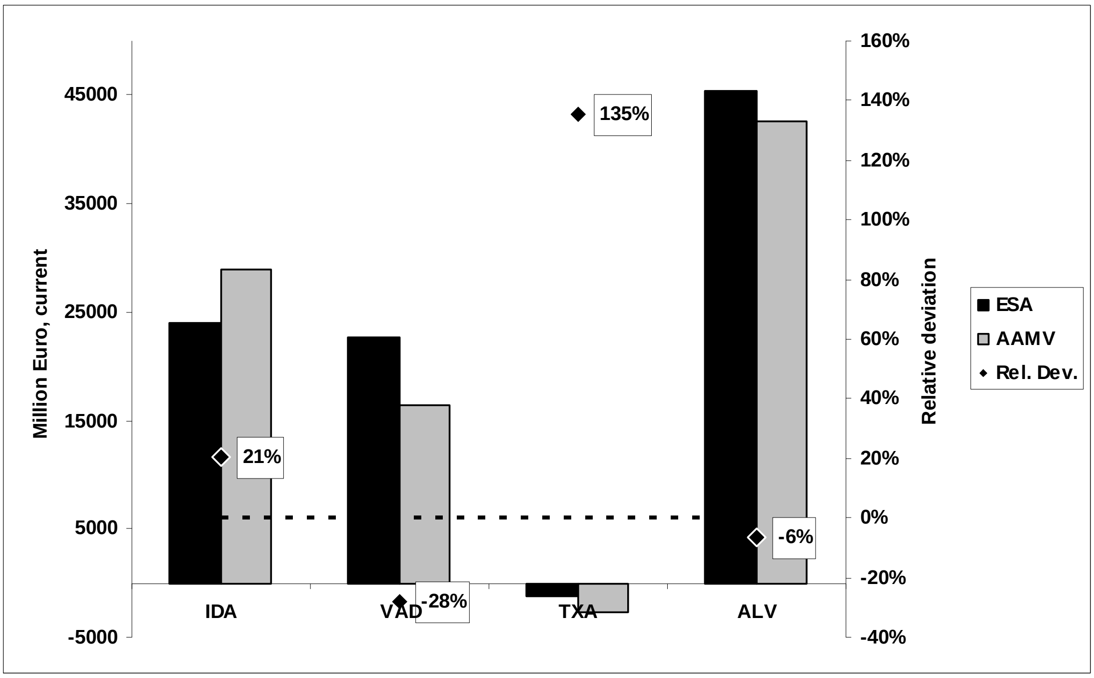
Where: IDA Vector of aggregate input demand per activity (in million Euros)
TOIN Total intermediate input at producer prices (CAPRI)

The results for the agricultural sector are displayed against the corresponding ESA totals in Figure 3. It appears that intermediate demand of the agricultural sector as obtained from the CAPRI database is 21% larger than the corresponding figure from the ESA accounts. The reason behind this could be that CAPRI provides values also for non-marketed inputs like pastures and manure. The higher total output value indicated by ESA may originate in the fact that agricultural output encompasses a wider range of products as are considered by CAPRI. Taxes on activities ("Other net taxes on production", d29_m_d39, in ESA notation) indicated by ESA are considerably lower (in absolute terms) than the aggregate CAP Premiums from CAPRI. Again, the reason for this observation is not clear, since details on the composition of the figures in question are not provided by either source. It seems anyway that some components of the CAP Premiums are booked as direct subsidies to agricultural holdings in the ESA framework rather than as activity-related payments in the CAPRI database.

Although the two databases present substantial differences in the definition and coverage of featured items, without clear information on the exact nature of those deviations, a multitude of components of the CAPRI database can be considered as reliable information (e.g. produced and trade quantities of agricultural and some processed commodities, activity levels, output- and input-coefficients, and basic prices). Both databases can be harmonized by incorporating the qualitative information about the potential sources of the deviations in the finally chosen estimation method.

Having derived IDA, VAD, TXA, and ALV, the minimum necessary set of items in the activity accounts was obtained to connect it to the corresponding commodity accounts.

Figure 3 Comparison between ESA and AAMV totals, Agricultural Sector, Germany 2000, in Million Euro, current



Source: EuroStat, CAPRI, own calculations

4.2 Commodity Accounts

The CAPRI database provides information on quantities of produced and trade commodities as well as the related prices. This information is deemed to be of significant use for the final estimation of the monetary flows within the target AgroSAMs, since the usage of quantities and plausible bounds on price estimates can be used to curb the possible variation of the final estimate and hence avoid severely distorted results.

Starting point is the transformation of the quantity-related data of the CAPRI database into SAM format, which will be called AAMQ (Agricultural Accounting Matrix in quantity terms) in the following. Again, CAPRI notation is used whenever possible to allow the comparison of the computations with the CAPRI documentation (Britz and Witzke 2008).

