The food euro : method and new results to analyze distribution of value in the French food chain

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The food euro : method and new results to analyze distribution of value in the French food chain[1]

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Abstract: "The food euro" denotes the method and results of the decomposition of food consumption into values added, imports and taxes, by means of calculations on the input-output tables. The article explains the role of price ratios in the (low) level and (downward) evolution of the share of the agricultural branch in this distribution. The contributions of the various final demands to the formation of the income of the agricultural branch are also measured. The article begins with a presentation of the method and concludes with a discussion about the scope of this approach and its prospects and constraints for improvement.

Keywords: final food consumption expenditure, value added, input-output matrix, food supply chain, agricultural income (JEL M21, M41).

Introduction

"The food euro" refers to the analysis of the distribution of food expenditure in France into value added, imports and taxes, inspired by the work on the "food dollar" of the Economic Research Service of the United States Department of Agriculture (Canning, 2011; Canning, Kelly, Weersink, 2016) and consisting of an application of calculations on input-output tables (IOT) of W. Leontief's "open model" (Leontief, 1936, 1986). These results complement by a macroeconomic view the microeconomic and sectoral analyses of the gap between agricultural and food prices carried out by the French "Observatory of the formation of prices and margins of food products" (OFPM, 2020). Compared to previous works (Boyer, Butault, 2012, 2013, 2014; OFPM, 2020), this article presents more recent results, from a revised method integrating food-services consumption (restaurants, institutional catering, food to go, home delivered meals).

1. Sources and methods

1.1. The symmetric input-output table and its adaptations

The main source used is the domestic *symmetric input-output table* (SIOT) at basic price produced by the French National Institute of Statistic and Economic Studies (Insee) for Eurostat, the European Union statistical service (Eurostat, 2008), and presented here in condensed version in Appendix A. It divides the use of each domestic product into intermediate consumption by the different industry groups (branches[2]) and final demands: final consumption, exports and gross capital formation.

[1] French version published in : Boyer Ph. (2021). L'euro alimentaire : méthode et nouveaux résultats pour l'analyse de la répartition de la valeur dans la chaîne agroalimentaire en France. *Économie rurale* 2021/4 (n° 378), pp. 137 - 157.

[2] In the French national accounts, the term "branch" (*branche*, in French) refers to a homogeneous unit of production, that is to say, which produces goods or service which belong to the same item of the classification of economic activity in question. (in this article, "industry groups" means "branches"). On the contrary, a "sector" groups together statistical units (enterprises, legal units) classified according to their main activity.

Output and its uses are at basic prices, *i.e.* the amount the producer receives from the buyer per unit of good or service he produced, *less* taxes on products and *plus* direct subsidies on products. For each product, the amount of the domestic resource is therefore equal to that of its uses, unlike the standard input-output table[3].

The number of products is equal to the number of industry groups, which are moreover "pure", in one-to-one relation to the products (the type of the SIOT used is “product-by-product”). This symmetry makes it possible to perform calculations that use the inversion of matrices linking industry groups to products.

But first, the SIOT must be adapted.

In the SIOT, the consumption of food products bought in the retail trade by customers is included in the final consumption at home of the products of these three industry groups : Agriculture, Fishery and aquaculture, Food products and beverage processing industry. The consumption in restaurants is not included in the final consumption of the products of agriculture, fishery or food processing : it is computed as the final consumption of *food services*, aggregated in the Eurostat SIOT with accommodation services. To take into account food services in food consumption requires adaptation of this SIOT to separate food services from accommodation services, in terms of intermediate and final uses of these services, and in terms of intermediate consumption, output and value added of their industry groups.

The distribution of the resource and its uses between food services and accommodation is based on the “Supply and Use Balance” tables of the national accounts, in which the two services are distinguished. Another source of national account, the “Accounts per Branches” gives the intermediate consumption of each industry group: food services and accommodation. The intermediate consumption of each branch is then broken down by type of input, on the basis of the statistics by sector given by the Business statistics system of Insee.

This results in a SIOT in which food services industry group, its production and uses, are individualized and separate from accomodation. This adaptation, now carried out on SIOT available since 1995, is an innovation compared to previous work (Boyer, Butault, 2012, 2013, 2014).

The resulting SIOT has yet to be adapted for two more purposes (Boyer, Butault, 2014). These are:

1°) reallocate wine production to the agricultural industry group, in accordance with the French national accounts of that branch, and unlike the SIOT of Eurostat, which allocates wine production to the Food products and beverage processing industry;

2°) eliminate subsidies to products included in the amounts at basic prices of uses and resources. So: with regard to uses, final consumption will be without subsidies, as is the actual expenditure of consumers; with regard to resources, outputs, and therefore value added, will not include amounts not derived from effective expenditure of purchasers[4].

Since 2008, the nomenclature of the SIOT aggregates food processing with tobacco products, and the impact of these non-food products on the results must be eliminated. The significant impact of tobacco margins and, especially, tobacco taxes, are corrected in the course of the calculations, and after, the otherwise minimal impact of the tobacco values excluding taxes and margins is eliminated by calibration on the final consumption of the products of the food processing industries excluding tobacco, given by the “Supply and Use Balance” tables of the national accounts.

[3] For a description of the structure and the properties of the symmetric input-output table, different from that of the standard input-output table: Braibant, 2011, Eurostat, 2006 and Malherbe, 2018.

[4] However, it is possible to make calculations with production maintained at basic prices: then, food consumption induces value added with subsidies to the products included. See Annex C, 4.

After these adjustments, the SIOT (at basic prices less subsides) presents values which do not yet incorporate the trade and transport margins of final consumption, although they represent almost a quarter of its purchase value, nor consumption taxes (VAT, excise duties on alcohol, etc.). They shall be taken into account after the series of calculations at the basic price excluding subsidies, described below.

1.2. The equality between final demand and "domestic value added"

Domestic value added is the balance between output and intermediate consumption of *domestic* products (Appendix A). The overall equality between domestic value added and final demand is an accounting obviousness: since overall domestic value added is the difference between output and its intermediate uses, it is therefore the part of output that is subject to final use. This equality is the basis for the calculations of the decomposition of food consumption into induced value added in each of the industry group of the national economy, imports and taxes.

The first stage of this decomposition consists in breaking down the above-mentioned overall equality into industry groups where domestic values added are formed, and into products, whose final demands induce these values added. A matrix calculation gives the *coefficients of domestic value added induced by final demands* (Appendix C, 1, [3]).

1.3. The breakdown of final consumption at basic prices excluding subsidies

As a consequence of the assumption, inherent in the input-output analysis, of the uniqueness and linearity of the production function of a product whatever its uses, the abovementioned coefficients apply to any element of final demand for the same product and, applied to the final consumption of agri-food products, they provide the “domestic value added” induced in each industry group by this final consumption.

