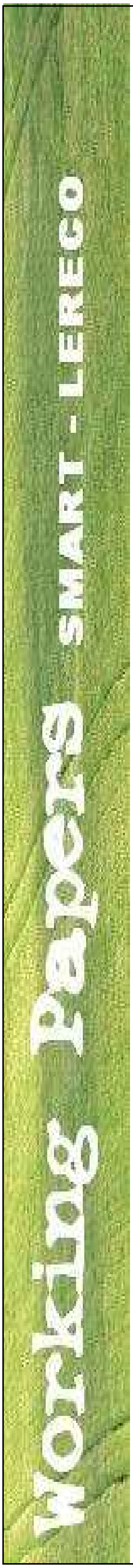

The role of public subsidies on farms' managerial efficiency: An application of a five-stage approach to France

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The role of public subsidies on farms' managerial efficiency: An application of a five-stage approach to France

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The role of public subsidies on farms' managerial efficiency: An application of a five-stage approach to France

Abstract

This paper applies a five-step approach to the investigation of the relationship between public subsidies, namely CAP direct payments, and managerial efficiency for French COP and beef farms in 2000. Managerial efficiency scores are calculated using a four-step approach that allows disentangling managerial inefficiency from unfavourable external conditions. Then, in a fifth stage, managerial efficiency scores are regressed over a set of explanatory variables, including CAP direct payments. Using individual farm data and meteorological data at the municipality level, we show that there is a non negligible component of inefficiency that is due to unfavourable conditions, and there is a strong significant negative relationship between managerial efficiency and CAP direct payments.

Keywords: technical efficiency, managerial efficiency, direct payments, farms, France
JEL Classification: D24, Q12

Le rôle des subventions publiques sur l'efficacité managériale des exploitations agricoles : Application d'une approche en cinq étapes à la France

Résumé

Nous appliquons une approche en cinq étapes à l'analyse de la relation entre les subventions agricoles, en particulier les aides directes de la PAC, et l'efficacité managériale des exploitations agricoles françaises spécialisées en céréales et oléo-protéagineux et en viande bovine en 2000. Les scores d'efficacité managériale sont calculés avec une approche à quatre étapes, qui permet de séparer l'inefficacité managériale des conditions externes défavorables. Puis, dans une cinquième étape, les scores d'efficacité managériale sont régressés sur des variables explicatives, dont les aides directes de la PAC. En utilisant des données individuelles d'exploitations et des données météorologiques au niveau communal, nous montrons qu'une part non-négligeable d'inefficacité est due à des conditions défavorables, et qu'il y a une forte relation négative entre l'efficacité managériale et les aides directes PAC.

Mots-clefs : efficacité technique, efficacité managériale, aides directes, exploitations agricoles, France

Classification JEL : D24, Q12

The role of public subsidies on farms' managerial efficiency: An application of a five-stage approach to France

1. Introduction

Farms' technical efficiency, as a component of competitiveness, has been the subject of great research interest. Several studies have investigated whether farms could improve their technical efficiency, that is to say whether they could make better use of the existing technology by increasing their produced output *ceteris paribus* (or by decreasing their input use *ceteris paribus*). Once technical efficiency scores have been measured, some studies focus on the comparison of several types of farms, such as crop and livestock farms, conventional and organic farms, or corporate and individual farms (e.g. Brada and King, 1993; Thiele and Brodersen, 1999; Mathijs and Swinnen, 2001; Tzouvelekas et al., 2001; Oude Lansink et al., 2002; Latruffe et al., 2005), or on the investigation of the sources of technical efficiency (e.g. Hallam and Machado, 1996; Abdulai and Eberlin, 2001; Wilson et al., 2001; Helfand et Levine, 2004; Latruffe et al., 2004; Chavas et al., 2005; Davidova and Latruffe, 2007). Among the determinants of technical efficiency, a large attention has been given to farms' characteristics (such as size, technology, indebtedness, etc) and to the human capital available on farm (such as manager's age and education, the importance of hired workforce, etc).

