Generation and distribution of productivity gains in French agriculture
Who are the winners and the losers over the last fifty years?

Jean-Philippe BOUSSEMART
University of Lille and LEM/IESEG-School of Management
jp.boussemart@ieseg.fr

Jean-Pierre BUTAULT
INRA Paris and INRANancy
Jean-Pierre.butault@nancy-engref.inra.fr

Oluwaseun OJO
CNRS/LEM and IÉSEG School of Management
o.ojo@ieseg.fr

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Abstract:

This paper offers an approach based on the economic theory of index numbers that revisits the classical surplus accounting technique. We measure the productivity gains and the combined effects of output and input price variation on French farmers' income between 1959 and 2011, for the whole agricultural sector. During this period, total factor productivity grows at an average annual rate of 1.4% mainly due to a decrease of input quantity over the last thirty years while output volume has stagnated since the end of the nineties. Over the whole period, with a share of nearly 70% of the global surplus, the customers appear as the main beneficiaries of these productivity gains through a decrease in agricultural and food prices. Farmers only retained 23% of the surplus corresponding to a low increase in farm income. Finally, the suppliers and taxpayers are the losers in the surplus distribution via respectively a significant decrease of relative intermediate input prices and a substantial growth of public subsidies in favour of the agricultural sector.

JEL classification: C43, D24, D33, Q18
Keywords : Index numbers, Total Factor Productivity, Factor income distribution, Agricultural and food policy

1. INTRODUCTION

As a major source of growth and the main determinant of real prices, productivity is a key variable in economics. As Zvi Griliches once stated it, if there was only one thing that should be measured in economics, one should focus on Total Factor Productivity (TFP). In fact, productivity is a variable of interest because its time changes determine welfare. However measuring productivity gains is only one side of the problem. Attention should also be paid to the distribution of productivity gains among the different inputs and outputs retained by the technology in order to assess which of them recover price advantages from technical innovations and better management.

For a long period, this last question has been considered as a key issue in productivity analysis. Kendrick (1961), Kendrick and Sato (1963), devoted a large part of their works to measure TFP growth from quantity changes and Productivity Surplus (PS) shares from price variations simultaneously. During the seventies, such analyses became a standard practice in France or other European countries. Particularly, the agricultural sector was one of the industries where numerous studies were conducted in order to conclude if the productivity gains generated by farmers were captured or not by the upstream and downstream sectors.

More recently, thanks to the index number theory and the use of flexible parametric functional forms or non parametric data envelopment techniques which allowed new technology modeling developments, TFP estimations have been an extraordinarily innovative field of research (Hulten et al., 2001; Fried et al., 2008). Unexpectedly, few interests have been focused on the distribution side of TFP gains. Several reasons can be mentioned to explain it. First, while the popular Laspeyres and Paasch indexes were the pillars of the surplus accounting techniques which allows the sharing of productivity changes into price variations among the different stakeholders, the index number theory shed light on the caveats concerning usual TFP estimations based on these Paasche and Laspeyres measures (Diewert, 1976). Second, the development of computable general equilibrium models made sectoral accounting analyses less fashionable (attractive). Third and especially in the agricultural sector, the debate about the link between productivity gains, the producer's income and its comparative level with other industries became less topical in the developed countries (even though the objective of parity is still embedded in the farm legislature). Finally in Europe, with the collapse of the Marxist analysis in agricultural economics, the distributive side of technical innovations received less attention.

Nevertheless, it seems crucial to include both generation and distribution of TFP changes in the debate on agricultural policy. Because many governments interfere with producer prices and provide direct payments to farmers, value advantages coming from TFP growth should be taken into account by policies setting administrative prices and subsidies. For example, if farmers are able to retain a significant share of their productivity gains, direct payments or output prices could be adjusted downwards over time in a relatively painless way. Inversely, if farmers leave their productivity gains to consumers through price decreases or to the upstream sector or to landowners by input price increases, it could be justified (at least in the short run) to augment direct payments as a compensation for policy reforms.

This paper proposes to evaluate the productivity gains and the combined effects of output and input price variations for the whole French agricultural sector over the last fifty year period. Through the surplus accounting technique and the use of superlative additive indexes, TFP changes are estimated as the difference between the output and input quantity variations. Simultaneously this global Productivity Surplus (PS) is splitted into its price change

components in order to determine the stakeholders (farmers, customers, suppliers, landowners, etc.) who are (or not) the beneficiaries of these TFP gains. Since the nineties, major reforms of the Common Agricultural Policy (CAP) have resulted to a decrease in institutional prices while "Compensatory Payments" have risen. Therefore, our study provides some arguments to justify or not the past refusal of some countries such as France to adopt the proposal of some Member states for making the direct payments degressive. In addition, our conclusions concerning the most recent period characterized by high levels and volatilities of output prices highlight the relevant current debate in Europe as regards the evolution of previous deficiency payments up to countercyclical subsidies as it is in progress in the United States.

