# Exploring structural transformation: a labour-based analysis of the evolution of French agricultural holdings 2000-2010

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**Exploring structural transformation:**

# a labour-based analysis of the evolution of French agricultural holdings 2000-2010

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Abstract

The question of farm size has long been a concern in the agricultural economics literature. The observation of a long-lasting persistence of so-called small farms drew the attention of numerous researchers. The size of farms is often approximated by the farm area in hectares or the added value and gross margin. We propose to investigate the opportunity to use labour (family labour and hired, permanent and seasonal, wage labour) as an entry point for a typology of agricultural holdings, with an application on French data from the Census collected in 2000 and 2010. We show that two dynamics are at stake: an evolution towards off-farm labour for the smallest farms relying on family labour; a convergence towards a model based on hired wage labour for the largest family farms.

JEL: D22, D13, J43, Q12

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## Introduction[4]

The question of farm size has long been a concern in the agricultural economics literature (Eastwood and al. 2010 for a review). The observed persistence of small farms raised, in particular, the question of the relationship between farm size and productivity (e.g. Barrett et al., 2010). In such studies, the size of farms is often approximated by the farm area in hectares (e.g, Butault and Delame, 2005). The added value and the gross margin are used as a measure of farm size as well. The latter definition of farm size is adopted by the European Union (EU) in the framework of the Farm Accountancy Data Network (FADN) where the economic dimension is constructed for each farm in terms of European Size Unit (ESU)[5].

However, those standards of measurement exhibit drawbacks: first, the farm area is measured whatever the type of crop cultivated; second the economic dimension produced in the EU framework describes a potential gross margin computed on the basis of standard transformation coefficients applied to the area cultivated according to regions and cropping systems. We propose to investigate the opportunity to use labour (namely, family labour and hired wage labour, permanent and seasonal) as a measure of farm size and investigate the evolution of French farms between 2000 and 2010.[6]

The first section presents a short review of the respective role and weight of family labour and hired wage labour as presented in the agricultural economics literature. On this basis, we propose, in the second section, a typology of French agricultural holdings based on

[4] This research is funded by and discussed in the framework of the World Agricultural Watch (FAO, 2012) http://www.worldagricultureswatch.org/

[5] http://ec.europa.eu/agriculture/rica/methodology1_en.cfm under the title "The economic size of farms" for a definition of the European Size Unit (ESU), last accessed October 2015

[6] A more precise static analysis (Census 2000) is available in a previous version of the paper (Bignebat et al., 2015)

their use of labour at the farm level: we distinguish thereby family labour, seasonal hired wage labour and permanent hired wage labour. In the third section, we apply the methodology on the French agricultural Censuses 2000 and 2010. The fourth section characterizes the holdings belonging to the groups defined in the typology by using econometric tools and draw conclusions on the evolution of the agricultural holdings across years. We conclude on the methodological and empirical contribution of the paper.

## 1. General question: farm size and family farming

### 1.1. Agricultural labour in the agricultural economics literature

A significant part of the agricultural economics literature deals with the historical debate on farm size: the question of a productivity inverse relationship aims at exploring why small farms could be found to be more productive than larger ones. This debate is more or less implicitly linked to the nature of the labour employed for farming. Usually, small farms are defined by the natural assets (hectares, thereafter ha), by the herd size or by the economic size and implicitly authors have examined these units as family farms. There are only few doubts that small farms and family farms categories partially overlap, but not necessarily; but this distinction has been seldom addressed. Nevertheless, we can assume that small farms can be understood as family farms where most of the labour is provided by the family whereas larger farms rely more on hired labour. Eastwood and al. (2010) recognize that: "*Although the term family farm is widespread in the literature, we have not been able to find a precise definition*". Many authors paid a specific attention to the market imperfections approach, searching to explain the "inverse relationship" and developed formalized models to represent the unit of production. Even if size is often taken as a key factor to handle the diversity of

farming units, a considerable literature developed approaches and models that consider labour as a key differentiating factor. We will limit our review to the most relevant for our purpose.

Eswaran and Kotwal (1986) model - assuming perfect markets for land and labour and heterogeneous assets distribution among households – leads to classify four categories based on assets or capital endowments, ranging from the labourer-cultivators to large capitalists. The main distinction among the four categories is based on the capacity to be employed (fully or not) on one's land, and if land and productive assets increase to employ hired workers. Then becoming employer of an increasing number of external workers, leads to specializing progressively in labour supervision. The authors focus on two specific skills that appear to be crucial in agriculture: the ability to supervise labour and the managerial ability for decision making in a risk prone environment regarding biological processes and unpredictable natural events, on one side, and market uncertainty, on the other side. Regarding hired labour and tenancy contracts, they underline the need to consider the quantity of labour hired and the supervision effort to reduce shirking.

Allen and Lueck (1998) combine the now classical conception of the firm developed by Coase (1937) with technical insight deriving from the specificity of the biological processes in farming. Their definition of the farm is therefore close to a firm in Coase's perspective: "*A "pure" family farm is the simplest case, where a single farmer owns the output and controls all the farm assets, including all labour assets*" (Allen and Lueck, 1998, p. 347). This definition is directly opposed to "factory-style corporate agriculture" defined as a production unit "*where many people own the farm and labour is provided by large groups of specialized fixed wage labour*" (ibid, p. 355). In between, they identify an intermediate form "*in which two or three owners share output and capital and each owner provides labour*" (ibid., p. 347). They call it "partnerships". In this definition of family farms, they consider the household (husband and wife) as a single agent and ignore intra-family shirking as well as the distinction

between farm ownership and renting. The specific performance of family farms compared to "factory-style corporate agriculture" lies in the capacity of family labour to closely monitor and / or react to random events (combination of climate shocks and biological reactions of plants and /or animals) and to adapt to an intra-annual uneven distribution of labour needs along with the plant or animal biological cycles around the year.