Very little concern has however been given to the role of public subsidies on farms' technical efficiency, in spite of the fact that farmers in Western countries have for long been highly subsidised. While initially subsidisation was a way of boosting post-war agriculture and achieving food self-sufficiency, public support has started to be questioned in the 80's. Overproduction, and an increase of the burden on taxpayers and food consumers, were the main arguments behind disapprovals. Another claim against agricultural support is that public subsidies may have reduced farm performance. Empirical investigation of this issue is however very recent, and economic theory provides relatively few guidelines on the shape of this relationship.

Within the existing literature, one may find however some theoretical results regarding the impact of various support policies on farm technical efficiency at the 'extensive margin'. In a model with free entry and exit, Leathers (1992) and Guyomard et al. (2001) show that direct aids to farmers are likely to negatively affect the average technical efficiency of the farming sector as a whole by allowing relatively less efficient farms to stay in business. In these models however, the technical efficiency of a given farm is modelled as an exogenous variable entering the production, cost or profit function. As a result, this kind of studies cannot account for the potential impact of farm subsidies on the technical efficiency of each farm (i.e., at the 'intensive margin'). By contrast, Bergström (2000) argues that subsidies can have a negative impact on technical efficiency for at least two reasons. First, higher profits weaken managers' motivation in the form of slack or lack of effort. Second, subsidies can help managers to avoid bankruptcy and postpone activity reorganisation and performance improving. The same idea arises from the model proposed by Martin and Page (1983). Following Bergsman (1974) and Balassa (1975), arguing that protection increases inefficiency, and building on work by Corden (1970) and Martin (1978) showing how to model inefficiency effects, Martin and Page develop an analytical framework where each firm's owner-manager maximizes his utility that depends positively on firm's profits and negatively on his own work time. The production function, in addition to usual arguments, is specified as an increasing function of efficiency. Efficiency is modelled as a positive function of available information stock and total management effort, i.e., the management effort by the manager himself and the "management effort" bought on the market at a given price. Within this modelling framework, Martin and Page show that direct aids have a negative impact on the manager's work time, on total management effort and finally on efficiency. Empirical results based on cross-section data from a survey of firms in Ghana's logging and sawmilling industries confirm this negative relationship between direct aids and firms' efficiency. Regarding agriculture, a few empirical studies confirm the negative relationship between public subsidies and efficiency, in the Western EU countries (e.g Rezitis et al., 2003; Emvalomatis et al., 2008; Zhu et al., 2008), in Northern America America (e.g. Giannakas et al., 2001; Serra et al., 2008), or in the EU New Member States (e.g. Bakucs et al., 2007; Bojnec and Latruffe, 2009).

However, these agricultural studies consider the overall technical efficiency of farms, while the notion of efficiency upon which the Martin and Page's (1983) model is built on, as well as the first reason invoked by Bergström (2000) for an expected negative relationship between subsidies and efficiency, rather relate to managerial efficiency only. Managerial efficiency indeed represents the ability and the effort of farmers-managers. It is thus a more suitable variable on which subsidies may impact relative to other inefficiency components, notably those related to the farms' external conditions. External conditions refer to the environment where farmers operate and on which they have little, if not zero, control. In particular, climate and soil characteristics heavily influence farmers' production and performance but little except irrigation and fertilisation can be done to improve bad natural conditions. The majority of studies dealing with the sources of farms' technical inefficiency have included localisation variables or soil characteristics among the inefficiency determinants (e.g. Hallam and Machado, 1996; Liu and Zhuang 2000; Latruffe et al., 2004; Davidova and Latruffe, 2007; Mahadevan, 2008) in order to investigate the impact of farms' localisation conditions on their performance. In this study, however, we attempt to precisely measure farms' managerial efficiency scores in order to assess the impact of public subsidies on them. For this reason, we use the four-step approach initially developed by Fried et al. (1999) in so far as this approach seeks to disentangle managerial inefficiency from other technical inefficiency components, notably what is due to unfavourable external conditions. The calculation of managerial efficiency scores, although common in service sectors such as banks, hospitals and education (Drake et al., 2006; Wang et al., 2006; Wang and Huang, 2007; Cordero-Ferrera et al., 2008), has, to our knowledge, never been done in agriculture. We combine Fried et al.'s (1999) four-step approach with the traditional two-stage approach in non-parametric efficiency calculation (the first stage being the calculation of efficiency scores and the second stage being the regression of these scores on several determinants): our analysis is therefore performed in a five-step framework.