Using the SIOT data, these “domestic value added” are then broken down into value added, imported intermediate consumption, and taxes on intermediate consumption (Appendix C, 2, [6] to [8]).

Another Eurostat table, the “Importation IOT”, gives the final consumption of imported agri-food products, excluding margins and taxes.

1.4. Taking into account trade and transport margins and taxes

Margins are the value of services produced by trade and transport. In the SIOT, the use of these services by each industry group constitutes its intermediate consumption of trade and transport services, and the margins of final expenditure *all domestic products together* are included in final demands (including final consumption) in trade and transport. On the other hand, since the SIOT are at basic prices, final expenditure *by product* does not include trade and transport margins.

Thus, the breakdown of final consumption obtained at this stage relates to expenditure which would have been done without margins. However, these margins correspond to a final consumption of trade and transport services, which induces, like any final demand, values added, imported intermediate consumption, and taxes on intermediate consumption.

The “Supply and Use Balance” gives margins on final consumption by product, domestic and imported. The components of these margins in values added, imported intermediate consumption and taxes on intermediate consumption are calculated and added member to member to composition without margins, obtained previously, to obtain the composition including margins (Appendix C, 3).

Final consumption taxes are estimated as the difference between final consumption including margins and final consumption *at purchasers' prices* (i.e. taxes included) provided by the “Supply and Use Balance” tables.

1.5. The calibration on effective food consumption

At this stage, the decomposition obtained relates to a consumption of agri-food products, assimilated to actual food products. However, final consumption of agri-food products includes that of non-food products, identifiable in the detailed national accounts by products in a more precise nomenclature.

For agricultural products, these *a priori* non-food products are flowers, plants and pets, which account for 18% of final consumption of agricultural products in 2018.

Among the products of the food processing industry, pet food, which accounts for 2% of final food products consumption, is also to be excluded since only human consumption is concerned.[5]

The impact of these products is roughly corrected by recalibrating the results on the final consumption of only a *priori* food products, given by national accounts at a detailed level of nomenclature of products, then by a final calibration on the total amount of *effective food consumption*, given by national accounts of final consumption by function (Appendix B).

1.6. Notes on the calculation of the other results of the euro food

An equation of the same type as that giving induced output (Appendix C, 1, [4]) provides the employment (in full time equivalent) induced in the branches by food consumption (Appendix C, 5).

For the purpose of farm income analysis, we calculate the contribution to the formation of agricultural value added by different final demands for different commodities: food consumption, agri-food exports and fixed capital formation, other final demands for other products (for example: bio-fuel, textile…). The results are derived from a symmetrical calculation of the breakdown of final demands (Appendix C, 6).

17. Retropolation of results obtained in previous databases

National accounts "change their base" periodically. These changes may affect the nomenclatures, the classification of transactions in the accounts[6] and evaluation methods[7]. National accounts must also comply with the European System of Accounts (ESA), also periodically amended (CE, 2010).

There is no retropolation in new bases of formers SIOT published by Eurostat in previous bases, so the comparability of "food euro" results from different bases is compromised.

Thus, the results developed here relate with some exceptions to the years 2010-2018, calculated in base 2010 until 2014, then in base 2014. These two bases are under the ESA 2010 and the changes made by the 2014 base have a negligible impact on the euro food[8].

[5] Food stuffs *for farm cattle* are also food processing industries products, but, unlike pet-food, bought by households, they are not computed in final consumption: theis domestic use is intermediate consumption, bought by agriculture industry group.

[6] For example, expenditures of firms for research and development, formerly classified as intermediate consumption, are reclassified since base 2010 as investment, that increases the value added.

[7] For example, since 1995 : evaluation of the production at basic price (including subsides to products, les taxes), instead of delivery price (without net subsidies to products).

[8] The results obtained in base 2010 have been recalibrated on the amounts of final demands of agri-food products in base 2014, very little different from those in the previous base.

2. Results

2.1. Distribution of food expenditure in value added, imports and taxes in 2018

In 2018, the food consumption (with food services) amounts to 255 805 M€ of which 71 5366 M€, or 27%, in food services. The Table 1 shows its distribution and the following explanatory ratios:

- the "*production coefficient of food consumption"*, the ratio of the production induced by food consumption in a given industry group, in the food consumption,
- the "*value added ratio" :* the ratio of the value added of the industry group in its production.

Table 1. **Content of food consumption in value added, importations and taxes in 2018**

		% Food consumption	Branch production coefficient of food consumption	Value added ratio of the branch	% Value added induced by food consumption
		(a) = (b) x (c)	(b)	(c)	(d) = (a) / (e)
Domestic industry groups	Agriculture, fisheries and aquaculture	6.9% (*)	16.6%	41.5%	10.9%
	Industries of food products and beverages	10.4%	40.8%	25.4%	16.5%
	Others industries	3.1%	9.8%	31.2%	4.9%
	Food services	13.6%	26.8%	50.7%	21.5%
	Trade	15.3%	29.9%	51.4%	24.3%
	Other services	13.8% (**)	27.0%	51.3%	21.9%
Total induced value added (e)		**63.1%**			**100.0%**
Imported intermediate consumptions		15.4%			
Final food importations		10.6%			
Total importations		**26.0%**			
Taxes		10.9%			
Food consumption		**100.0%**			

(*) fisheries and aquaculture with very low weight (0,5 %)

(**) which transport (2 %).

Sources : author's calculation from Insee and Eurostat data.

The share of the value added induced in agriculture by food consumption is low, with 6.9% of the food expenditure, due to production coefficient and value added ratio lower than the average for other industry groups.

The weight of food services, trade and other services is important compared to that of upstream industry groups : agriculture and food industry.

In 2018, the value added induced in trade represented more than 15% of food consumption and nearly a quarter of the value added induced by all branches. This refers to all trade activities, wholesale and retail, contributing directly or indirectly to the satisfaction of food demand, and not just food retailing.

Compared to the initial approaches of the euro food (Boyer, Butault, 2014), the share of other sectors is reduced by taking into account food services, where the value added induced is important: 13.6% of food consumption and 21.5% of the value added induced by all industry groups.

"Other services" cover a large number of industry groups where dominate, for more than 55% of the value added induced in these branches: legal, accounting, management consulting and head office services, real estate, employment services (including temporary work), financial and insurance activities.

The other very important aspect of the distribution is the weight of importations : they account for more than the quarter of food expenditures. They come from European Union for 61% all products combined, and for 69% for agri-food imports only. They break down as described in Table 2.