The remaining part of this paper is therefore organized as follows. In the next section, we present the surplus accounting technique, its superlative quantity and price indexes necessary to measure and to share TFP gains while stating their relevance to this paper. Section 3 details the computation of TFP changes and price advantages for our empirical application on the French agricultural sector as linked with its main different stakeholders. Lastly, section 4 summarizes our conclusions.

2. SURPLUS ACCOUNTING REVISITED

2.1 Surplus accounting

Surplus accounting provides an extension of the index number approach by describing how the economic surplus resulting from productivity growth are shared between the various agents (Kendrick and Sato, 1963; Courbis and Temple, 1975; CERC, 1980). Considering that the total value of *J* differents outputs is exhausted into returns to *I* differents inputs, the accounting identity holds for any particular sector.

$$\sum_{j=1}^{J} p_j y_j = \sum_{i=1}^{I} w_i x_i \qquad (1)$$

with p_j price of output y_j and w_i price of input x_i

The difference of equation (1) between period t and period s leads to:

$$\sum_{j=1}^{J} p_j^t y_j^t - \sum_{j=1}^{J} p_j^s y_j^s = \sum_{i=1}^{I} w_i^t x_i^t - \sum_{i=1}^{I} w_i^s x_i^s \quad (2)$$

Given equation (2), changes in the output and input values between two periods can be expressed in terms of changes in quantities and prices. Considering that $p_j^t = (p_j^s + dp_j)$, $y_j^t = (y_j^s + dy_j)$, $w_i^t = (w_i^s + dw_i)$ and $x_i^t = (x_i^s + dx_i)$, equation 2 can be transformed as:

$$\sum_{j=1}^{J} (p_j^s + dp_j)(y_j^s + dy_j) - \sum_{j=1}^{J} p_j^s y_j^s = \sum_{i=1}^{I} (w_i^s + dw_i)(x_i^s + dx_i) - \sum_{i=1}^{I} w_i^s x_i^s$$

$$\sum_{j=1}^{J} p_j^s y_j^s + \sum_{j=1}^{J} p_j^s dy_j + \sum_{j=1}^{J} dp_j y_j^s + \sum_{j=1}^{J} dp_j dy_j - \sum_{j=1}^{J} p_j^s y_j^s = \sum_{i=1}^{I} w_i^s x_i^s + \sum_{i=1}^{I} w_i^s dx_i + \sum_{i=1}^{I} dw_i x_i^s + \sum_{i=1}^{I} dw_i dx_i - \sum_{i=1}^{I} w_i^s x_i^s$$

$$\sum_{j=1}^{J} p_j^s dy_j + \sum_{j=1}^{J} dp_j (y_j^s + dy_j) = \sum_{i=1}^{I} w_i^s dx_i + \sum_{i=1}^{I} dw_i (x_i^s + dx_i)$$

And after simplification and re-arrangment, it leads to equation (3)

$$\sum_{j=1}^{J} p_j^s dy_j - \sum_{i=1}^{I} w_i^s dx_i = -\sum_{j=1}^{J} dp_j y_j^t + \sum_{i=1}^{I} dw_i x_i^t \quad (3)$$
$$PS = PA$$

where the left hand side represents the productivity surplus (PS) defined as a difference between the price weighted changes in output and input quantities. The right hand side measures the sum of price advantages (PA). For any stakeholder, its price advantage or remuneration change over the two periods is equal to the difference between the quantity weighted changes in its related output or input price[1]. Such price variations result in transfers between agents that add to the value of the productivity surplus and fundamentally, equation 3 means that the sum of remuneration changes shared among the different stakeholders (PA) cannot exceed the total productivity gains (PS). By regrouping positive price advantages on the left hand side and on the right hand side, PS with all price disadvantages (negative price advantages in absolute value), one can establish the following balanced productivity surplus account (table 1):

Table 1. Balanced surplus account

Uses	**Resources**
	PS (if >0)
	+
$-dp_j y_j^t$ for any price decrease of output *j*	$dp_j y_j^t$ for any price increase of output *j*
+	+
$dw_i x_i^t$ for any price increase of input *i*	$-dw_i x_i^t$ for any price decrease of input *i*
…	…
Total economic surplus	**Total economic surplus**

The productivity surplus can be negative (productivity losses). In such a case, since the equality between PS and PA has to be maintained in equation (3), the productivity losses have to be compensated through increases in some output prices or decreases in some input costs.