Roumasset (1995) remains in the tracks of Coase (1937) and others when he defines the firm: "*as an organization of economic agents bound together by a common governance structure for the profitable production and sale of goods and/or services*" (page 165). But when it comes to specify for agriculture, he focuses on the "constitutional" and governance structure that directly impact on production decisions and implementation and especially the control of shirking. Especially in agriculture "*agricultural firms can be distinguished according to the governance structure controlling the shirking of labour and the abuse of land and capital assets*" (ibid., p. 165). This leads the author to present a typology of the different types of firm based on the degree of labour specialization ranging from the "Owner-Operator" (e.g., family farmer without distinction between decision-making and implementation) up to the "Hired-Manager" (e.g., enterprise with a profound division of labour from the unskilled worker up to the top manager, with a strategic decision making in the hands of the shareholders' representatives).

### 1.2. Family labour and hired labour to define family farming

There is a wide literature on peasant and family farming which questions disciplinary approaches, family being a social institution and agriculture being treated as an economic activity. Complexity increases when considering the dual nature of the production that can simultaneously feed the family or be sold on markets. Economy of farming only partially fits with the basics of standard economics because the production function is not exclusively

driven by market signals, the search for profit maximization is not the core objective of farmers and the decision making cannot stay away from social issues. The household is at the same time a production and a consumption unit, and the savings feed at the same time the assets consolidation and the family patrimony.

On peasant farming, the abundant literature combines a wide number of variables to define a peasant. Some refer to the balance between self-provision and market orientation (Marx, 1850; Thorner, 1962; de Janvry and Deere, 1979), others to the inclusion in a local peasant community (Mendras, 1976), others to the limited size of peasant's farms compared to more commercially oriented agriculture (Otsuka, 1998) and many recognize as Wolf (1966) the "domination of peasantry by outsiders" (Shanin, 1987, p. 4) But all scholars who defined peasant farming share one common feature which is the reliance on family labour. This reliance is neither exclusive nor limited to agriculture (pluriactivity is part of peasant farming – Chayanov, 1923). So peasant farming is based on family labour.

On family farming, we follow the vision developed by scholars like Chayanov (1923), Lamarche (1990), Hill (1993), Djurfeldt (1993) and recently by Brookfield (2007). "*Family management, coupled with substantial work input, seems adequately to define family farms not only in Europe, but elsewhere. This mode of management and production is found in all continents"* (Brookfield, 2008). Once defined as such, it is almost impossible with the available data to precisely define which holding is run by a family. The legal status is specific to each context and is often related to fiscal or organizational choices within the family. Size is also not robust since large scale farms can be run by families. Bélières and al. (2014) propose to consider both the organic linkage between the family patrimony and the economic assets of the farm (as a productive unit) and the exclusion of permanent hired labour (Figure 1). As far as we know, the first criteria is not accessible in the available data bases or surveys,

but limiting family farms to those relying exclusively on family labour is possible with censuses or surveys in which labour use is properly captured. Then, on the opposite, it is possible to strictly define the corporate type of farming as entities relying solely on hired labour and with no organic linkages between the workers and the asset owners.

**Figure 1. Description of farms**

| **Farming types** | Entrepreneurial farming …… Family farming | | |
|---|---|---|---|
| **Types of farms** | Corporations | Family business farms | Family farms |
| **Labour** | Exclusively hired labour | Family and hired labour | Family labour, no permanent hired labour |
| **Assets' ownership** | Ownership is independent from labour | Family ownership | Family ownership |

Based on Bélières et al. (2014) and FAO (2012)

The French case is particularly relevant for this study as 75% of the total amount of labour engaged in agriculture consist of family labour in 2000 (Agricultural Census, 2000). However, this share is rapidly declining: family labour represented 84% of total labour in 1988 and represents 70% in 2010 (Agricultural Census 1988, 2010). Boosted by the dynamics of farm structures, the demographic evolution of families towards smaller households, the diversification of family members towards off-farm wage labour and the exoneration of taxes for agricultural short-term contracts, agricultural wage labour gains in weight (Darpeix et al., 2014).

## 2. A labour-based categorization of agricultural holdings: rationale

This section draws on the previous definitions to present the rationale for a typology of agricultural holdings based on labour use. We consider four categories (graph 1).

*Corporate farms* consist in the farms with exclusively hired labour and a clear separation between ownership of productive assets and labour. They are empirically defined as farms that report more than 95% of wage (familial and non-familial) labour compared to total labour[7].

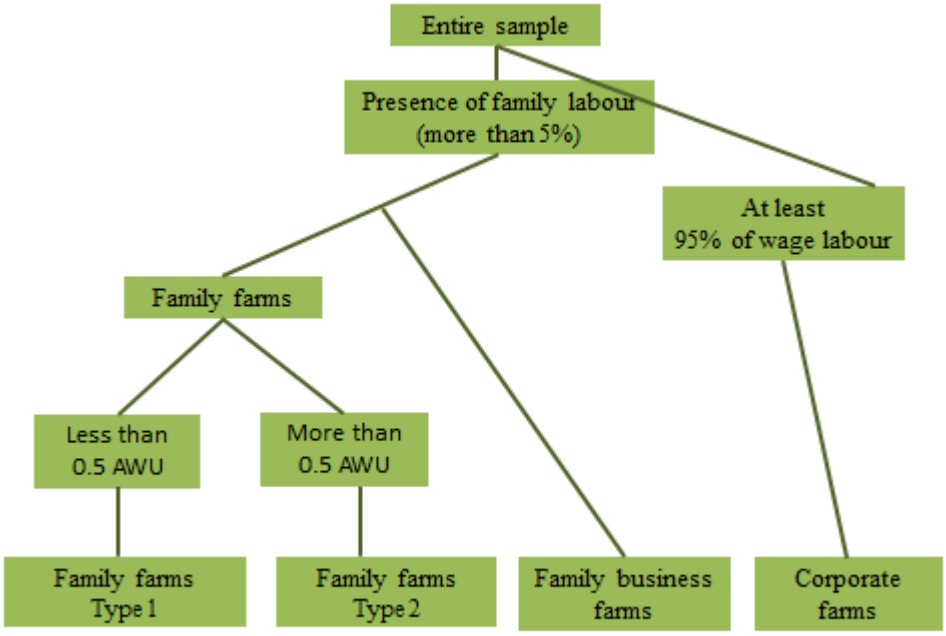
The holdings that reported more than one Annual Work Unit[8] (thereafter AWU) of hired permanent wage labour are classified as *Family business farms*. We decided to add to those holdings a part of the remaining subsample using k-mean method (Appendix 1). In fact, some of the holdings report a very high proportion of seasonal wage labour in total labour. Those wage workers are substitutes to permanent workers: as the cost of seasonal workers is less than that of permanent workers, farmers get round the law and use strategically seasonal contracts (Darpeix et al., 2013).