Table 2. **Structure of the import content of food consumption in 2018**

	Food services consumption	Food consumption at home	Total food consumption
Products of agriculture (i.e. non processed)	8.2%	15.2%	14.1% (a)
Processed food	41.1%	43.4%	43.1% (b)
Energy, chemical and mineral products	13.3%	12.2%	12.4%
Wood, rubber, paper, plastics, textiles	5.7%	4.6%	4.8%
Machinery, equipments, vehicles	5.7%	5.7%	5.7%
Other manufactured products	5.1%	4.2%	4.4%
Services	20.9%	14.6%	15.6%
Total final and intermediate importations	100.0%	100.0%	100.0%

Which final import : (a) : 9,2% et (b) : 33,7%

Sources : author's calculation from Insee and Eurostat data.

The weight of agri-food imports is normally high in the import content of food consumption. Food services is sometimes considered to make significant use of these imports, but according to Table 3, they represent 7.5% of the value of food services consumption.

Table 3. **Weight of agri-food imports in food consumption in 2018**

	Food services consumption	Food consumption at home	Total food consumption
Importations of agri-food products	7.3%	17.8%	14.9%
which for final consumption	0.0%	14.7%	10.6%
which for intermediaite consumption	7.3%	3.1%	4.3%

Sources : author's calculation from Insee and Eurostat data.

In comparison, agri-food imports for intermediate consumption alone represent 3.1% of food expenditure excluding food services, so less than in food services (7.3%), but 17.8% when final imports are added[9].

A significant share of induced imports are services, of which trade and transport account for just under half.

2.2. The evolution of the share of agriculture in the food euro

The share of value added of an industry group in food consumption is the product of its ratio of value added in the output by its coefficient of production in food consumption. These two terms are associated with the two following relative prices: the agricultural price index in relation to the food price index[10], involved in the variations in the coefficient of production, and the agricultural price index in relation to the intermediate consumption price index of this industry group[11], involved in the variations in its value added rate.

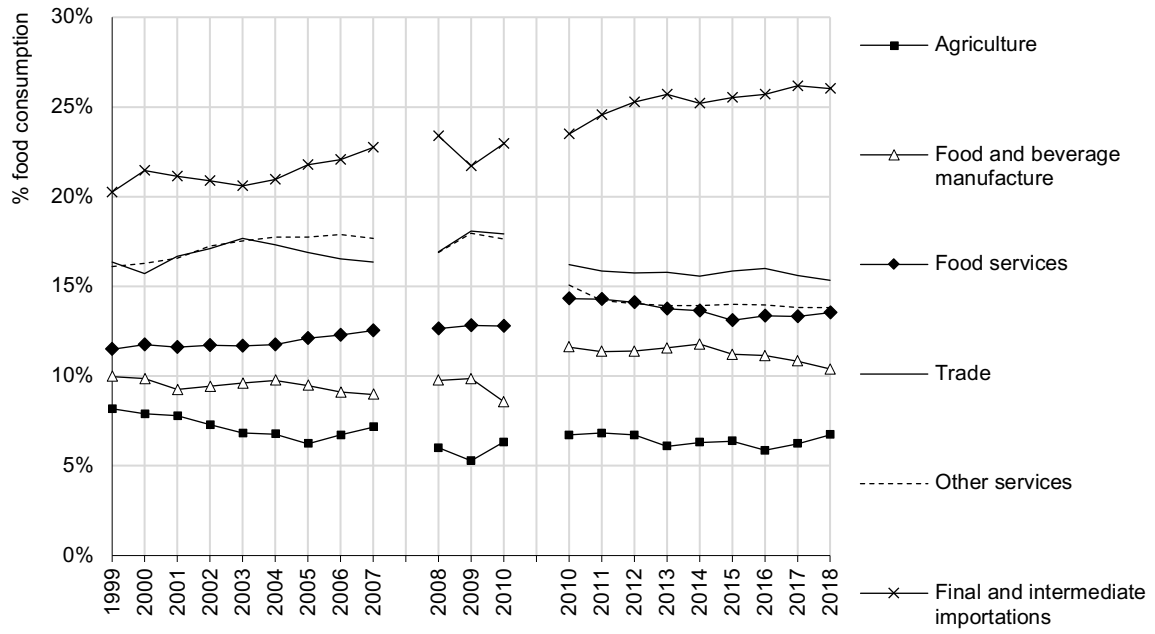
[9] There are no final imports of food services, but only imports of inputs for the production of such services.

[10] Index of the price of agricultural production, in the national accounts per branch ; index of the food consumption prices, including "restaurant," canteen, cafes" (Insee).

[11] Index of the prices of intermediate consumption of agriculture branch, in the national accounts per branch (Insee).

Because of breaks in series due to national accounts base changes, the results since 1999 belongs to three non-homogeneous time series, allowing only comparisons on the direction of evolutions (Chart 1).

Chart 1. **Evolution of induced value added and imports in food consumption**



NB : (1) Series breaks are represented by breaks on the curves. (2) Taxes (fairly stable around 10%), fisheries and aquaculture (less than 1%), transport (3%) and non-agri-food industries (4%) are not represented.

Sources : author's calculation from Insee and Eurostat data.

The period 1995-2007 was studied in the initial article on the food euro (Boyer, Butault, 2014). Until 2005, the decrease of relative agricultural prices as a result of successive CAP reforms (which reduced support of agricultural prices support by bringing them closer to world prices), led to a decline in the share of agricultural value added.

Added to this is the increase of imports, which also affects the share of other industry groups.