Domestic marketed production quantities QX are computed by:

(12) $$\sum_A AAMQ_{A,C} = QX_C = \begin{cases} NETF_C & \forall C \in Agriculture \\ MAPR_C & \forall C \in FoodIndustry \end{cases}$$

Where:

AAMQ	Agricultural accounting matrix in quantity terms based on CAPRI data
QX	Domestic marketed production (quantities)
NETF	Net trade on farm **(CAPRI)**
MAPR	Marketed production **(CAPRI)**
C:	Index for commodities

Imports and exports are derived in a similar way:

(13)
$$AAMQ_{C,'ROW'} = QE_C = EXPT_C \;\; \forall C \in Agriculture, FoodIndustry$$
$$AAMQ_{'ROW',C} = QM_C = IMPT_C \;\; \forall C \in Agriculture, FoodIndustry$$

Where:

QE	Exports of commodities (quantities)
QM	Imports of commodities (quantities)
EXPT	Exports total **(CAPRI)**
IMPT	Imports total **(CAPRI)**

Total domestic supply QDS is composed of domestic production QX plus imports QM minus exports QE. On the demand side, the items IDC (domestic intermediate demand for commodities; note the difference to IDA which is the intermediate demand for commodities by activities), GVT (governmental consumption), H (final consumption by households), STC (stock changes), FCF (fixed capital formation), and LOS (losses on markets) can only partially be derived from the CAPRI. So is investment demand for agricultural commodities treated as "on-farm usage" of investment commodities like young animals and live plants (e.g. trees for orchards), but not as consumption on markets. Domestic demand in the AAMQ as derived from CAPRI data is consequently represented by the following entries:

(14)
$$QDD_C = QX_C + QM_C - QE_C = QIDC_C + QH_C + QSTC_C + QLOS_C$$
$$\forall C \in Agriculture, Foodindustry$$

With the following correspondence to CAPRI data:

Intermediate consumption:

(15) $$\sum_A AAMQ_{C,A} = QIDC_C = INDM_C \; + \; PRCM_C \; + \; FEDM_C \; + \; SEDM_C$$

Household consumption:

(16) $$AAMQ_{C,'I\_HHLD'} = QH_C = HCOM_C$$

Stock changes:

(17) $$AAMQ_{C,'I\_STCH'} = QSTC_C = STCM_C$$

Losses:

(18) $$AAMQ_{C,'T\_TRD'} = QLOS_C = LOSM_C + SADM_C$$

Where:

QDD	Domestic absorption
QIDC	Intermediate demand per commodity
QH	Household final consumption per commodity
QSTC	Stock changes
QLOS	Losses on markets
INDM	Industrial use market (CAPRI)
PRCM	Processing to derived products market (CAPRI)
FEDM	Feed use on market (CAPRI)

SEDM	Seed use on market (CAPRI)
HCOM	Human consumption market (CAPRI)
STCM	Stock changes on market (CAPRI)
LOSM	Losses on market (CAPRI)
SADM	Statistical adjustment on market (CAPRI)

Losses on markets are here booked in the account for transaction costs and will serve at a later stage as proxy for the estimation of commodity-specific trade margins in the AgroSAM.

4.3 Input and Output Matrices

Accounts for activities and commodities are linked via two sub-matrices, the intermediate input use and the output-by-activity tables (fields I and D, respectively, in **Fehler! Verweisquelle konnte nicht gefunden werden.**). CAPRI provides information about the intermediate demand of the agricultural sector in value terms (e.g. pharmaceutical inputs or energy in constant 1995 Euro/ha) and in quantity terms (fertilizer in kg/ha), while outputs (or yields) of each agricultural activity are recorded as quantities (kg/ha).
The sub-matrix for domestic output can be therefore fully derived by multiplying the output coefficient with the activity levels:

(19) $$AAMQ_{A,C} = QD_{A,C} = OUTP_{C,A} \cdot LEVL_A$$

Where:

QD	Domestic production quantity by activity
OUTP	Output coefficient (CAPRI)

The input matrix on the other hand has two representations:

(20) $$\begin{aligned} AAMQ_{C,A} &= QI_{C,A} = INPT_{C,A} \cdot LEVL_A \;\; \forall INPT_{C,A} \text{ measured in quantities} \\ AAMV_{C,A} &= VI_{C,A} = INPT_{C,A} \cdot LEVL_A \;\; \forall INPT_{C,A} \text{ measured in values} \end{aligned}$$

Where:

QI	Domestic intermediate demand quantity by activity
VI	Domestic intermediate demand value by activity
INPT	Input coefficient

4.4 Splitting Agriculture and Food Industry

One of the main challenges when attempting to harmonize the CAPRI database with the SUT in ESA format is the fundamental difference in the treatment of processed agricultural commodities. These are part of the agricultural sector in the EAA (and consequently CAPRI) framework, but belong to the food processing industries in the ESA framework.
For this reason, a new set of auxiliary activities was introduced in the SAM while processing the CAPRI data. These correspond with the agricultural outputs in CAPRI considered as processed commodities in the AgroSAM framework, particularly beef, pork, sheep and goat meat, and wine. The domestically produced quantities are here mapped to the corresponding industrial activities:

(21) $$AAMQ_{A,C} = QD_{A,C} = QX_C \cdot PRCOUT_{A,C} \qquad \forall A,C \in FoodIndustry$$

Where:

PRCOUT Binary aggregator matrix (1 if activity A produces commodity C, else 0)

Since these products are not anymore considered as outputs of the agricultural sector, the corresponding entries under agricultural activities have to be set to 0:

(22) $$AAMQ_{A,C} = QD_{A,C} = 0 \qquad \forall A \in Agriculture, C \in FoodIndustry$$

A similar approach is chosen for the input demand. The new activity "beef meat" (A_BEEF) demands slaughtered animals from the agricultural sector, the activity "Rice milled" demands paddy rice, and so on:

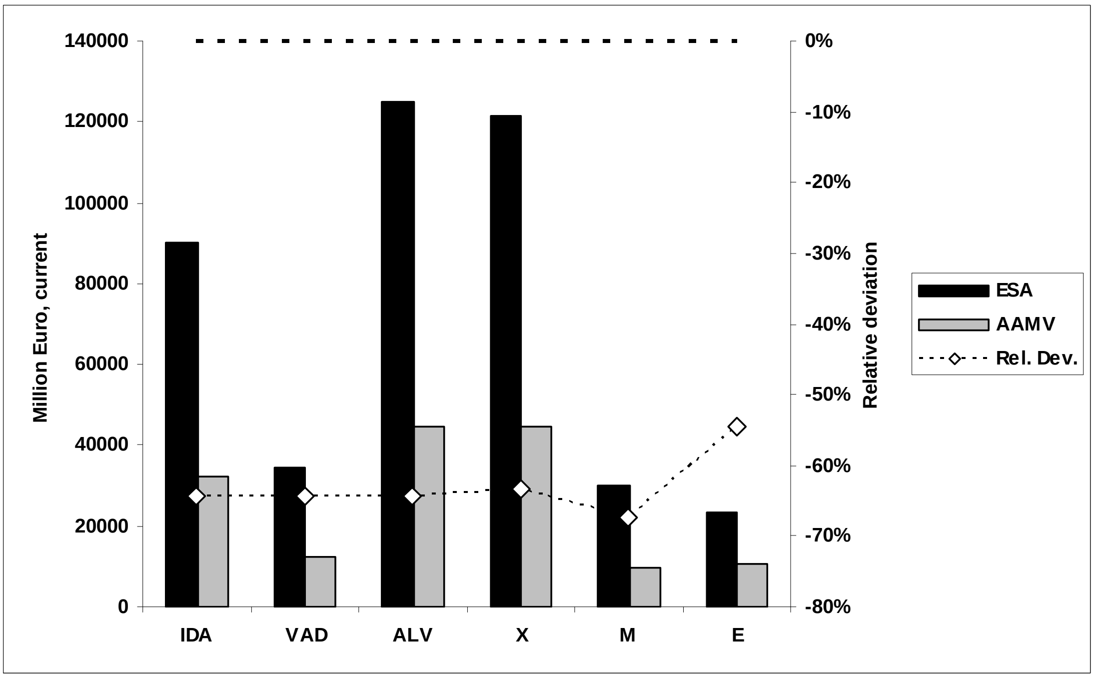
(23) $$AAMQ_{C,A} = QI_{C,A} = QX_C \cdot PRCINP_{C,A} \qquad \forall A \in FoodIndustry, C \in Agriculture$$

Where:

PRCINP Binary aggregator matrix (1 if activity A demands commodity C, else 0)

The thus derived values are compared with the ESA totals in Figure 4. It appears that, in contrast to the agricultural sector, the food industry sector is only represented to a limited extent in the CAPRI database and consequently in the agricultural accounting matrix. This issue will be addressed when compiling a prior SAM in section **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Figure 4 Comparison between ESA and AAMV totals, Food Industry Sector, Germany 2000, in Million Euro, current



Source: EuroStat, CAPRI, own calculations

Table 5 New activities and corresponding CAPRI commodities

CAPRI Commodities	Code	New processing activities	
Rice milled	C_RICE	A_RICE	Rice milled
Molasse	C_MOLA	A_SUGA	Processed sugar
Starch	C_STAR	A_STAR	Starch
Processed sugar	C_SUGA	A_SUGA	Processed sugar
Rape seed oil	C_RAPO	A_RAPO	Rape seed oil
Sunflower seed oil	C_SUNO	A_SUNO	Sunflower seed oil
Soya oil	C_SOYO	A_SOYO	Soya oil
Olive oil	C_OLIO	A_OLIO	Olive oil
Other oil	C_OTHO	A_OTHO	Other oil
Rape seed cake	C_RAPC	A_RAPO	Rape seed oil
Sunflowe seed cake	C_SUNC	A_SUNO	Sunflower seed oil
Soya cake	C_SOYC	A_SOYO	Soya oil
Olive cake	C_OLIC	A_OLIO	Olive oil
Other cake	C_OTHC	A_OTHO	Other oil
Raw milk at dairy	C_MILK	A_MILK	Raw milk at dairy
Butter	C_BUTT	A_MILK	Raw milk at dairy
Skimmed milk powder	C_SMIP	A_MILK	Raw milk at dairy
Cheese	C_CHES	A_MILK	Raw milk at dairy
Fresh milk products	C_FRMI	A_MILK	Raw milk at dairy
Cream	C_CREM	A_MILK	Raw milk at dairy
Concentrated milk	C_COCM	A_MILK	Raw milk at dairy
Whole milk powder	C_WMIP	A_MILK	Raw milk at dairy
Beef meat	C_BEEF	A_BEEF	Beef meat
Pork meat	C_PORK	A_PORK	Pork meat
Sheep and goat meat	C_SGMT	A_SGMT	Sheep and goat meat
Poultry meat	C_POUM	A_POUM	Poultry meat
Fodder rich protein	C_FPRO	A_ANFD	Animal feed
Fodder rich energy	C_FENE	A_ANFD	Animal feed
Fodder other	C_FOTH	A_ANFD	Animal feed

4.5 Prices and Values

The ESA95 SUT distinguishes between basic prices and purchaser's prices. However, as the CAPRI data do not provide a conversion from basic prices to purchaser's prices (as done in ESA SUT with vectors for trade margins (p118) and net-taxes on commodities (d21_m_d39), only unit values at basic prices (UVAB) were used at this stage to determine starting values for domestic, import, and export prices. In case they were not available from CAPRI for certain processed commodities (e.g. oilcakes or molasses), it was necessary to rely on other sources, among which FAOSTAT appeared to be the most appropriate for the commodity groups distinguished in CAPRI. It should be emphasized at this stage that the prices entering the following computations are best first guesses, which will be altered in the subsequent balancing steps.