The remaining farms of the sample consist of holdings that use family labour and potentially a small proportion of seasonal wage labour. In order to discriminate further holdings belonging to this large and heterogeneous category, we break it down into two categories according to the amount of family labour engaged in farming: (i) If the number of AWU is higher than 0.5, we consider holdings as significantly engaged in agricultural production (thereafter called *family farms type 2*). (ii) If the number of AWU is less than 0.5, we consider holdings as engaged in agricultural production as a minor activity (*family farms type 1*).

[7] The threshold of 95% was chosen because misreporting of some data was discovered; in particular, part of the holdings are reporting no familial labour whereas the total amount of labour is higher than the amount wage labour (See appendix 1 for the robustness checks).

[8] An Annual Work Unit corresponds to the work performed by one person who is occupied on an agricultural holding on a full-time basis

**<u>Graph 1.</u> The categorization of holdings**




## 3. Results from Census 2000 and 2010: descriptive statistics

The French Agricultural Censuses 2000 and 2010 provide a large range of characteristics of agricultural holdings. The data set reports for each holding: the amount of family labour (permanent and seasonal, wage labour or not) in AWU); the amount of hired wage labour (permanent and seasonal separately) in AWU, including labour provided by companies and cooperatives for collective use of agricultural equipment (CUMA and ETA). Even though the data provide a rich set of information about labour issues, some shortages should be noticed. First, the level above which an entity is considered as an agricultural holding is rather low so that it does not exclude small entities where the agricultural production is marginal, for instance in the case leisure farming. Therefore, we try to discriminate them by isolating the smallest farms defined as those with less than 0.5 AWU

and thus gain in homogeneity within groups. Second, the number is AWU is reported[9] using a categorical variable distinguishing between 0 to ¼ of full-time; ¼ to ½; ½ to ¾ and ¾ to full-time for each of the family members reported in the survey. In order to get the total amount of family labour in AWU at the farm level, we followed the methodology provided by the Census and used the average of those intervals. Last, we should acknowledge the fact that the probability of misreporting, intentional or not, of the amount of labour is high, but both for family and hired wage labour.

Censuses 2000 and 2010 provide two pictures of the total number of agricultural holdings. We cannot track the holdings across years so that we are not able to study transitions at the individual level. We thus turn to an aggregated comparative static approach using comparable variables for both years.

### 3.1. Evolution of the categories

Family farms as defined largely predominate in the sample (representing 81.6% of the total number as a whole in 2000, Table 1) and Family business farms reach 17.2% of the total sample: an overwhelming share of farms is run by the family and only a small percentage are considered as corporate farms (1.2% in 2000). Interesting is the weight of family business farms, far from negligible in the French agricultural landscape.

[9] Except or the amount of labour provided by companies and cooperatives for collective use of agricultural equipment (CUMA and ETA)

**Table 1: Dynamics of the labour-based categories of holdings, 2000-2010**

| | RA2000 | | RA2010 | | Variation, number of holdings 2000-2010 (%) |
|---|---|---|---|---|---|
| | Number | % | Number | % | |
| Family farms type 1 | 180,691 | 27.3% | 110,524 | 22.5% | - 38.9% |
| Family farms type 2 | 360,242 | 54.3% | 271,795 | 55.3% | - 24.5% |
| Family business farms | 113,996 | 17.2% | 102,469 | 20.9% | - 10.1% |
| Corporate farms | 8,112 | 1.2% | 6,596 | 1.3% | - 18.7% |
| Total | 663,041 | 100% | 491,384 | 100% | - 25.9% |

All the categories exhibit a sharp decrease in the total number of holdings (-25.9% on average) but the smallest farms, namely Family farms type 1, are the most affected (-38.9%). This induces a decline of their share in the total general distribution, dropping from 27.3% to 22.5%. Conversely, Family farms type 2 and Corporate farms maintain roughly their share in the whole sample (representing respectively around 55.3% and 1.3% of the sample). And the Family business category turns out to be the most stable in number with a slight decrease of 10.1% that leads to an increased share in the total sample (from 17.2% in 2000 to 20.9% in 2010).

### 3.2. Description of the categories and their evolution

Tables 2.1 and 2.2 give the contribution of each category of holdings to total labour (AWU) and production (SGM and SGP[10]) for 2000 and 2010 respectively.

[10] The Standard Gross Production (SGP) describes the production or economic dimension of an agricultural holding. Activities, for each type of crop and livestock, are weighted according to a standardized coefficient representing both the region and the technical orientation). The sum of the net revenues drawn from the different agricultural activities represents the profit to be realized at the farm level under normal conditions. As this definition replaced that of Standard Gross Margin (SGM) for the Census 2010, we report the results in terms of the SGM only in table 2.1 and then work with the SGP further in the paper for the sake of comparison.