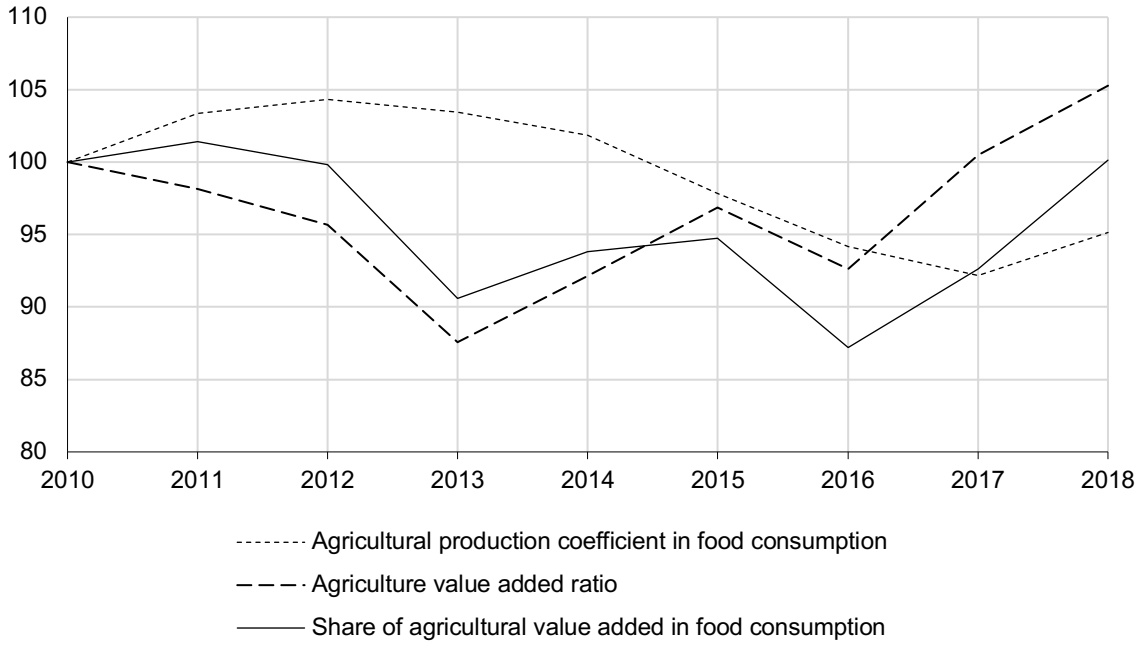
From 2006, deregulated agricultural prices were exposed to volatility, in an upward trend which follows that of raw materials and energy, between 2005 and 2008, in a context of climatic hazards, low stocks, speculation and increased demand (Huchet-Bourdon, 2011; Voiturier, 2009). This led to the increase of agriculture share in 2007.

The national accounts base change in 2008 leads to a second and short series of results, (2008-2010), characterized by the decrease of the share of agriculture in 2009, due to that of agricultural prices reported to food prices (-15%) or reported to those of intermediate consumption (- 9%); this decrease of relative agricultural prices in 2009 results of an excess in supply in response to the previous price increase.

The third series covers the years 2010[12]-2018. Imports are increasing and, correspondingly, the shares of value added are on a downward trend, more or less regular depending on the branch, including restaurants, trade and services. During this period, the downward trend in the share of agricultural value added is given by the decrease in the agricultural production coefficient after 2012 and in the value added rate from 2011, which also contributes to yearly short run variations (Chart 2).

[12] 2010 is the only year for which a input-outpout table is available in the new and the former base.

Chart 2. **Share of agricultural value added in food consumption, agriculture value added ratio and agricultural production coefficient in food consumption**

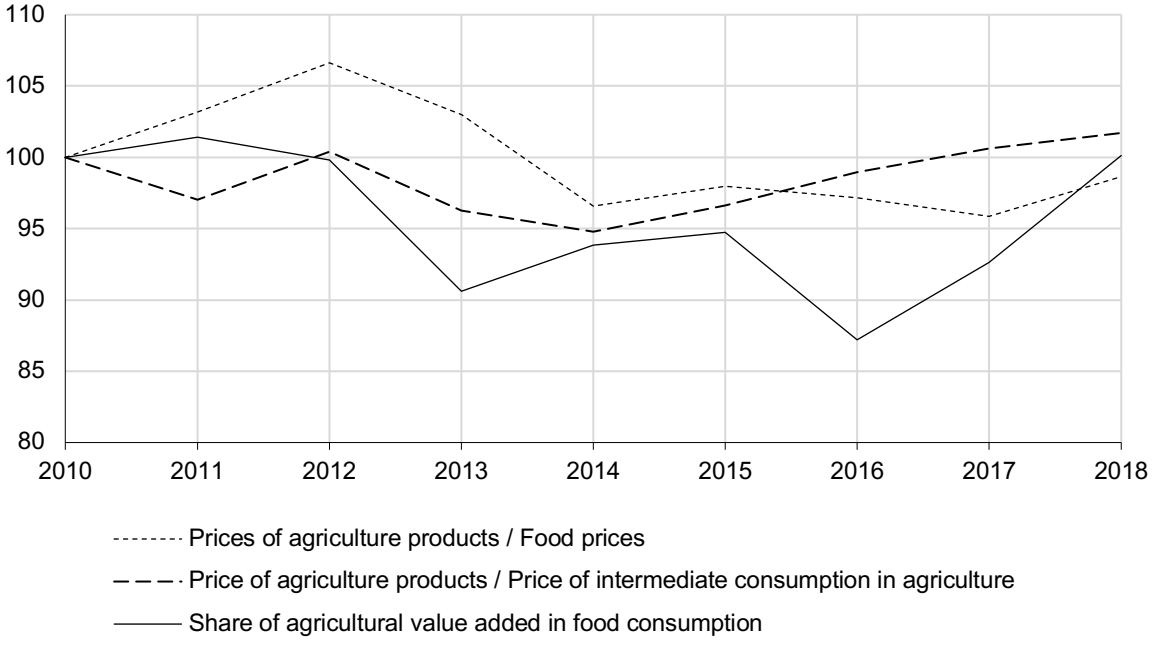


Sources : author's calculation from Insee and Eurostat data.

The ratio of agricultural prices to food prices, which is involved in the production coefficient, tends to decline after 2012 and thus reduces the share of value added in agriculture (Chart 3).

The impact of variations of the prices of agricultural products reported to food prices is reduced or amplified by variations of the prices of agricultural products reported to those of their intermediate consumption, the downward trend of the latter report being less marked since 2010 than in the previous ten years (Insee, 2020).

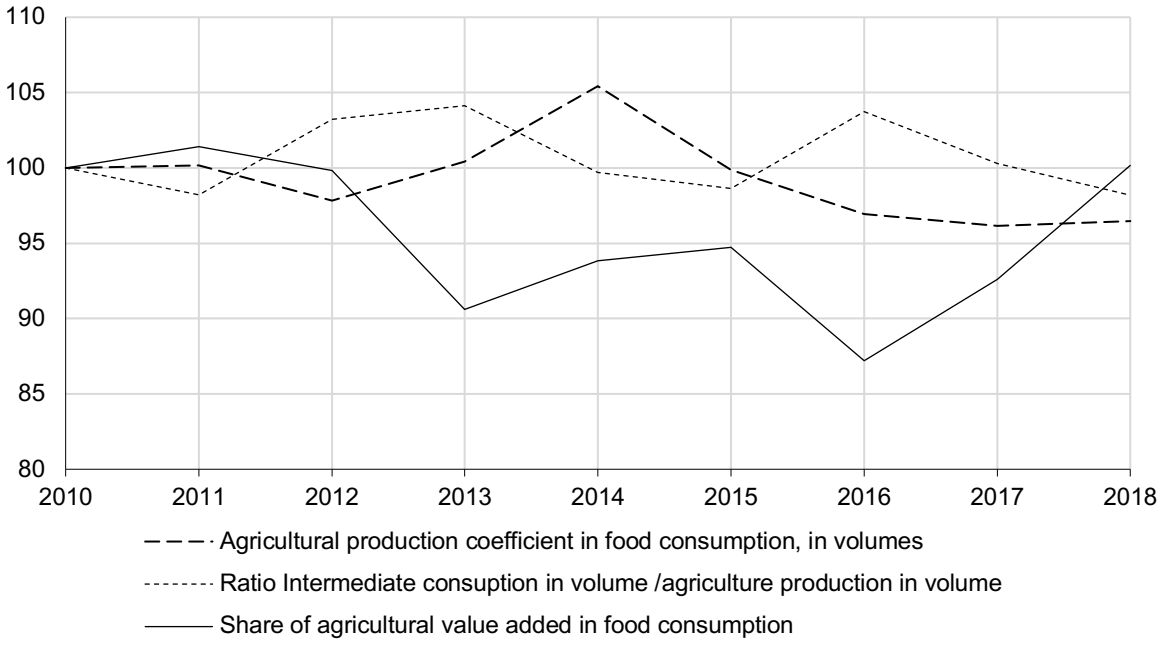
Chart 3. **Share of agricultural value added in food consumption and relative prices**