Overall, the various changes in quantities and prices correspond to either an "origin" (resources) or a "distribution" (uses) of the total economic surplus. For instance, national accounts available at the French agricultural sector level allow the splitting of value changes into quantity and price effects. Thus enabling us to analyze all the corresponding transfers among customers, suppliers of intermediate inputs (seeds, chemicals, energy, feeding stuffs, services, …), suppliers of primary inputs (labour, land, fixed assets) and government (subsidies and taxes). Table 2 depicts the corresponding transfers.

[1] An input price increase is considered as a price advantage for the corresponding input (its remuneration is increasing) while an output price decrease has to be considered as a price advantage for the customer (output price is becoming cheaper).

Table 2. Origin and distribution of the total economic surplus

	Total economic surplus	
	Distribution or uses	Origin or resources
Technical and Efficiency changes	Negative productivity surplus	Positive productivity surplus
Customers	Decrease in output prices	Increase in output prices
Suppliers of intermediate inputs	Increase in the price of intermediate inputs	Decrease in the price of intermediate inputs
Suppliers of primary inputs	Increase in the return to primary inputs	Decrease in the return to primary inputs
Government	Increase in taxes, decrease in subsidies	Decrease in taxes, increase in subsidies

2.2 Productivity surplus (PS) and Total Factor Productivity (TFP) change

With equation (3), productivity gains (PS) are defined as the difference between output and input quantity variations expressed in absolute terms (i.e in euros). They can also be directly referred to the usual Solow technical change residual as a measure of TFP growth rate expressed in relative terms (%). Let us define the traditional underlying multi-output and multi-input production function:

$$\begin{gathered} F(\mathrm{y},\mathrm{x},t)=0 \\ \text{with t a time trend} \\ \text{and x, y input and output vectors respectively} \\ \mathrm{x}=(x_1,x_2,...,x_i,...,x_I) \\ \mathrm{y}=(y_j,y_2,...,y_j,...,y_J) \end{gathered} \quad (4)$$

From equation (4) and assuming output prices equal to marginal costs and marginal productivity returns for input prices, the residual technical change defining TFP growth rate over time can be estimated as the weighted output variations not explained by weighted input changes:

$$\frac{dTFP}{TFP}=\sum_{j=1}^{J}\alpha_j\frac{dy_j}{y_j}-\sum_{i=1}^{I}\beta_i\frac{dx_i}{x_i} \quad (5)$$

With α = vector of the J output shares in total revenue and β vector of the I input shares in total cost.

Replacing $\alpha_j\frac{dy_j}{y_j}$ by $\frac{p_j dy_j}{\sum_{j=1}^{J}p_j y_j}$ and $\beta_i\frac{dx_i}{x_i}$ by $\frac{w_i dx_i}{\sum_{i=1}^{I}w_i x_i}$ and considering that the total revenue is entirely exhausted into the total cost ($\sum_{j=1}^{J}p_j y_j=\sum_{i=1}^{I}w_i x_i$), TFP growth rate becomes:

$$\frac{dTFP}{TFP}=\frac{\sum_{j=1}^{J}p_j dy_j-\sum_{i=1}^{I}w_i dx_i}{\sum_{j=1}^{J}p_j y_j} \quad (6)$$

which is the productivity surplus rate defined as PS from equation (3) divided by the total output value.

2.3 A Bennet based productivity surplus decomposition

In equation (3), PS is defined as Laspeyres output and input quantitity changes weighted by price levels from initial period s while PA is equal to Paasch output and input price variations weighted by quantity levels from final period t. These two components can be similarly defined through a Paasch quantity changes and a Laspeyres price variation respectively:

$$\sum_{j=1}^{J} p_j^t dy_j - \sum_{i=1}^{I} w_i^t dx_i = -\sum_{j=1}^{J} dp_j y_j^s + \sum_{i=1}^{I} dw_i x_i^s$$

$$PS^{Paasche} = PA^{Laspeyres}$$

The equivalent relationship could be expressed in terms of a Bennet additive index which relies on an arithmetic average of the two Laspeyres and Paasch expressions of PS and/or PA

$$\sum_{j=1}^{J}\left(\frac{p_j^t + p_j^s}{2}\right)dy_j - \sum_{i=1}^{I}\left(\frac{w_i^t + w_i^s}{2}\right)dx_i = -\sum_{j=1}^{J} dp_j\left(\frac{y_j^t + y_j^s}{2}\right) + \sum_{i=1}^{I} dw_i\left(\frac{x_i^t + x_i^s}{2}\right)$$

$$\frac{1}{2}\left(PS^{Laspeyres} + PS^{Paasch}\right) = \frac{1}{2}\left(PA^{Paasch} + PA^{Laspeyres}\right) \qquad (7)$$