**Table 2.1- Summary statistics, overall distribution across categories of holdings 2000**

| **2000** | AWU distribution in the total | Familial AWU distribution in the total | Wage Labour AWU distribution in the total | SGM in the total | SGP in the total |
|---|---|---|---|---|---|
| Family farms (1) | 4.2% | 6.2% | 0.0% | 2.8% | 2.4% |
| Family farms (2) | 55.9% | 73.5% | 7,5% | 53.7% | 53.8% |
| Family business farms | 32.3% | 20.2% | 64.8% | 37.7% | 36.7% |
| Corporate farms | 7.6% | 0.1% | 27.7% | 5.8% | 6.9% |
| Total | 100% | 100% | 100% | 100% | 100% |

**Table 2.2- - Summary statistics, overall distribution across categories of holdings 2010**

| **2010** | AWU distribution the total | Familial AWU distribution the total | Wage Labour AWU distribution in the total | SGP in the total |
|---|---|---|---|---|
| Family farms (1) | 3.2% | 4.5% | 0.5% | 2.4% |
| Family farms (2) | 51.5% | 72.1% | 7,8% | 50.6% |
| Family business farms | 36.4% | 23.3% | 64.4% | 40.5% |
| Corporate farms | 8.8% | 0.1% | 27.3% | 6.5% |
| Total | 100% | 100% | 100% | 100% |

The contribution of Family business farms is high as they account for about one-third of total labour and up to 40% of the added-value in 2000. Strikingly, they play as well an important role for family labour (about 20% of the total) in complementarity with wage labour (more than 60% of the total) for which they are the major contributor. Their role increases between 2000 and 2010 in terms of labour (from 32.3% to 36.4% of the total amount of AWU) and SGP (from 36.7% to 40.5% of the total SGP). This statement has to be linked to the overall increased share of the category in the total sample (table 1). Interesting to mention is that their increased contribution to labour is due to family labour (from 20.2% of the total in 2000 to 23.3% in 2010), whereas their wage labour share remains relatively stable.

Parallel to this evolution, the contribution of Family farms decreases in terms of total AWU. However, the differentiation between both categories of family farms is noticeable: Family farms type 1 reveal a very low contribution to labour and wealth; whereas the large group of Family farms type 2 is still at the origin of more than the half of both labour and SGP.

Last, the contribution of Corporate farms is far from being negligible even though they are few in number as they generate nearly 9% in 2010 against 7.6% in 2000 of total employment and more than 6% of the total SGP for both years.

**Table 3.1: Further insights on descriptive statistics according to labour-based holding types, 2000**

| 2000 | UAA (ha) * | SGM (1000 €)* | SGP (1000 €) | AWU (total)* | AWU per ha |
|---|---|---|---|---|---|
| Family farms (1) | 5.9 (191%) | 4.9 (196%) | 7.3 (253%) | 0.2 (53%) | 0.25 (485%) |
| Family farms (2) | 52.5 (100%) | 51.7 (92%) | 80.6 (126%) | 1.4 (47%) | 0.22 (1160%) |
| Family business farms | 64.7 (131%) | 114.36 (109%) | 174.2 (131%) | 2.7 (97%) | 0.42 (732%) |
| Corporate farms | 62.1 (125%) | 246.91 (253%) | 459.3 (366%) | 8.9 (201%) | 2.04 (512%) |
| Total sample | 42 (177%) | 52.1 (195%) | 81.3 (286%) | 1.4 (180%) | 0.28 (922%) |

* In parentheses standardized standard deviation (percentage of variation around the mean)

**Table 3.2: Further insights on descriptive statistics according to labour-based holding types, 2010 (**Δ=variation 2000-2010)

| 2010 | UAA (ha) * | SGP (1000 €)* Nominal prices | SGP (1000 €)* Constant prices 2000 | AWU (total)* | AWU per ha* |
|---|---|---|---|---|---|
| Family farms (1) | 10.8 (650%) (Δ= +83%) | 10.9 (280%) (Δ= +49%) | 9,2 (Δ= +26%) | 0.2 (61%) (Δ= +0%) | 0.23 (485%) (Δ= -8%) |
| Family farms (2) | 64.8 (100%) (Δ= +23%) | 95.4 (138%) (Δ= +18%) | 80,7 (Δ= +0.1%) | 1.4 (49%) (Δ= +0%) | 0.26 (1184%) (Δ= +18%) |
| Family business farms | 82.1 (155%) (Δ= +27%) | 202.7 (148%) (Δ= +16%) | 171,5 (Δ= -1.5%) | 2.7 (95%) (Δ= +0%) | 0.43 (2382%) (Δ= +2%) |
| Corporate farms | 73.5 (325%) (Δ= +18%) | 506.4 (509%) (Δ= +10%) | 428,4 (Δ= -6.2%) | 10 (205%) (Δ= +12%) | 2.9 (579%) (Δ= +42%) |
| Total sample | 56.4 (161%) (Δ= +34%) | 104.3 (338%) (Δ= +28%) | 88,2 (Δ= -8.5%) | 1.5 (190%) (Δ= +7%) | 0.32 (173%) (Δ= +14%) |

* In parentheses standardized standard deviation (percentage of variation around the mean)

Tables 3.1 and 3.2 show that Family farms are significantly smaller in terms of labour use and total cultivated land area than both Family business and Corporate farms. Even though Family business and Corporate farms do not differ much in terms of UAA, labour intensity is far higher. Corporate farms are noticeably larger in terms of SGP. However, we can note a very high dispersion (standardized standard errors) in the latter case. The category of corporate holdings is highly heterogeneous: it entails large commercial companies as well as small owners that produce on a recreational basis without being directly involved in the production process (as in vineyard, in particular).

The size of the holdings (UAA) increased significantly for all the categories (reported in bracket as differential between 2000 and 2010, Δ). However, Family farms type 1 is the category which is the most sensitive to this evolution with an increase of the average hectares used per holding of 83%. This observation combined with that of the decrease in the number of holdings suggests that the smallest farms disappeared, even though we cannot directly test for this hypothesis. Moreover, if they would have transited from Family farms type 1 to Family farms type 2, they would probably have lowered the average size (UAA) of farms belonging to this latter category, whereas the size is increasing (+23%).

The average SGP increased for the different categories and somehow reflects the increase in size (hectares) with the most important increase observed for the smallest holdings. However, we should note that this increase is less important for Family business and Corporate farms which exhibit even a decrease in SGP in constant prices[11].

The total AWU active on the holdings increased, on average, between 2000 and 2010 but less than the number of hectares used. The increase in AWU is uniquely due to the evolution

[11] Aggregate agricultural price levels were taken into account to correct for inflation.

of Corporate farms with a stability of the other farm types. The average increase in labour intensity hides very heterogeneous evolutions across farm types.