This analytical framework is applied to a sample of French farms in 2000 and will allow us to analyse to what extent direct payments of EU Common Agricultural Policy (CAP) influence the managerial efficiency of cereal, oilseeds and proteinseeds (COP) and beef farmers. These two types of farms are the most supported by the CAP, and are therefore relevant for the investigation.

The paper is organised as follows. We first describe the five-step approach that has been implemented. In the following two sections, we present the empirical model and data, and the results. The paper ends with some concluding remarks.

2. The five-stage methodology

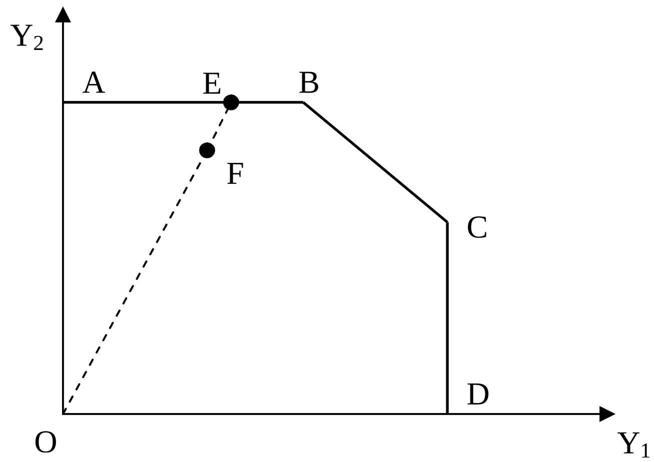
The Data Envelopment Analysis (DEA) approach is used to measure technical efficiency (Charnes et al., 1978). This non-parametric method presents the advantages of not relying on a particular functional form for the frontier and of considering several outputs and inputs simultaneously. As mentioned above, studies using DEA for investigating the effects of explanatory factors on technical efficiency resort to a two-stage approach in which the technical efficiency scores calculated with DEA in a first stage are regressed over the set of retained factors in a second stage. As our objective in this study is to investigate the impact of CAP direct payments on French farms' managerial efficiency, we use the four-stage approach proposed by Fried et al. (1999) that allows adjusting the technical efficiency scores for the operating environment and extracting managerial efficiency, followed by a regression of managerial efficiency scores.

Fried et al.'s (1999) procedure is proposed for an input-orientated framework. In the first stage, technical efficiency (*TE*) is estimated with DEA including standard inputs and outputs. This gives, for each observation (i.e., each firm or farm), the total potential reduction of each input calculated as the radial reduction given by the efficiency score plus the non radial reduction given by input slacks. In the second stage, the total potential reduction for each input is regressed over a set of variables characterizing the operating environment. The predicted input reductions are then used to adjust the primary input data in a third stage. Finally, in a fourth stage, new technical efficiency scores are calculated again using DEA but with the adjusted inputs. This stage provides the managerial efficiency, that is to say the technical efficiency disentangled from external conditions. In this paper, we adapt the Fried et al.'s (1999) four-stage procedure to the output-orientated framework: we consider that this framework is more suitable for the French farms considered (specialised in COP and specialised in beef), as they are not constrained in their output expansion. The five stages of the approach are defined as follows.