The starting values for basic prices are:

$$(24) \qquad PB_C = \begin{cases} UVAB_C \;\; \forall C \in \; Agriculture, FoodIndustry \\ FAOPRIC_C \;\; if \;\; not \;\; UVAB_C \end{cases}$$

Where:

PB	Starting values for basic commodity prices
UVAB	Unit value at basic prices (CAPRI)
FAOPRIC	Prices for processed commodities from FAOSTAT

With this price vector at hand, it is now possible to connect the two agricultural accounting matrices into a common format (AAM):

(25) $$AAM_{AC,AC'} = \begin{cases} AAMV_{AC,AC'} \ if \ AAMV_{AC,AC'} \\ AAMQ_{AC,AC'} \cdot PB_{AC} \ if \ not \ AAMV_{AC,AC'} \end{cases}$$

Where:

AAM	Agricultural accounting matrix in basic prices

The next step is to combine ESASAM and AAM into a prior AgroSAM, which will enter the balancing procedure later on. First, the AAM were aggregated into the target classification. It has to be noted again, that the AAM is measured at basic prices while the ESASAM are a mixture of basic and purchaser's prices. It is therefore not possible to merge directly all accounts of the agricultural and food-industry sectors, but only those which are given in basic prices within the ESASAM. These accounts are mainly domestic production and imports of commodities, but also total activity output and total intermediate demand. Exports and domestic use accounts are measured in purchaser's prices and the AAM data cannot be used directly. Instead, the row-shares of each commodity account were used to disaggregate the respective account total. However, the population of the agricultural and food-commodity accounts based on AAM data comes at the end of a rather lengthy compilation procedure, which is outlined in the subsequent section.

4.6 Deriving Row- and Column Totals

Deriving prior values for row- and column totals of the agricultural and food commodity and activity accounts is a first and crucial step in the compilation of the AgroSAM prior as these values represent the boundary conditions for all transactions within the respective accounts. To ensure consistency with the AAM, these tables were aggregated into the target classification (AAM2), and the row-totals were calculated. For readability purposes, from now on activity and commodity accounts of the AgroSAM will be denoted A and C, respectively, whereas the accounts of AAM will be indicated with C_COC and A_COC respectively.

(26) $$AAM2_{AC,AC'} = \sum_{AC \in AC\_COC} \sum_{AC' \in AC\_COC'} AAM_{AC\_COC,AC\_COC'}$$

$$\forall AC \in Agriculture, FoodIndustry$$

For the agricultural sector, it is assumed that it is completely covered by the data used in the CAPRI model, whereas the food industry sector only to some extent, as "other food" and "beverage" industries are not part of the AAM. To generate a complete set of row- and column totals, additional information on these sub-sectors is used from PRODCOM datasets.

Because of the substantial deviation between ESA and AAM values in the food processing sector and because of the fact that some accounts are not covered completely by the CAPRI database ('other food products', 'beverages'), it was necessary to include additional information from PRODCOM and COMEXT datasets. The account totals were derived as follows:

Domestic production:

(27) $$VX_C = \begin{cases} \sum_A AAM2_{A,C} & if\ AAM2_{A,C} > 0 \\ PRODCOM_C & if\ AAM2_{A,C} = 0 \end{cases}$$

Imports:

(28) $$VM_C = \begin{cases} AAM2_{'I\_ROWD',C} & if\ AAM2_{'I\_ROWD',C} > 0 \\ COMEXT_C & if\ AAM2_{'I\_ROWD',C} = 0 \end{cases}$$

Where:

I_ROWD: Index for trade partners (Rest of World)

Domestic production (VX) and imports (VM) were then added up to derive total commodity supply, which serves as prior for the column-totals ($AgroCOL^{ABS}$) of the AgroSAM:

(29) $$AgroCOL_C^{ABS} = VX_C + VM_C$$

The total activity output was derived as either the sum over all commodities produced by the activities in question, if available from AAM. For those accounts not included in AAM, the activity totals were derived by multiplying domestic production (VX) with a binary matrix PRCOUT that maps the produced commodities to the respective activities:

(30) $$AgroCOL_A^{ABS} = \begin{cases} \sum_C AAM2_{A,C} & if\ AAM2_{A,C} > 0 \\ \sum_C VX_C \cdot PRCOUT_{A,C} & if\ AAM2_{A,C} = 0 \end{cases}$$

Next, the share of each activity and commodity ($AgroCOL^{SHR}$) within the corresponding account in ESA format (AC_ESA) was derived:

(31) $$AgroCOL_{AC}^{SHR} = \frac{AgroCOL_{AC}^{ABS}}{\sum_{AC\_ESA}\left[\sum_{AC} AgroCOL_{AC}^{ABS} \cdot G_{AC,AC\_ESA}\right] \cdot G_{AC,AC\_ESA}}$$

Where:

G: Aggregator matrices between AgroSAM and ESASAM accounts

AC_ESA: Account in ESA format

These shares served to compute a first, default prior for the AgroSAM by expanding the ESASAM into target classification and multiplying it row- and column-wise with the derived share-vectors, as discussed in the following section.