Sources : author's calculation from Insee and Eurostat data.

On Chart 4, the variations of the ratio of intermediate consumption in volume to agriculture production in volume are , sometimes in phase, sometimes in phase opposition to those of price ratios, accentuate or cushion the impact of the latter on the share of value added.

Chart 4. **Share of agricultural value added in food consumption and relative volumes**



Sources : author's calculation from Insee and Eurostat data.

From 1999 to 2018, observed over each period of homogeneous basis, the coefficient of agricultural production in food consumption (in value) tends to decrease : from 20% to 18% on 1999 - 2007, from 17% to 16% on 2010 - 2018.

This decline is mainly due to that of agricultural prices reported to food prices: -9% per year by average over 2003-2018, but also to the growth of imports that replace domestic resources.

Added to this is the quality effect of the increasing *incorporation in volume* of non-agricultural elements in food expenditure: industrial processing, packaging, services (advertising, marketing, health safety).

These elements obviously do not replace the agricultural raw material but they are added to it and modify the composition of the "basket" of the food supply.

This trend is slower than that of price ratios. It is perceptible over 1999-2018, through the decrease of less than 1% per year on average in the coefficient of agricultural production estimated *in volume*.

23. The formation of the agricultural income by the various final demands

In 2018, the gross income of the agriculture branch breaks down as follows, in terms of contributions of final demand and subsidies (Table 4).

Food consumption contributes 40% to the "gross value added at factors costs" (GVACF) of the branch. The contribution of food services alone is much lower (5.7%) than its share in food consumption (28%). This results from lower coefficients for domestic agricultural and agro-industrial products in consumption of food services (8% and 22% respectively) than in food consumption excluding food services (19% and 48%).

A quarter of the value added of the agriculture branch comes from exports of agricultural products and goods of food processing and beverages industry.

Gross capital formation (GCF) in agri-food products covers the final demand represented by the storage of these products or their fixed assets (e.g. perennial plantations in agriculture) which constitute gross fixed capital formation.

"Other final demands for goods and services" include domestic consumption, GCF or exports of products other than agri-food, but incorporating intermediate consumption with agricultural origin: demand for bio-based materials and energy (biofuels) and goods or services whose production incorporates these products.

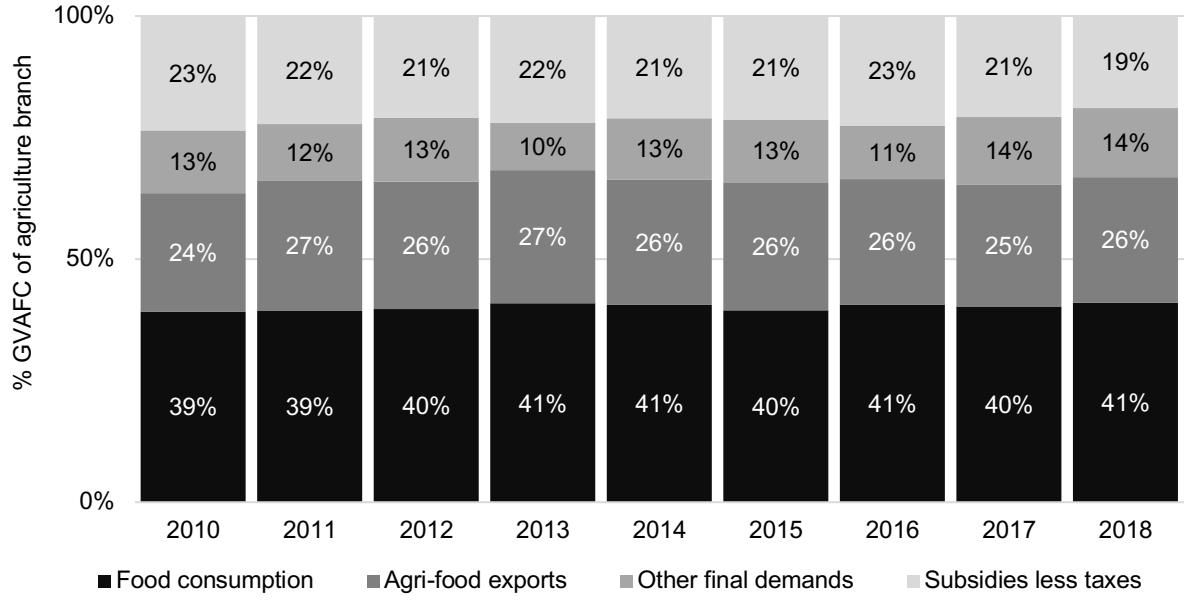
Table 4. **Contribution of final demands and subsidies to gross factor income of the agriculture branch in 2018**

		Value added		Gross operating surplus and mixed income		Salaires bruts	
		M €	%	M €	%	M €	%
Food consumption		15 396	*40.0%*	11 221	*37.1%*	4 176	*50.4%*
Which food services		*2 128*	*5.5%*	*1 551*	*5.1%*	*577*	*7.0%*
Exportations of agri-food and beverages products		9 621	*25.0%*	7 012	*23.2%*	2 609	*31.5%*
Gross capital formation in agri-food products		1 942	*5.0%*	1 415	*4.7%*	527	*6.4%*
Other final demands for goods and services		3 564	*9.3%*	2 598	*8.6%*	967	*11.7%*
Subsidies less taxes		7 979	*20.7%*	7 979	*26.4%*	0	*0.0%*
Gross income of primary factors	Gross Value Added at Factors Costs	38 503	*100.0%*				
	Which Compensation of Employees			*30 224*	*100.0%*		
	Wich Gross Operating Surplus and Mixed Income					*8 278*	*100.0%*

Sources : author's calculation from Insee and Eurostat data.