$$PS^{Bennet} = PA^{Bennet}$$

This productivity surplus decomposition does not depend on any arbitrary choice between the two periods. It can be refered to as the superlative index concept notably the Fisher, while the additivity property of the aggregation formula enables the splitting of value changes into price and quantity effect in absolute terms. However this Bennet based productivity surplus decomposition has not received a great deal of attention in the literature, it can here prove its usefulness. Compared to the Fisher index, it is not multiplicative but additive[2] and presents the same relevant properties of equicharacteristicity[3]. Additionally, this Bennet computation of PS is consistent with the general Malmquist or Luenberger TFP formulations. Namely, Caves et al (1982) have shown that the Bennet index closely approximates the true TFP change that is as much defendable as the Fisher index which is considered as the most general and satisfactory index (Diewert, 1992). In practice, both indexes lead to extremely similar results (and so does the Törnqvist index). This has been observed by all users who have made empirical comparisons of index numbers in time series as well as in cross section analyses (see for example Bureau et al, 1990).

[2]The additivity property means that the real value (or volume) of an aggregate is equal to that obtained by adding the real values of the components at any aggregation sub-level.

[3]Property which says that an index should not be dependent on the basket of goods of one particular period.

3. GENERATION AND DISTRIBUTION OF PRODUCTIVITY GAINS IN FRENCH AGRICULTURE

3.1 The data

This study focuses on the French aggregate agricultural sector. Value, quantity and price indexes originate from National Accounts published by INSEE (Institut National de la Statistique et des Etudes Economiques) and Eurostat. The methodology of the Agricultural National Accounts is detailed in Eurostat (2000). Over the period 1959-2011, the accounts are expressed in current national currency and in chain-type quantity or price indexes (base year 100=2005). The output vector comprises 30 different products (18 crops, 10 animal products and 2 service activities) while the input vector contains 15 specific inputs (10 intermediate inputs, capital consumption, land, government, hired labour and finally managerial or entrepreneurial input).

Table 3. Inputs and outputs retained in the surplus decomposition

Inputs	Outputs	
Intermediate inputs:	**Crop products:**	**Animal products :**
Seeds and planting stock	Durum	Cattle
Energy and lubricants	Wheat	Calf
Fertilisers and soil improvers	Grain maize	Sheep and goats
Pesticides	Barley	Equines
Veterinary expenses	Other cereals	Pigs
Feedingstuffs	Oeaginous products	Poultry
Maintenance of materials	Protein crops	Eggs
Maintenance of buildings	Raw Tobacco	Milk
Agricultutal services	Sugar Beet	Dairy products
Other good and services	Other industrial crops	Other animal products
Fixed capital consumption	Fodder maize	**Agricultural services output**
Land	Others forage plants	
Hired Labour	Fresh vegetables	**Secondary activities**
Government	Plant and flowers	
Entrepreneurial income	Potatoes	
	Fresh fruit	
	Quality wine	
	Table wine	

Concerning the primary inputs (fixed assets, land and labour), some rules have to be stipulated to decompose value changes in quantity and price effects. The quantity of capital consumption (machinery and building equipment) is calculated by the depreciation at constant price. Land quantity is measured as the total surface in hectare (hired and owned land) and changes in quality are assumed to be reflected in price variations. The quantity of hired labour is estimated in full time worker equivalent. Regarding the price of primary factors, user costs were defined so as to respect the accounting identity (1). For hired land, the user cost is defined as the value of land rents paid. As regards to the owned land, a fictitious price equal to the hired cost of leased land is used. The unit cost of hired labour is equal to the total compensation of salaries divided by full time equivalents of hired workers. Since farmers pay

taxes and receive subsidies, the stakeholder “government” has to be put into consideration. For this specific stakeholder, we consider a return calculated by total taxes minus total subsidies in value terms. Quantity variations of land taxes are supposed to be correlated with land surfaces owned by the famers while the volumes of taxes and subsidies on production are directly linked to their related quantity output indexes. Finally, the entrepreneurial or managerial income is measured as the difference between the value of output (including taxes and subsidies) and the value of all other inputs. Therefore, its unit cost is obtained by dividing this income by the family labour units expressed in full time equivalent persons.

3.2 Generation of productivity gains and TFP growth

PS measured as the gap between input and output quantity variations leads to different results according to the chosen price system (Laspeyres or Paasch formulations). With Laspeyres price weights for quantities, the average annual PS amounts to 1 228 millions of 2005 euros while with Paasch weights, it only reaches 899 millions of 2005 euros. This result takes its origin from the significant negative correlation between quantity and price of some main products in the agricultutal sector such as fruits, potatoes, wine, poultry and pork. For these outputs, there is no price intervention to prevent price volatility due to an inelastic demand. Therefore, the Bennet PS calculated as an arithmetic mean of the Paasche and Laspeyres PS is around 1 064 millions of 2005 euros. Over the whole period, the cumulated PS represents a total of 55 327 millions of constant euros.