4.7 Combining ESASAM and AAM

Having determined column-totals and the corresponding share vectors, it is now possible to expand the ESASAM in the following manner:

(32)
$$\overline{AgroSAM}_{AC,AC'} = AgroCOL_{AC}^{SHR} \cdot AgroCOL_{AC'}^{SHR} \cdot \left[\sum_{AC\_ESA'} \left[\sum_{AC\_ESA} G_{AC,AC\_ESA} \cdot ESASAM_{AC\_ESA,AC\_ESA'} \right] \cdot G_{AC',AC\_ESA'} \right]$$

Where:

$\overline{AgroSAM}$: Prior AgroSAM

G: Aggregator matrices between AgroSAM and ESASAM accounts

This represents the default setting, in the sense that in the absence of additional information, the total-shares are used to populate the unbalanced prior AgroSAM. The disadvantage of this approach becomes evident when assuming that e.g. wheat production has the highest share of all agricultural production activities and dairy commodities the highest share within food commodities. As a result, the combined shares will lead to a high value of intermediate demand of the wheat activity for dairy commodities in the intermediate demand sub-matrix (commodity C demanded by activity A), which is clearly implausible and unrealistic. However, in the absence of additional information on e.g. final consumption of food commodities, it is not implausible to assume that the commodity with the highest share in domestic production also has a high share in consumption as the aggregate output has to be consumed one way or another. The same applies for the production of agricultural commodities from e.g. the ferrous industry, for which non-zero entries may occur in the ESASAM. The reason for such entries is the fact that firms may generate more than 50% of their annual income from their main activity, thus being recorded as belonging to a certain economic branch, but having side-activities as well. In such a case, it is as likely as any other assumption that the agricultural output of these activities is composed similar to the economy-wide agricultural output-patterns.

Additional information on agriculture and food industry accounts is available from the AAM, for instance the intermediate demand of agricultural activities for food commodities (which, in reference to the example above, is always zero for intermediate demand for dairy commodities from crop producing activities). For those sub-matrices that are measured in basic prices (e.g. domestic production by activities and imports), the AAM entries can be used directly:

(33)
$$\overline{AgroSAM}_{A,C} = AAM2_{A,C} \qquad \forall C \in Agriculture, FoodIndustry$$
$$\overline{AgroSAM}_{'I\_ROWD',C} = AAM2_{'I\_ROWD',C} \quad \forall C \in Agriculture, FoodIndustry$$

Final and intermediate consumption on the other hand are measured in basic prices in AAM and cannot be introduced directly into the prior AgroSAM as the commodity accounts are row-wise measured in purchaser's prices. Instead, the row-wise share of the commodity accounts for agriculture and food industries were multiplied with the corresponding row-totals:

(34) $$\overline{AgroSAM}_{C,AC} = \frac{AAM2_{C,AC}}{AAM2_{C,'Total'}} \cdot \overline{AgroSAM}_{C,'Total'} \; \forall C \in Agriculture, FoodIndustry$$

The operations above ensure that the entries of the commodity accounts reflect the data from AAM either directly as values (commodity-columns) or at least according to the consumption shares (commodity-rows) for final and intermediate demand. For agricultural activities, subsidies on activities and column-totals were also taken directly from AAM:

(35) $$\overline{AgroSAM}_{'T\_SBAC',A} = AAM2_{'T\_SBAC',A} \, ; \; \overline{AgroSAM}_{'Total',A} = AAM2_{'Total',A} \forall A \in Agriculture$$

It has to be noted again that the sets 'Agriculture' and 'FoodIndustry' refer to those accounts available from AAM. This means that they exclude accounts which are part of the agricultural and food industry sectors in ESA95 classification, but are not part of the CAPRI model ('beverages' and 'other food'). For those accounts, the default prior (Equation (32)) applies.

4.8 Control Totals for Agriculture and Food Industries

In addition to information on specific entries in the targeted AgroSAM (like domestic outputs by activities or import values of commodities), the CAPRI dataset includes information on sub-totals of the AgroSAM like total intermediate demand (TOIN) of agricultural activities or total marketed production of agricultural and food commodities (MAPR). Furthermore, as it is foreseen to expand the trade account of the AgroSAMs with respect to additional trade partners (at least intra- and extra-EU trade) a control total on imports was also introduced. Altogether, the following control totals were considered:

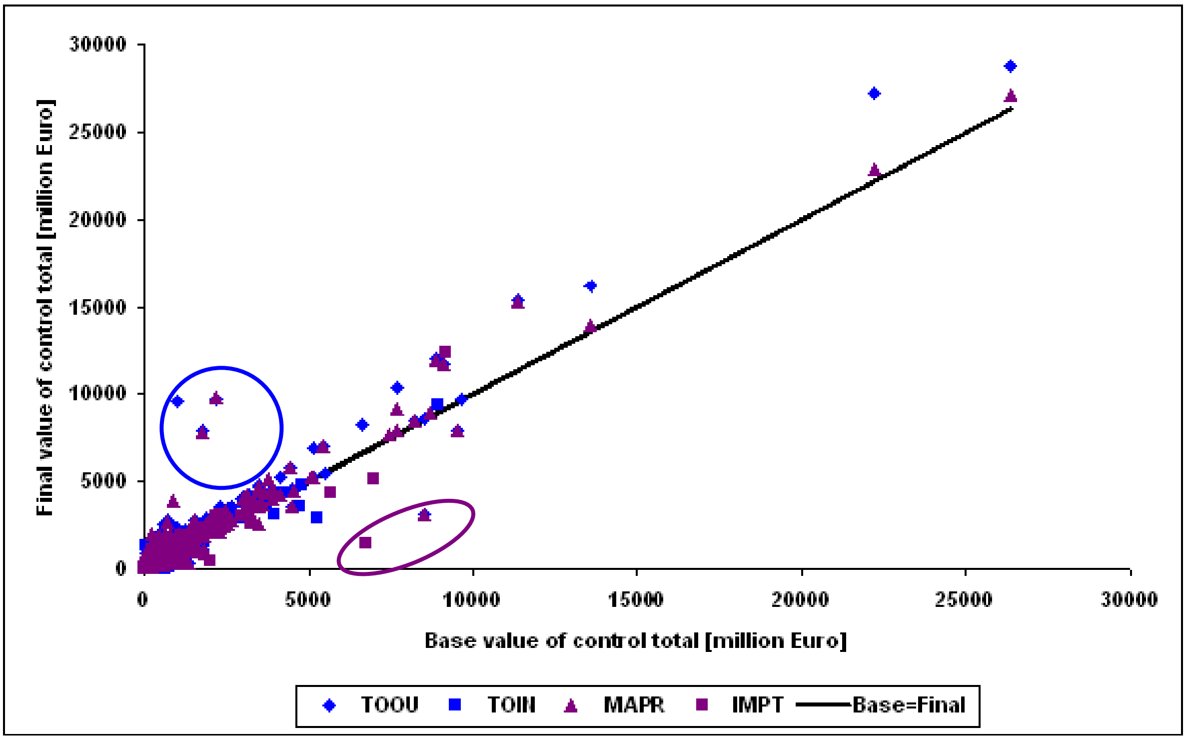
(36)
$$\begin{aligned}
&CAPCTR_{'TOOU',A} = TOOU_A \cdot LEVL_A && \forall A \in Agriculture \\
&CAPCTR_{'TOIN',A} = TOIN_A \cdot LEVL_A && \forall A \in Agriculture \\
&CAPCTR_{'MAPR',C} = MAPR_C && \forall C \in Agriculture, FoodIndustry \\
&CAPCTR_{'IMPT',C} = IMPT_C && \forall C \in Agriculture, FoodIndustry
\end{aligned}$$

5 Differences between CAPRI Database and ESA

Having constructed a set of unbalanced (a priori) AgroSAMs ($\overline{AgroSAM}$) based on the available information as described in the previous section, the next step was to apply an estimation procedure to create a balanced set of AgroSAMs, which is as close as possible to the prior data. As the ESASAMs were balanced with respect to macro totals, now the AgroSAMs are forced to add up to the corresponding values of the ESASAMs. In addition to this deterministic control totals, stochastic control totals were also included, which were derived from the CAPRI database (CAPCTR). At this point it became most evident that the accounting schemes for ESA95 and EAA, on which the CAPRI database is mainly built, deviate to some extent. Therefore, it was not possible to strictly enforce control totals from both datasets at the same time. As the main input and framework for the AgroSAMs are the national SUT in ESA95 format, it is necessary to associate the control totals derived from the CAPRI datasets with an error term, which enters the objective function in the same way as the error terms in the previous steps.

When comparing the final results with the control totals derived from the CAPRI model's database (Figure 5), it can be seen that the majority of estimated values lie within a comparatively narrow range around the imposed corresponding control values. Notable exceptions are highlighted in Figure 5 with the blue and purple circles. The blue circle refers to large positive deviations (estimated is much larger than observed), while the purple circle to large negative deviations (observed is much larger than estimated). The data points within the blue circle refer to 'animal feed' and 'poultry meat' in Italy, and to 'other crops' in France. Large negative deviations can be found for 'fruit and vegetable' production in Italy and Belgium. The main reason for these deviations is the fact that these activities and commodity groupings were not considered as core accounts (see Table 6 for a list of core accounts) of the AgroSAM estimation procedure and the variance of the stochastic control total was therefore larger than in the case of the core accounts (bold entries in Table 6).