The evolution of the contributions of the various final demand to the agricultural Gross Value Added at Factors Costs (GVAFC) is shown on Chart 5, it is not very marked over the period considered.

Chart 5. **Contributions of final demand and subsidies to gross value added at factor cost of the agriculture industry**



Sources : author's calculation from Insee and Eurostat data.

The contribution of a final demand to the agriculture GVAFC depends on the amount of that final demand and the share of agriculture value added induced in this final demand. Changes in the value of these items are shown in Charts 6a and 6b for the two major demands on agriculture: agri-food exports (6a) and food consumption (6b).

Chart 6a. **Evolution of agri-food exports, share of agriculture value added in agri-food exports and contribution of agri-food exports to agricultural GVAFC**

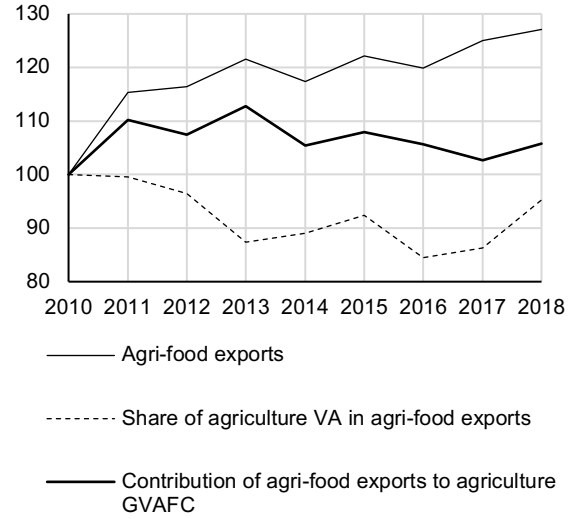
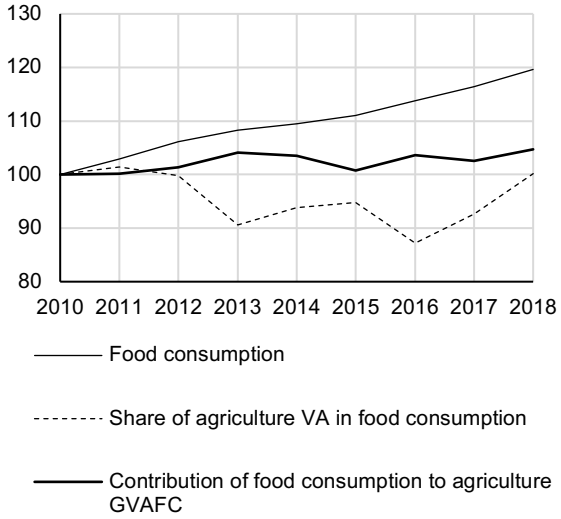


Chart 6b. **Evolution of food consumption, share of agriculture value added in food consumption and contribution of food consumption to agricultural GVAFC**



Sources : author's calculation from Insee and Eurostat data.

The trends in the shares of agricultural value added in food consumption and in agri-food exports are very similar, which is normal: agricultural products are exported more (32% of their final demand) than products of the food industries (26%) but, because of the hypothesis inherent in SIOT, the coefficients of value added induced by the demand final for a given product are identical whatever this demand (consumption, export or GCF).

These shares of value added in food consumption and in exports are variable and trending downwards. Their evolution contributes to the decline and variations in the contribution of these two final demands to the agriculture GVAFC, but their impact on the contribution of these final demands to the agricultural GVAFC is mitigated by the increase of these demands.

Unlike exports, the increase is fairly steady for final consumption, whose prices (and of course volumes) are less volatile, the downstream margins in food chains cushioning the impact on consumer prices of changes in agricultural prices (OFPM, 2020).

On the other hand, the weight of "commodities" in agri-food exports exposes them to the volatility of world prices.

The variability of the contribution of food consumption to agricultural GVAFC is thus less than that of exports.

3. Discussion: scope of results, limitations, outlook

3.1. Scope of results: contribution to debates about sharing or creation of value

The old question of the distribution of value in food chains has been revived by the disarmament of agricultural market regulation policies and the strengthening of competition rules, with their questionable application to the agricultural sector (Prieto, 2018), in a context of price volatility (Huchet-Bourdon, 2011) and concentration of food distribution (Allain *et al*, 2016).

It is in this context that the OFPM is developing a sectoral approach by chain of products, aimed at breaking down the prices of various food goods into the value of the agricultural raw material incorporated and downstream "margins"[13], followed by an analysis of the costs contained in these components.

Compared to this approach, the “food euro” completes in some way the decomposition of costs down to their content in primary factors incomes and, as a result, involves all industry groups in the distribution of value, and not only these considered in the vertical chain of agri-food products.

This going beyond the sectoral analysis and also distinguishes the “food euro” from the study of the distribution of added value in the agri-food chain carried out by the European Commission (EC, 2018), consisting in measuring the share of each agri-food sector in the total value added of all these sectors: in this distribution, French agriculture receives about 20% of the value added *(of the agri-food sectors)*, instead of about 10% of the value added *(induced in all industry groups by food demand)* in the “food euro”.

The comparison between value added and labour induced by food consumption shows that agriculture represents 10% of the value added induced by all industry groups for 15% of induced units of employment measured in full-time equivalent (average 2010-2018).

This refers to certain debates of the OFPM: according to some, the level of agricultural prices result from market structures unfavorable to agriculture and do not make it possible to remunerate agricultural work at the level of its contribution to the creation of value ; for others, on the contrary, prices reveal the values created by each industry, and the distribution unfavorable to agriculture would reflect, above all, the still insufficient productivity of the sector (despite its strong increase in labour productivity, cf. Dechambre 1994, Veysse*t et al*, 2017).

The decomposition of food expenditure into primary factors incomes puts the question of the distribution of value in the agri-food sector into the larger debate about the sharing of value added between labour and capital (Cotis, 2009). However, both data and method constraints limit here the approach to a breakdown in terms of gross incomes.

3.2. The limits of the “food euro”

The SIOT does not allow to go beyond a distribution of gross income: wages, and gross operating surplus including the gross mixed income of capital and self employed labour. The “Overall economic table” of National Accounts gives the decomposition of gross operating surplus into remuneration of owners of capital, net transfers[14], saving and income and wealth taxes, for the three institutional sectors[15].

[13]Trade margins in wholesale and retail trade and, by extension, in the agri-food industries, difference between agri-food production and its intermediate consumption of agricultural origin.

[14] Benefits received minus contributions paid, indemnification minus insurance premiums.

[15] Non-financial corporations, financial corporations, households.