2.1. First stage: calculation of technical efficiency and total potential output augmentations

DEA uses linear programming to construct the efficient frontier with the best performing farms of the sample so that all farms lie on or below the frontier. In the output-oriented framework, distance from a farm to the frontier on its output-ratio ray represents the extent of its radial (i.e. proportional) potential output augmentation; this distance defines the technical efficiency score. But a firm may also have the potential to augment further some of its outputs: 'radial' efficiency increase does not exhaust improvement possibilities as firms may also extend output 'non radially'. Such non-radial output augmentations, also called slacks, are inherent to the DEA method. The distinction between radial and non-radial proportions is explained on Figure 1 in the two output case (Y_1 and Y_2), *ABCD* is the efficient frontier constructed with DEA. Point *F* represents a non-efficient farm. Its projection on the frontier along the output-ratio is *E*. Its efficiency score is thus *OF*/*OE* calculated as the radial potential augmentation of each output that the farm could implement without changing its input use. Additionally, farm *F* could increase its first output Y_1 by *EB* and still use the same quantities of inputs. Distance *EB* represents (in absolute value) the non-radial potential augmentation of the first output.

Figure 1: Illustration of radial (distance *FE*) and non-radial (distance *EB*) output augmentations for farm F in a two-output DEA model



Running several linear programming models gives for each farm, firstly the output-oriented technical efficiency score, and secondly the non-radial potential augmentation for each output. For each output and each farm, the total potential augmentation is then calculated as:

$$OTA_{i,k} = (TE_i - 1) * 100 + NRA_{i,k} \quad (1)$$

where $OTA_{i,k}$ is the *i*-th farm total potential augmentation of output *k*, TE_i is the *i*-th farm's output-oriented technical efficiency score (in the output-orientation model, this score is equal to 1 for efficient farms; the less efficient a farm, the greater than 1 its score is) and $NRA_{i,k}$ is the *i*-th farm's non-radial potential augmentation of output *k* expressed as a percentage of the initial output level.

2.2. Second stage: regression of each output total potential augmentation on environmental variables

A total of *K* equations are estimated, where *K* is the number of outputs. For the *k*-th output, the equation to estimate is:

$$OTA_{i,k} = g(Z_{i,k}) + u_{i,k} \qquad \text{for } i = 1,\dots,N \text{ farms} \tag{2}$$

where $Z_{i,k}$ is a vector of environmental variables for the *k*-th output, *g* is a function and $u_{i,k}$ is the error term.

The predicted total augmentation of the *k*-th output, $OT\hat{A}_{i,k}$, represents the output loss that can be attributed to the external environment.

2.3. Third stage: adjustment of primary output levels

The predicted output total augmentations are then used to adjust the primary output data. The adjustment is realised using a base for comparison. The base we retained corresponds to the most favourable external conditions: for a farm operating in the best environment, the adjusted output is thus equal to the initial output; for the other farms, the adjustment formula increases the initial levels of outputs as the underlying assumption is to compensate the farm that produces proportionally less output because it operates in an unfavourable external environment. Therefore, the primary output data are adjusted using the difference between the predicted total augmentation in outputs for the farm considered and the minimum predicted total augmentation in the sample. For the *k*-th output, the computation is as follows:

$$Y_{i,k}^{adj} = Y_{i,k} + \left[OT\hat{A}_{i,k} - \min\left(OT\hat{A}_{j,k} \right) \right] \qquad \text{for } i, j = 1,\dots,N \text{ farms} \tag{3}$$

with $Y_{i,k}^{adj}$ the adjusted *k*-th output and $Y_{i,k}$ the *k*-th primary output of the *i*-th farm.

2.4. Fourth and fifth stages: calculation of the managerial efficiency and analysis of the impact of CAP direct payments

The adjusted outputs are finally used in a second DEA linear programming model. The technical efficiency scores obtained can be interpreted as measures of managerial efficiency. The managerial efficiency scores are regressed over a set of variables that are not characteristics of the environment. These explanatory variables include CAP direct payments.

3. Data and empirical model

Data are extracted from the French Farm Accountancy Data Network (FADN) for the year 2000 for farms specialised in COP production (European Type of Farming 13) and farms specialised in beef production (European Type of Farming 42). The FADN database contains detailed bookkeeping information at the farm level. After cleaning for missing and inconsistent data, the sample sizes are 1,407 for COP farms and 562 for beef farms.