According to equation (6), the ratio between PS and the global output value represents the annual TFP growth rate generated by technological and efficiency changes. Figure 1 presents TFP evolutions between 1959 and 2011 using the Laspeyres, Paasch and Bennet formulations and calculated through equation (6). As for the various calculations of PS, there are significant differences between the Paasche and Laspeyres indexes since their respective annual growth rates range from 1.20% to 1.68% respectively. Retaining the arithmetic mean of these two trends thanks to the Bennet formulation, French agricultural productivity gains reaches 1.44% per year over the whole period. Indeed, TFP growth rates are significantly different based on four different periods. Between 1959 and 1973, despite a high progress in input utilisations and especially in chemical, machinery and feedstuff concentrates, TFP have augmented by 1.37% per year thanks to a rapid progression of output volume (2.20%). As a consequence, capital and intermediate input productivities have decreased while the partial productivities of labour and land have increased. During the second period (1974-1991), TFP grows faster and attains 1.89% per year. Despite a slowdown of output growth (1.76%), this significant TFP gains essentially results from labour savings combined with a stagnation of machinery and chemical. This follows that the partial productivity increments for each input and notably for labour. The third period beginning in 1992 until 2002 is still characterized by a high TFP growth rate (1.65%) mainly due to a rapid decrease of family labour whereas hired labour seems to be increasing. Finally over the last period (2003-2011), TFP rates declines significantly despite a continuous decrease of family labour input and a stagnation of the other input quantities. This low performance originates from a lack of output progress which seems mainly explained by the successive CAP reforms and the liberalisation process of international exchanges. The intervention price reductions and the decoupling of agricultural aids have partially promoted more extensive farming techniques and crop yield contractions.

Figure 1 TFP evolutions in logarithm terms over the period 1959-2011
(100 = 1959)

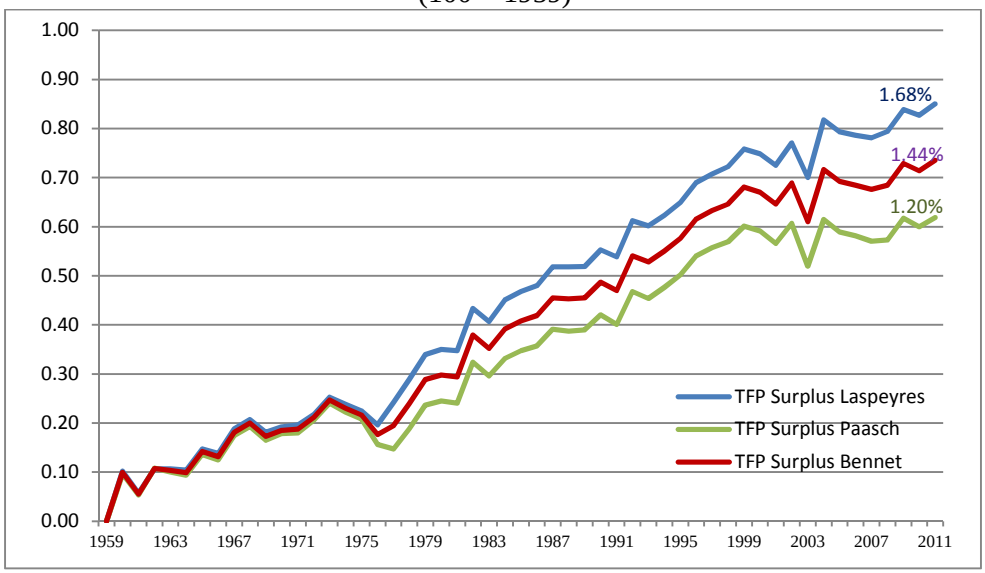


Table 4 : Annual growth rate of output, input, TFP and partial productivities in French agriculture based on four sub-periods and the PS Bennet formulation

	1959-1973	1974-1991	1992-2002	2003-2011
Output (%)	2.20	1.76	0.90	0.23
Input (%)	0.83	-0.18	-0.78	-0.75
TFP or surplus rate (%)	1.37	1.89	1.65	0.94
Partial productivities				
Intermediate inputs (%)	-1.16	0.67	0.30	0.63
Capital (%)	-3.19	1.10	0.72	0.20
Land (%)	2.44	2.33	1.27	0.86
Hired labour (%)	6.05	4.27	-0.50	0.50
Family labour (%)	5.09	5.28	4.79	2.74

3.3 Distribution of economic surplus and price advantages

Over the whole period, the global economic surplus cumulating PS and all negative price advantages expressed in absolute value represents a total of 84 000 millions of constant euros. This aggregate mainly comes from productivity gains (66%) but also from relative price decreases (price disadvantages) related to different stakeholders as suppliers (18%) government (12%) and land owners (4%). These resources are distributed among customers who are the principal beneficiary stakeholders (69%) followed by the farmers 23% and salaries (7%).