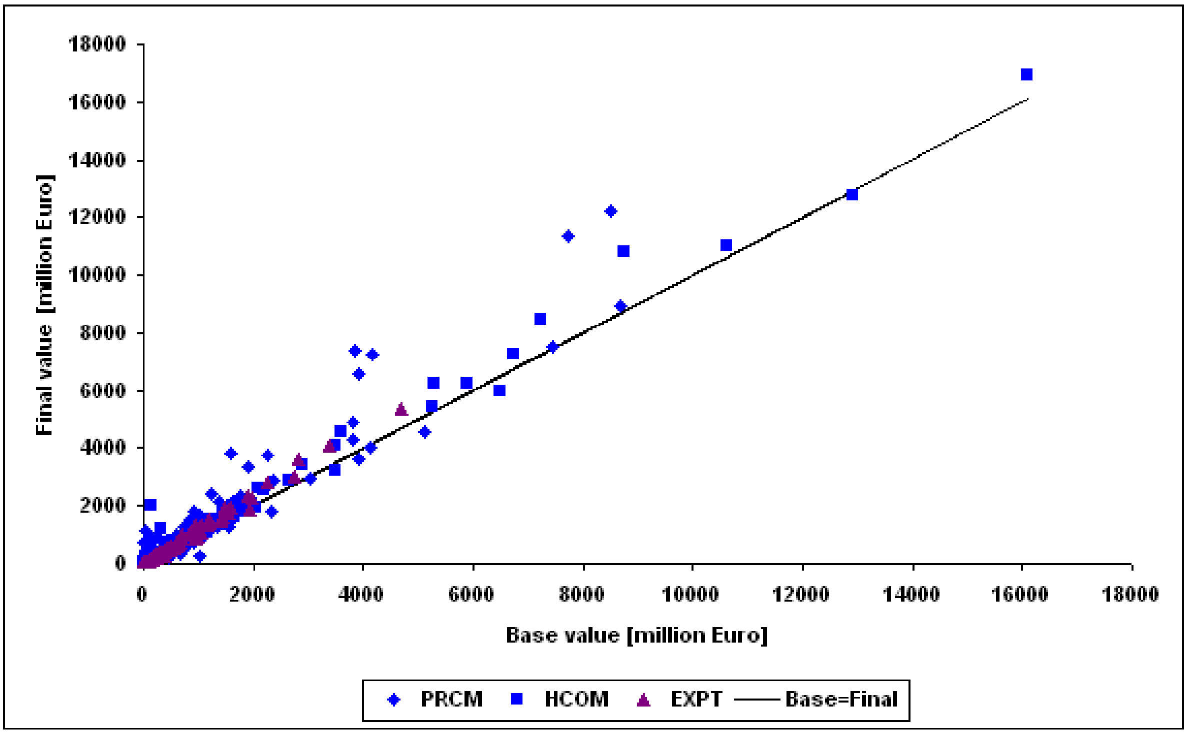
Figure 5 Control Totals and Final Estimates for all Commodities and Activities



Notes: TOOU: Total output at basic prices
TOIN: Total input at basic prices
MAPR: Marketed production at basic prices
IMPT: Imports at basic prices

Particularly the large deviations for the 'fruit and vegetable' sector in Italy will have to be addressed in further stages of the AgroSAM project as this sector plays an important role within the national agricultural sector. A potential solution will be to impose the stochastic control totals not with equal variances for all Member States as done here, but according to the relative importance of the respective sub-sector.

Figure 6 Uses of Core Commodities



Notes: PRCM: Processing demand
HCOM: Human consumption
EXPT: Exports

The estimation results for demand-side items are in general less satisfying than for the supply-side, but show no deviations in the order of magnitude for the core commodities. Approaches to estimate the demand-side with a higher accuracy will require more detailed information on the domestic transformation from basic- to purchaser's prices for the commodities in question. Particularly trade margins and export subsidies will be the information to be compiled for each commodity group. In general, the deviations are highest for 'processing demand'. As the CAPRI database does not distinguish between the demanding industries, the distribution of the total 'processing demand' has to be distributed based on shares and plausibility considerations. In some cases, for instance in the case of 'raw milk', it is evident that the largest share is processed by the dairy industry, but 'other food industries' may also demand a smaller amount. In most Member States, the total supply of raw milk is large enough to be distributed across numerous demanding industries while maintaining the relevance of dairy as the main consumer. Likewise, raw tobacco has to be mainly processed by the tobacco industry, but total tobacco supply is in some cases smaller than the intermediate demand of the tobacco industry for agricultural commodities as indicated by the EuroStat SUT. These figures sometimes even exceed the total supply of the aggregate 'other crop products', of which 'raw tobacco' is a part in the MAC scheme. As a consequence, the corresponding total supply values have to be adjusted such that compliance with the EuroStat SUT is achieved.

Table 6 Agriculture and Food Industry Sub-sectors, and Core Accounts

Description	Activity	Commodity
Agriculture		
Other wheat	**A_OWHE**	**C_OWHE**

Durum wheat	**A_DWHE**	**C_DWHE**
Barley	**A_BARL**	**C_BARL**
Grain maize	**A_MAIZ**	**C_MAIZ**
Other cereals	A_OCER	C_OCER
Paddy rice	A_PARI	C_PARI
Rape seed	**A_RAPE**	**C_RAPE**
Sunflower seed	**A_SUNF**	**C_SUNF**
Soya seed	**A_SOYA**	**C_SOYA**
Other oil plants	A_OOIL	C_OOIL
Other starch and protein plants	A_STPR	C_STPR
Potatoes	A_POTA	C_POTA
Sugar beet	**A_SUGB**	**C_SUGB**
Fibre plants	A_FIBR	C_FIBR
Other crop products	A_OTCR	C_OTCR
Grapes	A_GRPS	C_GRPS
Fresh vegetables, fruit, and nuts	A_FVEG	C_FVEG
Live plants	A_LPLT	C_LPLT
Fodder crops	A_FODD	C_FODD
Set-aside	A_SETA	
Raw milk from bovine cattle	**A_COMI**	**C_COMI**
Bovine cattle, slaughtered	A_LCAT	C_LCAT
Swine, slaughtered	**A_PIGF**	**C_PIGF**
Raw milk from sheep and goats	A_SGMI	C_SGMI
Sheep, goats, horses, asses, mules and hinnies, slaughtered	A_LSGE	C_LSGE
Eggs	A_EGGS	C_EGGS
Poultry, slaughtered	A_PLTR	C_PLTR
Other animals, live, and their products	A_OANM	C_OANM
Food Industry		
Rice, milled or husked	**A_RICE**	**C_RICE**
Processed sugar	**A_SUGA**	**C_SUGA**
Vegetable oils and fats, crude and refined; oil-cake and other solid residues, of vegetable fats or oils	**A_VOIL**	**C_VOIL**
Dairy products	**A_DAIR**	**C_DAIR**
Meat of bovine animals, fresh, chilled, or frozen	**A_BFVL**	**C_BFVL**
Meat of swine, fresh, chilled, or frozen	**A_PORK**	**C_PORK**
Meat of sheep, goats, and equines, fresh, chilled, or frozen	A_SGMT	C_SGMT
Meat and edible offal of poultry, fresh, chilled, or frozen	A_POUM	C_POUM
Prepared animal feeds	A_ANFD	C_ANFD