It is assumed that COP farms and beef farms do not use the same production technology, and therefore two DEA frontiers (one for each farm-type sample) are constructed. Technical efficiency is calculated with a multi-output multi-input DEA model under variable returns to scale. Two aggregate outputs are considered for both types of farms: crop output and livestock output. Four inputs are distinguished for COP farms, that is agricultural area in hectares, labour in Annual Working Units (AWU), the depreciated value of total assets for the capital factor, and intermediate inputs. The same inputs are used for beef farms, with total livestock units as an additional input. Table 1 displays descriptive characteristics for outputs and inputs used in the first DEA model. Input data are identical in the second DEA model while output data are initial data adjusted for accounting for environmental conditions.

Table 1: Descriptive statistics of the data used for the first DEA model (first stage)

	Crop output (thousand euros)	Livestock output (thousand euros)	Land (ha)	Total livestock units	Labour (AWU)	Capital (thousand euros)	Intermediate inputs (thousand euros)
	COP farms (1,407 farms)						
Mean	102.1	7.3	141.1	Not used	1.52	192.4	74.3
Standard deviation	65.2	19.5	79.4		0.70	144.8	43.2
Minimum	7.2	0	14.2		0.75	1.0	7.4
Maximum	635.6	237.0	655.7		6.00	1,669.2	500.5
	Beef farms (562 farms)						
Mean	5.6	57.0	97.6	115.2	1.50	230.9	40.5
Standard deviation	6.6	34.8	55.3	61.7	0.61	127.0	27.7
Minimum	0	8.3	15.7	18.3	0.82	23.4	4.2
Maximum	49.9	262.9	391.9	428.7	5.00	922.0	195.8

Notes: One AWU is equivalent to 2,200 hours of labour per year. Livestock units are calculated with the standard European FADN coefficients.

Unfortunately the FADN database does not provide detailed information about the specific operating environment facing each farm. However, meteorological data from Météo France were available for the year considered at the municipality level. They include, as averages in the municipality where the farm operates, altitude, slope, minimal and maximal temperatures, rain level, evaporation, sunshine period and the water stock capacity. Additional FADN data also proxying the environmental conditions where the farm operates were included: regional dummies (at the EU nomenclature level of NUTS2), two dummies indicating whether the farm is situated in Less Favoured Area (LFA) and whether in mountainous LFA, respectively, and the value of subsidies received for farms situated in remote mountainous areas and for farms that have experienced a natural disaster in 2000. It is expected that these Météo France and FADN variables characterise the main features of the operating environment faced by farms, notably climate conditions.

Finally, managerial efficiency scores obtained from the second DEA model are regressed over a set of explanatory variables, including CAP direct payments. This second set of explanatory variables excludes the variables that were used for adjusting output levels because of heterogeneous external conditions. In a general way, variables used in this final step and that are considered as main determinants of managerial efficiency, are chosen on the basis of past empirical studies and intuition as there is no unified theoretical framework upon which this selection could rely. Several groups of variables are commonly considered in the literature: human capital variables, farm characteristics, farm technology, and on- and off-farm structural factors (such as security of land ownership rights, farms' financial situation, credit access, institutional environment, etc.). We retained two human capital variables, the managers' age and whether they have a university education (dummy equal to 1). To proxy the farm legal status, a dummy equal to 1 if the farm is of individual type was included (other statuses include mainly various forms of partnership). Regarding the technology employed, the following variables were selected: the share of rented land in total utilised area, the share of hired labour in total farm labour, the capital to labour ratio and the land to labour ratio. The debt to asset level was also included to represent the use of external financing. Finally, the CAP direct payments received by the farm were considered. Such payments include area-based payments (crop and set-aside payments), headage premiums for livestock, LFA payments and agri-environmental aids. Various measures of CAP payments were included in separate regressions: the total amount of CAP payments received by farms (Regression 1); the amount of all CAP payments per total value of output produced (Regression 2); the amount of all CAP payments per hectare of utilised agricultural area for COP farms or per livestock unit for livestock farms (Regression 3); and finally the four components of CAP payments all per hectare, except for headage premiums that were included per livestock unit for livestock farms only[1] (Regression 4). Thus, four regressions are estimated for each sample. Table 2 reports descriptive statistics for the CAP direct payments received by the COP and beef samples. On average, COP farms received more CAP direct payments than beef farms in 2000 as a total amount per farm; however, the amount received by both types of farms was fairly similar when defined as a ratio of the value of total output produced (around 0.5 on average) or in euros per hectare of utilised agricultural area (around 340 euros/ha on average). As expected, COP farms received mainly area-based payments and beef farms mainly headage premiums. COP farms did not benefit from LFA or agri-environmental payments.