To carry out such a breakdown *branch-by-branch* for gross operating surplus induced by food consumption would require additional data and the distribution of gross operating surplus including mixed income of the SIOT into gross operating surplus at *stricto sensu* and remuneration of self-employment.

The same constraints would apply to the continuation of the decomposition up to the "cost and extra-cost of capital", distinguishing the "normal" remuneration of capital and rents derived from its property (Cordonnier et al., 2013; Garnier, Mahieu, Villetelle, 2015).

The nomenclature of the SIOT aggregates all agricultural products into a single product. Therefore, the SIOT does not allow analysis by chain of food product (meat, milk, fruits and vegs, etc.). If this were the case, the “food euro”, by giving the income obtained from food expenditure by each industry group for each chain of food product, could replace the current sectoral approach of the OFPM.

A fraction of “physiological” food consumption escapes the “food euro”. This is the part of the food services demand included in intermediate consumption by industry groups (business meals) and which is therefore not found in (final) food consumption. About 25% of food services production is used for intermediate consumption, for an amount that would increase food consumption by 9% if it were to be included. The calculation of the “food euro” with food consumption thus enlarged would require a transfer from intermediate consumption of food services to final consumption of these services, thus increasing the value added of the user branches.

As has already been pointed out, the insufficiently detailed nomenclature of the SIOT and its hypothesis of fixed coefficients determine the results of the euro food. The same applies to the treatment of subsidies to products, excluding them from basic prices.

3.3. Outlook

The breakdown of value added down to the cost *and extra-cost of capital* remains a possible objective, but rather in the context of a study than an annual review.

In terms of annual review, it would be useful to reconstruct a *long series of results in the new base of national accounts*. This requires redoing the calculations for previous years on SIOT “retropolated” (backcasted) in new base, with the support of Insee, which had built a tool for this purpose. (Bournay, Khelif, 2012).

The feasibility of a *food euro per food product chain* should be studied, in particular drawing inspiration from the SIOT adaptation work carried out in a study of employment induced by the agricultural sectors of Brittany (Bonnet et al., 2016).

Another goal could be to *extend the approach to other countries*. A test was carried out on twenty European countries for the year 2005 (Butault, Boyer, 2013), which showed significant differences in the composition of national food euros, in terms of the weight of upstream agri-food branch compared to imports or services.

The comparison with the *food dollar* of the United States (Canning, 2011) needs to consider the food euro excluding final imports because the USDA only breaks down the consumption of domestic products (even manufactured with imported inputs). The *food dollar* differs mainly from the *domestic food euro* by a greater weight of the food services (31% *vs* 17%, in 2018), resulting from very different food models and habits, and a smaller share of intermediate imports (6% *vs* 18%), probably due to greater energy autonomy of the USA. In addition, the shares of agriculture are significantly different. (5.6 % in USA *vs* 8.4% in France).

Conclusion

The *"à la Leontief"* calculations are an old macroeconomic method but still relevant for value analysis in the agri-food chain, highlighting the contributions of all activities beyond those that usually define the food chain, and by measuring the revenues they derive from our food expenditures.

This calls for a development of these works, as well as of the complementary studies on transfers of productivity gains in the agri-food sector, by the means of "surplus accounting method", applied to macroeconomic national accounts (Dechambre B., 1994) or to microeconomic sources (Veysset P. et al., 2017)… and also argues for the maintenance of homogeneous statistical series over a long period.

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Appendix

A. *Symmetric input-output table (SIOT) at basic prices excluding subsidies to products, branches and products aggregated*

	Year 2018 Unit : 10^9 €	Agriculture, Fisheries, Aquaculture (1)	Manufacture of food products and beverages and tobacco products	Food services (2)	Trade ans transport (3)	Other manufactures and services (4)	Total	Final consumption	Other final demands (6)	Total use
	Products of agriculture, fisheries, aquaculture (1)	12.3	44.8	1.6	0.0	0.8	59.5	10.1	14.2	**83.8**
	Food products. beverages and tobacco products	5.9	19.6	17.7	2.3	12.3	57.8	78.5	39.0	**175.3**
	Food services (2)	0.0	0.3	1.1	7.6	13.9	23.0	65.1	0.0	**88.1**
	Trade and transport (3)	4.6	15.4	7.3	87.7	123.3	238.2	244.8	153.2	**636.1**
	Other goods & services (4)	13.4	28.7	7.5	169.3	959.6	1 178.3	1 134.5	881.9	**3 194.8**
	Total at basic price *excluding subsidies to products*	36.2	108.8	35.1	266.8	1 109.9	**1 556.8**	**1 532.9**	**1 088.3**	**4 178.0**
+	Intermediate imports (a)	10.8	19.5	7.0	61.2	354.9	453.3			
+	Taxes on intermediate consumption (b)	2.0	2.4	1.4	14.8	67.0	87.6			
=	Intermediate consumption at purchaser's price	49.0	130.7	43.4	342.8	1 531.8	2 097.7			
+	Value added at basic price *excluding subsidies to products* (5)	34.8	44.6	44.6	293.3	1 663.0	2 080.3			
=	Production at basic price *excluding subsidies to products*	**83.8**	**175.3**	**88.1**	**636.1**	**3 194.8**	**4 178.0**			

Notes :

1 The SIOT actually use has 65 branches and products. and :

(1) It distinguishes agriculture from fisheries and aquaculture ;
(2) It does not distinguish, before adaptation, food services from accommodation ;
(3) It distinguishes 3 branches and products for trade and 3 branches and products for transport ;
(4) It distinguishes 29 branches and products in services and 24 branches and products other than food, beverages and tobacco products ;
(5) It breaks down value added into gross wages**,** gross operating surplus including mixed income, and subsidies less taxes ;
(6) It details the "other final demands" in "exportation" and "fixed capital formation".
(a) Importations are detailed by product an using branch in the symmetric table of importations.
(b) Taxes on intermediate subsidies : compare with the inital SIOT (before adaptations), this line is no longer corrected by the subsidies to products included in the value at basic prices of the intermediate consumption, because the deduction has been operated in the line per product.

2 Overall equality between domestic value added and final demand (at basic prices excluding product subsidies):

Domestic value added
= production – intermediate consumption of domestic products (4 178.0 - 1 556.8 = 2 621.2)
= final consumption + other final demands (1 532.9 + 1 088.3 = 2 621.2) = final demand (at basic prices)

Components of domestic value added:

Domestic value added
= value added + intermediate importations + taxes on intermediate consumption

Source : Eurostat, Insee ; adaptation : auteur.