Beyond this synthetic cumulated balanced surplus account, more detailed assessments can be drawn by different stakeholders according to the four previous sub-periods which are characterized by specific relative price evolutions (cf tables 6 to 9 and figures 3 to 4).

Table 5. Cumulated balanced surplus account 1959-2011
in millions of 2005 euros

	Uses	**%**		**Resources**	**%**
Customers	58 315	69.4	PS	55 327	65.8
Hired labour	6 119	7.3	Suppliers	15 365	18.3
Fixed assets	156	0.2	Government	9 962	11.9
Farmers	19 450	23.1	Land owners	3 386	4.0
Distribution of economic surplus	**84 040**	**100.0**	**Generation of economic surplus**	**84 040**	**100.0**

During the 60s until the beginning of the 70s (cf. table 6), productivity gains were mainly absorbed by the farmers while the consumers and/or the downstream industry get slight advantages in terms of regular food price decreases. Simultenaously, the intermediate input cost reduction and the progressive rise of public aids through the European intervention prices impacted farmers' incomes positively and represented significant resources of the global economic surplus.

Table 6. Origin and distribution of the total economic surplus for period 1960-1973
(annual average in millions of 2005 euros)

	Uses		Resources	
PS			1 348.8	62%
Customers	352.7	16.2%		
Suppliers			512.2	23.5%
Fixed Assets			57.7	2.6%
Land owners			62.6	2.9%
Government			199.5	9.1%
Hired Labour	205.8	9.4%		
Family Labour	1 622.3	74.4%		
Total economic surplus	2 180.8	100.0%	2 180.8	100.0%

The second period (cf. table 7) starting from the first oil shock to the 90s was still characterized by a significant TFP growth, a rapid decrease of intermediate input prices and high levels of European intervention prices. Contrary to the previous period, producers' revenue did not benefit from these components which contributed to providing substantial price advantages to the consumers. This later clearly signaled that French producers did not catch any advantage from the productivity gains that they were able to generate despite the objective of the CAP to improve their revenue.

Throughout the third period (cf. table 8) following the major 1992 CAP reform (1992-2002), one can note that both consumers and farmers' price advantages were augmented thanks to new resources coming from several components: high TFP growth rates, new direct "compensatory" payments (which were provided to producers on a per hectare basis for arable crops or on a per head of cattle basis for beef) introduced to compensate European intervention price reductions and continuous intermediate input cost reductions. All along this eleven year period, thanks to high productivity gains, the progressive direct payment

settlement seems to over-compensate the prevous price supports. Overall, farmers were able to keep two third of their productivity gain distribution. After the second wave of reforms called “Agenda 2000” adopted in 1999, new direct payments decoupling from the output production were introduced to offset further price decreases. Nevertheless, these decoupling subsidies did not compensate production price reductions and as a result, farmers’ income declined significantly while consumer’s advantages followed the chaotic TFP variations.

Table 7. Origin and distribution of the total economic surplus for period 1974-1991
(annual average in millions of 2005 euros)

	Uses		Resources	
PS			1 027.8	43.6%
Customers	2 214.3	94.0%	0.0	
Suppliers			577.0	24.5%
Fixed Assets			0.1	0.0%
Land owners			124.9	5.3%
Government			131.8	5.6%
Hired Labour	142.6	6.0%		
Family Labour			495.3	21.0%
Total economic surplus	2 356.8	100%	2 356.8	100.0%

Table 8. Origin and distribution of the total economic surplus for period 1992-2001
(annual average in millions of 2005 euros)

	Uses		Resources	
PS			1 325.5	62.2%
Customers	1 552.7	72.8%		
Suppliers			242.0	11.4%
Fixed Assets	13.9	0.7%		
Land owners	13.9	0.7%		
Government			564.5	26.5%
Hired Labour	16.6	0.8%		
Family Labour	534.9	25.1%		
Total economic surplus	2 132.0	100.0%	2 132.0	100.0%

Finally for the most recent period from 2005 to 2011(cf. table 9), the TFP slowdown combined with the output price volatility and the growth of intermediate input prices have led to huge deviations for producers’ revenue and significant price disadvantages for consumers whereas the suppliers have significantly turned up their own advantages. The degression of public aids has also resulted to a new favourable share of economic surplus for the Government[4].