### 3.4. Selected variables

We selected variables we thought to be discriminating in order to characterize the categories presented in the previous section for 2000 and 2010 and compare the two rounds[12] (Appendix 2 for detailed statistics).

The *technical and economic orientation (OTEX)* classifies the holdings into different types of production, specialized or mixed based on the economic dimension (SGP). Those production systems present different levels of labour intensity (Benjamin et al., 1996; Benjamin and Kimhi, 2006). Accordingly, we distinguish between 5 broad categories of OTEX: (1) Land-intensive growing systems: horticulture and off-soil livestock systems (poultry and pigs); (2) Permanent crops: fruit orchards and vineyard; (3) Average intensive/extensive farming systems: specialised dairy and mixed dairy; (4) Extensive farming systems, mainly cereals and grains; (5) Extensive livestock systems.

The *legal status* was shown to be related to the size of the holding and type of management (e.g. Bathélémy and Dussol, 2002). We consider: (1) Individual farms that are run by a single manager who is considered as a juridical person; (2) Agricultural Companies whose status is specific to the agricultural sector (e.g. GAEC[13] and EARL[14]); (3) Generic Companies (e.g. limited liability companies – LLC - or public liability companies - PLC).

[12] Even though the questions slightly changed between Census 2000 and Census 2010, we were able to strictly comparable variables to allow for parallel analyses for both years.

[13] GAEC for Groupement Agricole d'Exploitation en Commun, legal entities that gather individual persons into collective units dedicated to agricultural production.

[14] EARL for Entreprise Agricole à Responsabilité Limitée, limited liabibility agricultural company

*On-farm diversification* strategies may be linked to the farm type: on the one hand, Family farms may be more diversified (as an option for survival) than Family business or Corporate ones; on the other hand, Family business and Corporate farms may have an easier access to the capital needed to diversify farms (Aubert and Perrier-Cornet, 2009). We identified on-farm diversification as direct sales to consumers, on-farm processing of the product and agrotourism.

Last, off-farm job opportunities may affect the decision to hire agricultural workers that substitute for family labour, especially wives[15] (Benjamin and Kimhi, 2006). We summarize the involvement of the family in *off-farm wage activities* by computing the time spent working outside the farm relatively to the total potential time available at the family level, namely for individuals in working age. We end up with an index of the intensity of off-farm work at the family level.

[15] Between 1988 and 2007 the share of women head of holding or co-head raised from 12 to 24% (Gambino et al., 2012)

## 4. Description of the categories: an econometric assessment

In order to describe[16] the joint influence of the variables presented in the preceding section on the probability to belong to a specific category, we use a multinomial logit regression with the four categories as endogenous variable (table 4). We perform the analysis separately for each year. We ran a Hausman test for the assumption of independence of irrelevant alternatives. We accept the independence, only weakly (10%) in the case of corporate agriculture for the year 2000 only.

The relative risk ratios (RRR) are reported in table 4 where the category of "Family farms type 2" is chosen as the reference category. As we consider a logistic regression, the odd of success is $\frac{prob(y_j=1|x)}{prob(y_j=0|x)} = e^{\beta x} = \alpha$, where $y_j$ is the $j^{th}$ category, $j \in \{1\ldots4\}$, $x$ an exogenous variable and $\beta$ the raw coefficient associated to $x$ in the multinomial logit regression. If the relative risk ratio $\alpha$ is more than 1 for a category $j$, then the variable has a positive effect on the probability to belong to $j$ relatively to the reference category, namely Family farms type 2. Moreover the odds of belonging to the category $j$ is α times as large as belonging to the reference category.

[16] As some of the dependent variables may be endogenous, we use econometrics as a descriptive tool and not in terms of causal relationships.

**Table 4. Description of the characteristics for 2000 and 2010**

Probability to belong to the categories (multinomial logit), relative risk ratios

| **Year 2000** | Family farms 1 | Family farms 2 | Family business | Corporate farms |
|---|---|---|---|---|
| Land-intensive | 1.584*** | Ref | 2.817*** | 6.233*** |
| Permanent crops | 2.941*** | | 9.816*** | 20.65*** |
| Intensive/extensive | Ref | | Ref | Ref |
| Extensive, field crops | 3.03*** | | 2.281*** | 3.258*** |
| Extensive, livestock | 1.89*** | | 1.341*** | 2.849*** |
| Off-farm diversification (ratio) | 19.167*** | | 3.496*** | 5.503*** |
| Diversified holding (1 if yes) | 0.588*** | | 1.688*** | 2.024*** |
| Individual farm | 0.812*** | | 0.481*** | 0.048*** |
| Company status agriculture specific | Ref | | Ref | Ref |
| General company status | 0.771*** | | 1.875*** | 24.27*** |
| UAA (ha) | 0.956*** | | 1.003*** | 1.004*** |
| Economic dimension, SGP (1000 €) | 0.947*** | | 1.004*** | 1.005*** |
| Age | 1.039*** | | 1.012*** | 1.015*** |
| Family members (working age). Number | 0.613*** | | 0.783*** | 0.492*** |
| Constant | 0.369*** | | 0.073*** | 0.008*** |
| N=663,041 LL=-399776 $R^2$=0.421 | | | | |

*** p<0.01, ** p<0.05, * p<0.1

| **Year 2010** | Family farms 1 | Family farms 2 | Family business | Corporate farms |
|---|---|---|---|---|
| Land-intensive | 2.309*** | Ref | 1.607*** | 4.336*** |
| Permanent crops | 3.122*** | | 5.817*** | 20.65*** |
| Intensive/extensive | Ref | | Ref | Ref |
| Extensive, field crops | 2.884*** | | 1.581*** | 2.273*** |
| Extensive, livestock | 1.834*** | | 1.163*** | 2.477*** |
| Off-farm diversification (ratio) | 31.79*** | | 5.379*** | 7.514*** |
| Diversified holding (1 if yes) | 0.478*** | | 1.578*** | 1.522*** |
| Individual farm | 0.794*** | | 0.419*** | 0.021*** |
| Company status agriculture specific | Ref | | Ref | Ref |
| General company status | 2.834*** | | 0.252*** | 86.4*** |
| UAA (ha) | 0.986*** | | 1.001*** | 1.001*** |
| Economic dimension, SGP (1000 €) | 0.963*** | | 1.004*** | 1.005*** |
| Age | 1.056*** | | 1.014*** | 1.013*** |
| Family members (working age). number | 0.483*** | | 0.629*** | 0.343*** |
| Constant | 0.0759*** | | 0.141*** | 0.012*** |
| N=491,384 LL=-30291 $R^2$=0.358 | | | | |