B. *From final consumption of agri-food products to food consumption*

At purchaser's prices Year 2018 Unit : 10^6 €	Final consumption of products *(SIOT and supply-use tables)*	Final consumption of *a priori* food products *(National Accounts, detailed nomenclature)*	Effective consumption by fonction : food, food service. *Excluding territorial correction (*)* *(National Accounts)*
Products of agriculture, fisheries, aquaculture	34 301	28 499	28 021
Products of food and beverage manufactures	161 830	158 914	156 247
Total « food excluding food services »	196 131	187 413	184 268
Food services	70 718	70 718	71 536
Total « food including food services »	266 849	258 131	255 805

(*) territorial correction : the expenses of residents abroad (import) minus the expenses of non-residents in France (export).

Source : Eurostat, Insee

C. *Matrix calculations*

1) Domestic values added induced by final demands

Let $\left[V^{FD}\right]$ the square matrix with n branches and products, which terms are $V_j^{FD_i}$, *domestic* value added induced in the branch j by the final demand of the product i : FD_i such that (cf. Appendix A, note 2) :

$$\sum_{j=1}^{n} V_j^{FD_i} = FD_i \qquad [1]$$

Without exposing here the demonstration (see Leontief, 1936, 1986), we have :

$$\left[V^{FD}\right] = \langle v \rangle [I - A]^{-1} \langle FD \rangle \qquad [2]$$

with :

- $\langle v \rangle$ diagonal square matrix of the ratios of domestic values added in the output of branches j,
- $[I - A]^{-1}$ inverse of square matrix of difference between the square identity matrix $[I]$ and $[A]$ the square matrix of domestic technical coefficients of the SIOT formed by the ratios of intermediate consumption of each domestic product i in the production of each branch j.
- $\langle FD \rangle$ diagonal square matrix of final demands in domestic products i,

Each term of $[I - A]^{-1}$ is the output of branch j necessary for (or induced by) one euro of final demand of domestic product i. Each term of the square matrix :

$$[w] = \langle v \rangle [I - A]^{-1} \qquad [3]$$

is the coefficient of domestic value added in the branch j induced by one euro on the final demand of the domestic product i.

Note :

$$[I - A]^{-1} \langle FD \rangle = \left[P^{FD}\right] \qquad [4]$$

with $\left[P^{FD}\right]$ the square matrix of productions (in row) induced by final demand of products (in column).

2) Values added induced by final consumptions without margins

$$\left[V^{FC}\right] = [w]\langle FC\rangle \qquad [5]$$

is the square matrix of *domestic* values added induced in the branches by the final consumption in products, which terms, as in [1], verify :

$$\sum_{j=1}^{n} V_j^{FC_i} = FC_i \qquad [6]$$

From the SIOT, we have (cf. annexe A) :

$$V_j = VA_j + IC_{X\,j} + T_{IC\,j} \qquad [7]$$

with :

- V_j : *domestic* value added of branch j ;
- VA_j : value added of branch j ;
- $IC_{X\,j}$: intermediate consumptions of branch j in imported inputs :
- $T_{IC\,j}$: taxes on intermediate consumption of branch j.

The structure of domestic value added from equation [7] applies to the part of this domestic value added which is induced by the final consumption : from [6] and [7] is therefore derived the composition of the final consumption of any product i in values added, imported intermediate consumptions and taxes on intermediate consumptions, induced in the various branches j by the final consumption of i, then :

$$FC_i = \sum_{j=1}^{n} VA_j^{FC_i} + \sum_{j=1}^{n} IC_{X\,j}^{FC_i} + \sum_{j=1}^{n} T_{ICj}^{FC_i} \qquad [8]$$

For the index i corresponding to the agri-food products and food services, equation [8] gives the decomposition of the finals consumption of said domestic products and services, in values added, imported inputs and taxes on inputs induced in the n branches.

3) Taking into account margins

The “Supply and Use Balance” tables give MF_i , domestic margins of the final consumption of domestic and imported products i.

Let $VA_j^{MF_i}$, $CI_{X\,j}^{MF_i}$ et $T_{CIj}^{MF_i}$, the components of MF_i to be added term to term to those of [8], and such that :

$$MF_i = \sum_{j=1}^{n} VA_j^{MF_i} + \sum_{j=1}^{n} IC_{X\,j}^{MF_i} + \sum_{j=1}^{n} T_{ICj}^{MF_i}$$

They are obtained by weighting with :

$MF_i \,/FC_{t\&t}$, $FC_{t\&t}$ *being the final consumption of trade and transport given by the SIOT,* each of the the following terms :

$VA_j^{FC_{t\&t}}$, $IC_{Xj}^{FC_{t\&t}}$ and $T_{IC\,j}^{FC_{t\&t}}$, *obtained from* $V_j^{FC_{t\&t}}$ *: domestic value added induced by the final consumption of trade and transport, given by* $\left[V^{FC}\right]$ *(cf. [5]) and broken down by applying equality [7].*

4) Alternative approach

It is possible to calculate the matrix $[w]$ of [3] from the SIOT *maintained at basic prices (including subsidies to products)*, and to apply it as before to *final consumption excluding product subsidies*.

Then, compared with former results, the components of final consumption are:

- $\left(VA_j^{FC_i} + S_{P\,j}^{FC_i}\right)$, values added *at basic price*, thus including subsidies to products $S_{P\,j}^{FC_i}$;
- $IC_{X\,j}^{FC_i}$, imported intermediate consumption, term without change ;
- $\left(T_{ICj}^{FC_i} - S_{ICj}^{FC_i}\right)$, taxes on intermediate consumption, less their subsidies to products.

The share of value added in the food euro is thus increased, but by elements of subsidies not included in consumer expenditure (but indirectly induced by it). The share of the taxes are reduced. The calculation at basic price leads to consider that a part of the taxes included in consumer expenditure, ultimately paid by him to the State, finances the subsidies received by the producer, paid to them by the State, and therefore ultimately by consumers-tax-payers.

5) Employments induced by final consumption

They are obtained by a calculation of the type [4]:

$$\left[L^{FC}\right] = [l]\,[I - A]^{-1}[FC] \qquad [9]$$

L an l being respectively employments in full-time equivalent and employment ratios in the input of the branches.

6) Contributions of final demands to agricultural gross income

The Gross Value Added at Factors Costs (GVAFC) of branch j is given by

$GVACF_j = VA_j + S_j$

with VA_j : value added without subsidies to product, and S_j : all operating subsidies less all taxes on production.

The values added induced in the branches j by exportations and gross capital formation in products i ($VA_j^{EX_i}$ and $VA_j^{KF_i}$) are calculated as was calculated VA_j^{FCi}. And, the value added of any branch (which agriculture) being induced by the final demands to which the branch contributes to serve, we have :

$$GVACF_j = \sum_{i=1}^{n}\left(VA_j^{FC_i} + VA_j^{EX_i} + VA_j^{KF_i}\right) + S_j \qquad [10]$$