Note: Bold entries denote core commodities and activities

6 Summary and Outlook

This paper summarized the steps of the compilation of AgroSAMs for 27 EU Member States, based on datasets from the CAPRI model and SUT in ESA95 format. To combine these structurally different datasets, the CAPRI datasets were processed into an Agricultural Accounting Matrix, both in values at basic prices and physical quantities (balance sheets). The described task to combine the database of an agricultural sector model with Supply- and Use tables from EuroStat resulted in a number of methodological and data-handling challenges. Although information from both databases were used in a most exhaustive manner, at some stages (e.g. in the case of accounts of the food industry) additional sources had to be consulted. Although the chosen procedure was tailored to available data and respected the main requirements, there is still huge potential for improvement. The main challenges for future work are:

1) Although considerable effort was devoted to the construction of an Agricultural Accounting Matrix based on data from the CAPRI model, it was not possible to eliminate the sometimes substantial deviations from the corresponding entries in the ESA95 matrices. This caused a need to distribute the deviations across the accounts to be disaggregated, such that sometimes large deviations from the original CAPRI data could not be avoided. The main reason for this is essentially the fact that the Agricultural Accounting Matrix compilation is merely a re-structuring of the EAA/CAPRI data in SAM format, in which only the introduction of additional non-agricultural processing activities respects the structure of the ESA95 framework. Consequently would a revision of the compilation procedure with respect to the structural deviations between EAA and ESA95 accounting schemes help to generate a prior that is closer to the corresponding ESA95 totals and improve the performance of the balancing procedure.

2) The original objective was to create a database which can be mapped (many-to-one) into the format required by GTAP. This task could not be fulfilled totally. Although it was possible to represent the agricultural and food-industry sectors in a way that is compatible with GTAP, the oil and gas sector, the ferrous and non-ferrous metal sector, and a few others could not be split with the available data sources. Using the GTAP database itself was not considered as an option because of the general paradigm of the AgroSAM project to focus on publicly available data from EuroStat. The decision, which dataset to use for the split of the respective sectors, is left to the respective user, in case he intents to run GTAP on the AgroSAM database.

3) Commodity market taxes like VAT and import duties had to be estimated, as the Supply- and Use tables only provided information on net-taxes, while the used macroeconomic datasets contained only the total amount of taxes paid without a distinction of the market transactions on which the taxes were levied. Although the applied approach takes information on applicable tax rates within the EU into account (namely for import duties and value-added type taxes), it would be desirable to use data directly obtained from the national statistical departments.

4) The representation of factor markets in the AgroSAM is comparatively coarse as the available datasets did not support a distinction between labour inputs by skill-type or the contribution of land and natural resources to the sectoral value-added.

One of the major paradigms of the project summarized here was that Supply- and Use tables from EuroStat determine the boundary condition for the final AgroSAM, such that the aggregated AgroSAM replicate exactly the Supply- and Use tables. This strict requirement means that deviations from the agricultural sector data from the CAPRI model had to be permitted. An alternative would have been to treat the CAPRI data as given and re-arrange the Supply- and Use tables accordingly. This alternative would have guaranteed a better representation of the agricultural and food industry sectors at the cost of the information from the economy-wide datasets. However, as the main purpose of the AgroSAM project was to create a database for general equilibrium models that allow analysing the linkages between agriculture and other sectors of the economy, it was decided to maintain the inter-sectoral structure as represented in the Supply- and Use tables.

It also has to be emphasized that the AgroSAM mainly serve as a database from which a model dataset may be derived: The existence of empty accounts and the wide range of entry-values (very small to very large) in the AgroSAM creates a need for aggregation (e.g. into GTAP format) and elimination of small entries before a CGE model is calibrated. Again, an alternative would have been to perform these steps as part of the AgroSAM project, which would have come at the cost of its versatility.

Although the structural deviations between the combined datasets created some difficulties for the project, it is still a major achievement that a full set of Social Accounting Matrices in ESA95 format could be compiled that is consistent with the respective sets of macro-economic control totals. These ESASAM can be created flexibly from EuroStat data for any desired year between 1995 and 2005 and may serve as control-totals for further disaggregation. The current state of the approach allows a fully flexible incorporation of additional data, which is intended to continue upon data availability. In any case the compiled AgroSAM constitute a valuable resource for modellers in the fields of general and partial equilibrium models.

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