*** p<0.01, ** p<0.05, * p<0.1

The results reported in table 4 show that some general features are present for both years. The technical and economic orientation strongly influences the probability to belong to a specific category. In particular, permanent crops and, to a lesser extent, land-intensive farming systems (horticulture, pigs and poultry) are more likely to positively influence the probability to belong to the categories of Family business and Corporate farms (relatively to production systems under mixed intensive/extensive techniques) than they do for the reference group – namely Family farms 2: this may be due to the high level of up-front investment and costly inputs which is necessary to engage in those activities (physical assets, like farm buildings or greenhouses) and to the fact that they are also highly labour-intensive.

Farms with a high family involvement in off-farm wage labour are far more likely to be found in the category Family farms 1 than Family farms 2. To a lesser extent, the same observation can apply for Family business and Corporate farms. In fact, several drivers of farm income diversification have been identified for developed countries: on the one hand, the behaviour observed in the group Family farms 1 may correspond to a coping strategy aiming at securing uncertain and low farm incomes (Mishra and Goodwin, 1997; Mishra and Sandretto, 2002 for the US); on the other hand, the strategies of Family business and Corporate farms may be the substitution of family labour by hired labour (Benjamin and Kimhi, 2006): the opportunity cost of family members working on-farm actually differ according to individual characteristics, skills and education, and market opportunities.

Farms that diversify towards on-farm non-agricultural production are more likely to belong to the categories of Family business and Corporate farms than to those of family farming (in the case of 2000, RRR=1.688 and 2.024 respectively whereas RRR=0.588 for Family farms 1). Even though we may think on-farm diversification of activities could be an option for the survival of small family farms, Family business and Corporate farms are more likely to access the working capital needed to develop on-farm non-agricultural activities (especially direct

sales and processing): the latter driver turns out to overcome the former (Aubert and Perrier-Cornet, 2009). Diversification of activities increases the need for labour (Capt and Dussol, 2004) in a context where family labour is limited in number.

The legal status widely differs according to the farm category. Individual farms are more likely to be observed than companies with a status specific to agriculture (GAEC, EARL…) for Family farms 2 than for any other category, including Family farms 1 (RRR=0.812). Commercial companies with a generic legal status (LLC, PLC …) are more likely to be observed in the categories of Family business or Corporate farms than in Family farms type 2. However, Corporate farms largely distinguish themselves (with a RRR=22.2 for 2000) and Family business farms are more proximate to Family farms 2 (RRR=1.875). This may be due to the fact that statuses specific to the agricultural sector entail corporate organizations (GAEC) as a company type that encompasses co-workers, though they remain family farms from the organisational point of view (Vuillaume and Delame, 2009). It should be recalled here that this variable pictures the way family farms in general adapt to several types of constraints: financial and fiscal issues, social and labour issues, organization of work and access to leisure time. Patrimony dimensions remain under family ownership and governance.

Size indicators (UAA and SGP) do not highly influence the probability to belong to a category (the RRR are very close to 1), even though we can note that, in 2000, Family farms 1 are moderately smaller than Family farms 2 (RRR=0.956 and 0.947, respectively for UAA and SGP).

Regarding the demographic characteristics of the family, the number of family members registered in the survey, namely individuals working and/or living on the farm, plays a role. The higher the number of family member in working age, the less probable the fact to belong to any category relatively to Family farms 2.

Comparing the two tables (year 2000 and year 2010) the evolution shows that:

The technical economic orientation tends towards a convergence between Family farms 2 and Family business farms with all the RRR going down (even though a difference persists, especially for permanent crops). Conversely, Family farms 1 and 2 tend to get more different one from the other, with Family farms 1 specializing in land-intensive production and permanent crops.

The influence of the diversification towards off-farm wage incomes increases with Family farms 2 tending to concentrate on farm income even more than they do in 2000. In particular, the coefficient of this variable rises a lot in the case of Family farms 1. This result should be put in perspective with the overall evolution of the distribution of holdings according to their types that shows a sharp drop in the weight of the category Family farms 1, but a relative stability (or even increase, in terms of SGP) of their contribution. It may suggest that, in this category, the holdings that were diversified off-farm in 2000 maintained their activity.

The conclusions on the legal status of the holding partially hold, especially concerning the status of individual farms.

Lastly, the small influence of size indicators on the probability to belong to a specific category observed for the category Family farms 1 in 2000 tightened over the period. Family farms 1 tend to converge towards family farms type 2 in terms of size (UAA and SGP).

## Conclusion

We propose a typology of French agricultural holdings based on the type of agricultural labour. We distinguish thereby between family labour and permanent and seasonal hired labour in order to split the sample into four categories: family holdings with limited labour implication, family holdings with a larger labour implication, family business farms and corporate farms.

We then characterize the four categories. We find that (i) the technical and economic orientation is essential to understand the insertion of the farm in each of the category. In particular, seasonal labour intensive sectors (vineyards, horticulture, orchards) are more probably found in Family business and Corporate farms. Year-long labour-intensive sectors (dairy farms and other livestock based farming systems) are found in family based types of farms; (ii) the on-farm diversification towards non-agricultural activities is mostly observed in Family business and Corporate farms; whereas small family farm tend to diversify their activities outside the farm (iii) farm size – physical (ha) and economic (SGP) – does not seem to be a determinant of belonging to any of the categories we propose, when controlling for others factors. The fact that either the sole physical (land) or economic size is not a key variable to classify farms between our broad categories challenges the current vision of the transformation of agricultural holdings through modernizing.