[4] One can note that this recent period is characterized by the decoupling of public aids. As a result, splitting the value of subsidies between quantity and price effects are no more significantly linked to the output quantities as it is assumed in our surplus model for the past period. Another rule of calculation could modify our conclusion about the government’s surplus share.

As a last point, one can note that for hired labour its price advantages were continuously progressive over the whole period while land owners did not get any positive return from their land properties except during the second short period (1992-2001).

Table 9. Origin and distribution of the total economic surplus for period 2002-2011 (annual average in millions of 2005 euros**)**

	Uses		Resources	
PS			373.8	44.4%
Customers			395.4	47.0%
Suppliers	539.4	64.1%		
Fixed Assets	90.3	10.7%		
Land owners			46.1	5.5%
Government	157.0	18.7%		
Hired Labour	54.3	6.5%		
Family Labour			25.7	3.1%
Total economic surplus	840.9	100.0%	840.9	100.0%

Figure 3: Evolutions of resources by different stakeholders (in cumulated millions of constants euros 2005)

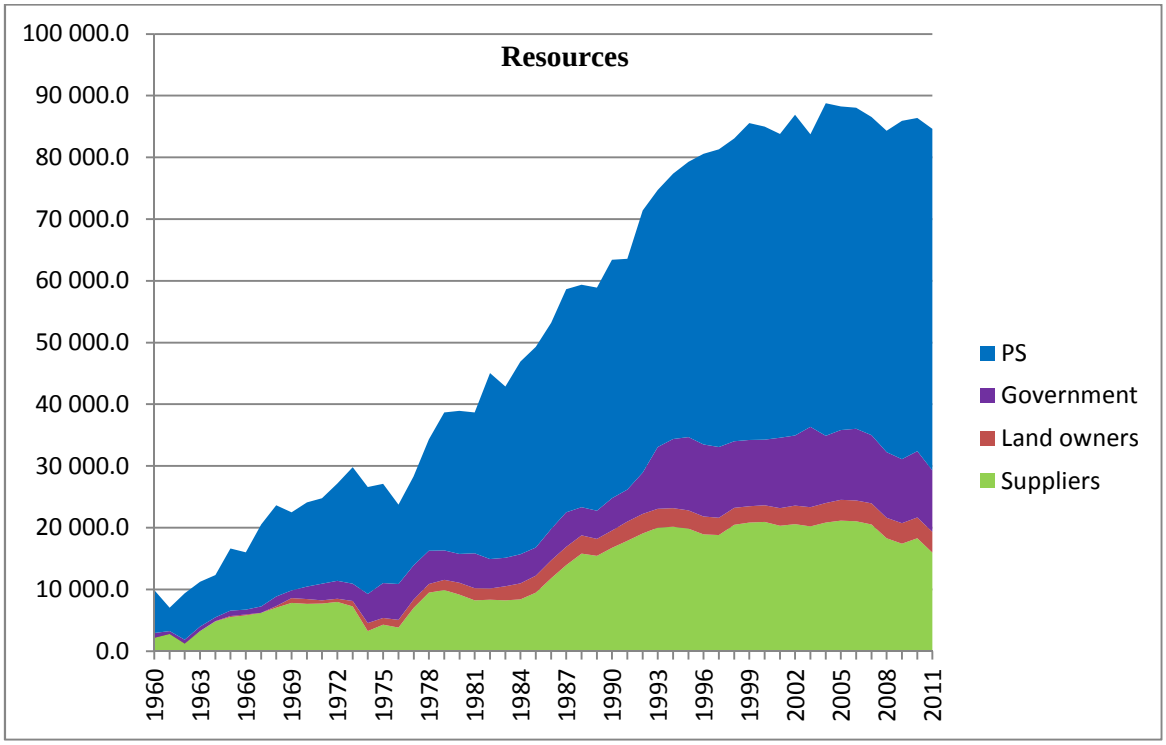
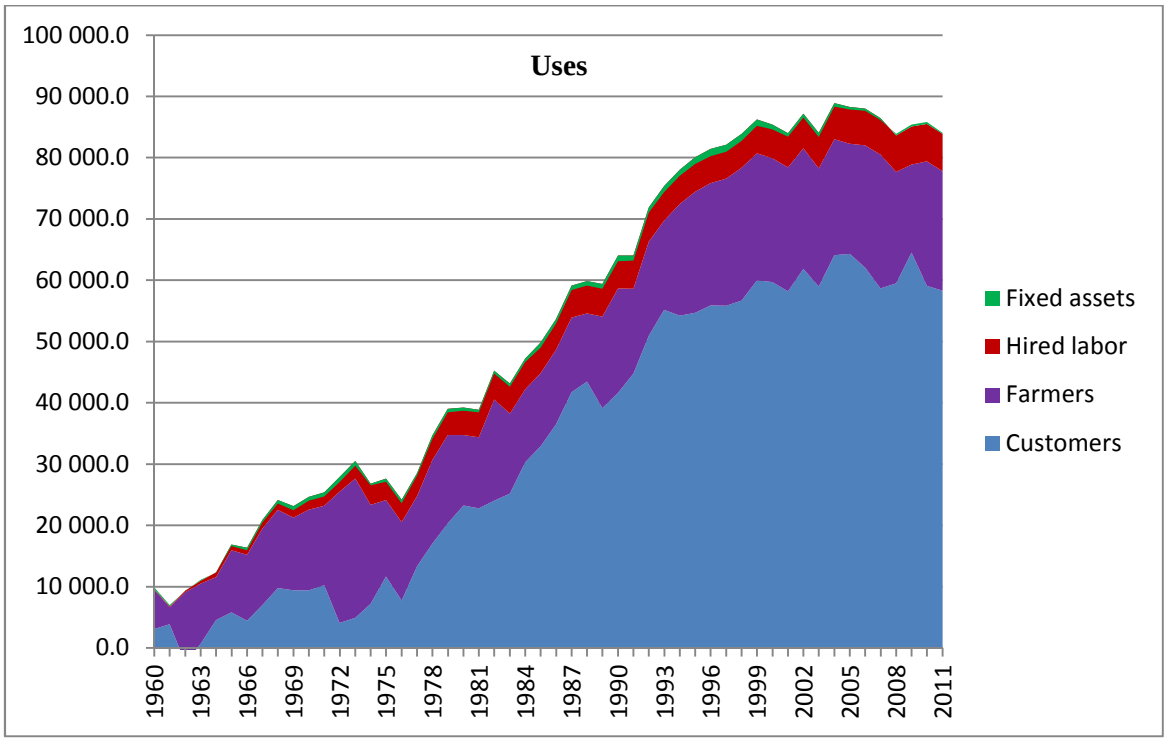


Figure 4: Evolutions of uses by different stakeholders
(in cumulated millions of constants euros 2005)



4. CONCLUSION

Several conclusions can be drawn from this study concerning the generation and distribution of productivity gains in French agriculture over the last fifty years.

From a methodological point of view, our results first argue in favor of using equicharateristic price or quantity indexes such as Bennet indexes in order to estimate TFP evolutions in an industry such as agricultural sector characterized by a high negative correlation between prices and output quantities through an inelastic demand. Second, they demonstrate the usefulness of the surplus accounting technique and its additive formulation in order to calculate simultaneously the generation and distribution of productivity gains from the farming sector among its upstream and downstream industries. Moreover, this framework can easily be applied to any component of the agrifood supply chain with the aim to improve its functioning about the key issue of stakeholder remunerations in relation (or not) to their own productivity gains and market powers.

From an empirical point of view, our study clearly supports the view that over the last fifties, the French and European agricultural policies have largely failed in their objective of improving French farmers' income. Indeed before the 1992 CAP reform, farm price supports did not prevent the transfer of the productivity gains generated by producers to the downstream food industry and consumers through lower market prices. Then, during a short period of six years, the Mac-Sharry reform has reversed the situation for the producers. They have obtained a significant income growth through new direct payments not totally decoupled from the supply quantities. Since 1999 with the Agenda 2000 policy, the degression and the progressive decoupling of aids have resulted to a new unfavourable share of economic surplus

for farmers. Therefore their revenue is no more correlated with the TFP evolution. Moreover since 2005, the recent chaotic price evolutions of output and intermediate inputs have led to an erratic share of the global economic surplus for the producers.

For the future, one can expect that generation and distribution of economic surplus in French agricultural sector will be settled on different bases. Comparatively to the last fifty years, the slowdown of technical yields in cash crop activities and the new agricultural practices, which aim at becoming more environmental friendly, will restrain the forthcoming TFP gains. Therefore, the economic surplus might become slighter and more difficult to share among the stakeholders. At the same time, as the convergence process between European and world prices seems already achieved, most of the projections point at the maintenance of prices at a quite high level but with an increasing volatility. Therefore, farmers's revenue will go on to fluctuate significantly around a slightly increasing trend; the consumers as well as downstream food industry will suffer higher market price levels and finally, the suppliers might recapture some advantages through the growth of prices for livestock feed and raw materials. In such a context, the debate concerning the European agricultural aids will certainly evolve as it is the case in the United States where all previous deficiency payments are turning to countercyclical subsidies.

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