Looking at the evolution of the farm types between 2000 and 2010, the results suggest a convergence between the family farms that are heavily engaged in agriculture (Family farms 2) and the Family business farms. The evolution regarding Family farms that are less engaged in agriculture (Family farms 1) is less obvious as they tend, to some extent, to diverge from the other types of family farms: in particular, they seem to rely more and more on off-farm

wage activities, to reduce their reliance on on-farm diversification, even though they form an heterogeneous category with an increasing presence of holdings under a generic company status in this category. Interestingly, when broken down into categories related to labour use, holdings do not differ much in terms of traditional measures of size (UAA, SGP) everything else equal. Therefore, the proposal to use labour as a measure of farm size to characterize the evolution of French agricultural landscape gives some insight into the evolution of farm structures. In particular, this leads us to pay a particular attention to small family farms whose path seems to diverge from the rest of the sector, but which contributes to rural development, biodiversity and landscape management.

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## Appendix 1: Discussion on the categorization of farms – robustness checks

In the Census, an agricultural holding is defined as an independent entity: (i) that operates more than 1 hectare of land; (ii) or more than 0.2 hectare of specialized production (vineyard, for instance); (iii) or exhibits a sufficient activity in agricultural production measured in number of livestock or production volume.

### (i) Subdivision of family farms

We evaluate the threshold above which family farms are distinguished. Two options were considered: (1) the first one consists in considering very small farms as farms reporting less than 0.5 family AWU engaged in on-farm activities; (2) the second viewed very small farms as farms where no-one is working at less part-time on-farm, namely where no family member is working at least 0.5 AWU.

**Table A reports for Census 2010 the distribution of the holdings for the two options**.

Table A: distribution of the holdings, Census 2010

| | Decision rule (1) | | Decision rule (2) | |
|---|---|---|---|---|
| Family farms 1 | 110,524 | 22.5% | 128,563 | 26.2% |
| Family farms 2 | 271,795 | 55.3% | 253,756 | 51.6% |
| Rest | 109,065 | 22.2% | 109,065 | 22.2% |
| Total | 491,384 | 100% | 491,384 | 100% |

We characterized the holdings that switched from Family farms 2 to Family farms 1 under decision rule (2) relatively to decision rule (1) (holdings, hereafter called switchers) in order to know if the difference may influence the results. These holdings report more than 0.5 AWU at the family level but none of the family members work at least 0.5 AWU.

On average the "switchers" are significantly larger (UAA, AWU, SGP) than the group of the 110,524 (family farms 1 for decision rule (1)) and far smaller (UAA, AWU, SGP) than the group of the 253,756 (family farms type 2 for decision rule (2)).

Their distribution across OTEX is significantly different (Chi2 test) from that of the group of Family farms 1 under decision rule (1) and that of Family farms 2 under decision rule (2) but closer to the former one.

| **Year 2010** | Family farms 1 Decision rule (1) | Switchers | Family farms 2 Decision rule (2) |
|---|---|---|---|
| Land-intensive | 3912 (4%) | 867 (5%) | 19419 (8%) |
| Permanent crops | 23344 (21%) | 4529 (24%) | 25941 (10%) |
| Intensive/extensive | 1701 (2%) | 433 (2%) | 53061 (21%) |
| Extensive, field crops | 41587 (28%) | 6049 (33%) | 79249 (31%) |
| Extensive, livestock | 39493 (36%) | 6648 (36%) | 76086 (30%) |
| Total | 110037 (100%) | 18526 (100%) | 253756 (100%) |

Their legal status is intermediary is halfway between the two group, though statistically different from each of them.

| **Year 2010** | Family farms 1 Decision rule (1) | Switchers | Family farms 2 Decision rule (2) |
|---|---|---|---|
| Individual farm | 106096 (96%) | 16376 (88%) | 171960 (68%) |
| Company status | 3104 (3%) | 2050 (11%) | 80860 (32%) |
| General company | 837 (1%) | 100 (1%) | 936 (0%) |
| Total | 110037 (100%) | 18526 (100%) | 253756 (100%) |

When looking closer, those switchers are most of the time couples, where the family head report being farmer as a primary occupation (30%), or retired (24%) or employee (20%); the spouse is retired (40%) or employee (20%) or farmer (14%). Most of them report no secondary job. Even though the frequency of retired people is high, it is far lower than that of the group of Family farms 1 under decision rule (1) – with 40% of retired family heads and 45% for the spouses. Moreover, in this group, only 12% of the family heads consider that

their primary occupation is farming. For these reasons, we decided to adopt the criteria of less than 0.5 AWU to identify Family farms type 1.

### (ii) Reallocation of holdings from family farms to business with regards to the weight of seasonal labour

In 2010, the reallocation of holdings with a large weight of seasonal labour in total labour (cluster procedure) from the category Family farms (2) to the category Family business concerns 40,328 holdings (compared to the total number of 102,469 as a whole, namely around 39% of the category). The threshold above which a holding is considered as Family business is 21% of seasonal labour in total labour (19% for 2000, for a reallocation of 49,777 holdings, namely 44% of the category).

Those holdings are on average significantly larger than the holdings of the category Family farms 2 for the three size dimensions (UAA, AWU and SGP). So that, we can believe they were at the margin.

### (iii) Confidence interval of 5% for corporate farms

For 2000, the confidence interval of 95% adds 1,772 holdings to those who report zero family labour (compared to a final total of 8,881 holdings). However, among those 1,772 holdings, 1,423 report more than 99% of wage labour.

**Appendix 2: Descriptive statistics of the variables according to the category of holding, 2000 and 2010**

# OTEX

## Year 2000

| Technical orientation | Family farms (1) | Family farms (2) | Family business | Corporate farms | Total |
|---|---|---|---|---|---|
| Land-intensive | 6131 (3%) | 26265 (7%) | 14306 (13%) | 2143 (26%) | 48845 (7%) |
| Permanent crops | 41595 (23%) | 35411 (10%) | 41939 (37%) | 2947 (36%) | 121892 (18%) |
| Intensive/extensive | 5289 (3%) | 92463 (26%) | 11468 (10%) | 340 (4%) | 109560 (17%) |
| Extensive, field crops | 48708 (27%) | 93910 (26%) | 31423 (28%) | 1575 (19%) | 175616 (26%) |
| Extensive, livestock | 78968 (44%) | 112193 (31%) | 14860 (13%) | 1107 (14%) | 207128 (31%) |
| Total | 180691 (100%) | 360242 (100%) | 113996 (100%) | 8112 (100%) | 663041 (100%) |

## Year 2010

| Technical orientation | Family farms (1) | Family farms (2) | Family business | Corporate farms | Total |
|---|---|---|---|---|---|
| Land-intensive | 3980 (4%) | 20218 (7%) | 12012 (12%) | 1839 (28%) | 38049 (8%) |
| Permanent crops | 23419 (21%) | 30395 (11%) | 32131 (31%) | 2613 (40%) | 88558 (18%) |
| Intensive/extensive | 1738 (2%) | 53457 (20%) | 11227 (11%) | 220 (3%) | 66642 (14%) |
| Extensive, field crops | 41811 (38%) | 85074 (31%) | 33115 (32%) | 1242 (19%) | 161242 (33%) |
| Extensive, livestock | 39576 (36%) | 82651 (30%) | 13984 (14%) | 682 (10%) | 136893 (28%) |
| Total | 110524 (100%) | 271795 (100%) | 102469 (100%) | 6596 (100%) | 491384 (100%) |

## Legal Status

### Year 2010

| **Legal status** | Family farms (1) | Family farms (2) | Family business | Corporate farms | Total |
|---|---|---|---|---|---|
| Individual farm | 178025 (33%) | 289359 (54%) | 68843 (13%) | 759 (0%) | 536986 (100%) |
| Agricultural company status | 1431 (1%) | 67680 (59%) | 42215 (37%) | 3307 (3%) | 114633 (100%) |
| Commercial company status | 1235 (11%) | 3203 (28%) | 2938 (26%) | 4046 (35%) | 11422 (100%) |
| Total | 180691 (27%) | 360242 (54%) | 113996 (17%) | 8112 (1%) | 663041 (100%) |

### Year 2010

| **Legal status** | Family farms (1) | Family farms (2) | Family business | Corporate farms | Total |
|---|---|---|---|---|---|
| Individual farm | 106186 (31%) | 188246 (55%) | 47078 (14%) | 198 (0%) | 341708 (100%) |
| Agricultural company status | 3413 (2%) | 82601 (59%) | 52025 (337%) | 2874 (2%) | 140913 (100%) |
| Commercial company status | 925 (11%) | 948 (11%) | 3366 (38%) | 3524 (40%) | 8763 (100%) |
| Total | 110524 (22%) | 271795 (55%) | 102469 (21%) | 6596 (1%) | 491384 (100%) |

## On-farm on agricultural diversification of activities

### Year 2000

| **2000** | Mean |
|---|---|
| Family farms (1) | 12,8% |
| Family farms (2) | 18,4% |
| Family business farms | 33,7% |
| Corporate farms | 43,7% |
| Total sample | 19,8% |

**Year 2010**

| **2010** | Mean |
|---|---|
| Family farms (1) | 9,7% |
| Family farms (2) | 20,6% |
| Family business farms | 25,1% |
| Corporate farms | 25,4% |
| Total sample | 19,2% |

## Off-farm diversification of activities (ratio)

**Year 2000**

| **2000** | Mean (std) |
|---|---|
| Family farms (1) | 0,3294 (0,3996) |
| Family farms (2) | 0,1486 (0,2231) |
| Family business farms | 0,1881 (0,2911) |
| Corporate farms | 0,2098 (0,3199) |
| Total sample | 0,2054 (0,3029) |

**Year 2010**

| **2010** | Mean |
|---|---|
| Family farms (1) | 0,4065 (0,3588) |
| Family farms (2) | 0,1644 (0,2032) |
| Family business farms | 0,2299 (0,2527) |
| Corporate farms | 0,2139 (0,2832) |
| Total sample | 0,2331 (0,2747) |

## Appendix 3: Summary statistics

**Year 2000 – number of observations: 663,041**

| | mean | std | min | Max |
|---|---|---|---|---|
| Land-intensive | 0.07 | | 0 | 1 |
| Permanent crops | 0.184 | | 0 | 1 |
| Intensive/extensive | 0.165 | | 0 | 1 |
| Extensive, field crops | 0.264 | | 0 | 1 |
| Extensive, livestock | 0.312 | | 0 | 1 |
| Off-farm diversification | 0.205 | 0.274 | 0 | 0.982 |
| Diversified holding (1 if yes) | 0.198 | | 0 | 1 |
| Individual farm | 0.809 | | 0 | 1 |
| Company status agriculture specific | 0.173 | | 0 | 1 |
| General company status | 0.017 | | 0 | 1 |
| UAA (ha) | 42.0 | 57.4 | 0 | 3046.5 |
| Economic dimension (1000 €) | 81.3 | 232.4 | 0 | 41942.6 |
| Age | 49.6 | 13.2 | 16 | 100 |
| Family members (working age), number | 2.3 | 1.3 | 1 | 19 |

**Year 2010 – number of observations: 491,384**

| | mean | std | min | Max |
|---|---|---|---|---|
| Land-intensive | 0.07 | | 0 | 1 |
| Permanent crops | 0.18 | | 0 | 1 |
| Intensive/extensive | 0.135 | | 0 | 1 |
| Extensive, field crops | 0.328 | | 0 | 1 |
| Extensive, livestock | 0.278 | | 0 | 1 |
| Off-farm diversification | 0.233 | 0.302 | 0 | 0.968 |
| Diversified holding (1 if yes) | 0.191 | | 0 | 1 |
| Individual farm | 0.695 | | 0 | 1 |
| Company status agriculture specific | 0.287 | | 0 | 1 |
| General company status | 0.018 | | 0 | 1 |
| UAA (ha) | 56.4 | 90.9 | 0 | 17527 |
| Economic dimension (1000 €) | 104.3 | 352.2 | 0 | 122527 |
| Age | 51.1 | 12.3 | 16 | 100 |
| Family members (working age), number | 2 | 0.92 | 1 | 25 |