[1] For the COP sample, headage premiums could not be included per livestock unit as a large number of COP farms have no livestock units, therefore reducing the sample for the regression.

Table 2: Descriptive statistics of CAP direct payments received by farms in the samples used

	COP farms (1,047 farms)				Beef farms (562 farms)			
	Mean	Standard deviation	Min	Max	Mean	Standard deviation	Min	Max
Amount per farm (thousand euros)								
All payments	49.4	26.6	4.7	227.8	30.9	16.0	4.3	111.2
Amount per total output value								
All payments	0.51	0.21	0.15	2.46	0.56	0.24	0.07	2.33
Amount per hectare of agricultural area (euros)								
All payments	358.1	56.2	143.1	1,090.1	331.8	83.1	81.7	845.3
Area-based payments only	345.8	59.2	143.1	676.4	37.7	35.5	0	196.1
Headage premiums only	10.2	29.7	0	627.6	235.5	70.4	53.3	675.0
LFA payments only	0.5	2.9	0	49.8	35.5	37.2	0	228.5
Agri-environmental aids only	1.7	7.9	0	107.0	23.0	23.0	0	153.8

Notes: CAP direct payments include area-based payments, headage premiums, LFA payments and agri-environmental aids. For beef farms, headage premiums per livestock unit are 194 euros on average, with a minimum of 41 euros and a maximum of 355 euros in the sample.

4. Results

4.1. Technical and managerial efficiency

Descriptive statistics of technical efficiency scores (first DEA model; first stage) and of managerial efficiency scores (second DEA model; fourth stage) are given in Table 3. Conventionally, the inverse of the scores given by the output-orientated models is used (the inverse is therefore between 0 and 1, with greater score indicating greater efficiency). As expected, the managerial efficiency is greater than the technical efficiency as it has been disentangled from unfavourable environmental effects. On average, there is a non negligible difference between managerial efficiency scores and technical efficiency scores: efficiency scores are on average higher by 0.07 for COP farms and by 0.09 for beef farms. These figures indicate that on average 10 percent (COP farms) and 12 percent (beef farms) of the technical inefficiency are explained by unfavourable operating conditions. Although managerial inefficiency is the main source of technical inefficiency, inefficiency could be significantly reduced if the farms could operate in better external conditions.

Table 3: Descriptive statistics of technical and managerial efficiency scores

	Technical efficiency score (first stage)	Managerial efficiency score (fourth stage)
	COP farms (1,047 farms)	
Mean	0.623	0.696
Standard deviation	0.172	0.146
Minimum	0.151	0.199
Maximum	1	1
	Beef farms (562 farms)	
Mean	0.655	0.740
Standard deviation	0.178	0.144
Minimum	0.196	0.345
Maximum	1	1

Note: For easy-reading, these descriptive statistics are for the inverses of the efficiency scores obtained with an output-oriented DEA model (in the output-orientation, scores for efficient farms are 1, while score for inefficient farms are greater than 1).

4.2. Impact of direct payments on managerial efficiency

Although by construction the efficiency score distribution is bounded at 1, only a few farms are on the frontier (5 percent in the COP sample, 8 percent in the beef sample), and therefore a standard Ordinary Least Squares regression was preferred to a limited dependent variable regression. The dependent variable in our regression is the inverse of the managerial efficiency score obtained with the output-oriented DEA model: it therefore ranges between 0 and 1, and the higher its value, the higher the efficiency. Table 4 and Table 5 present the results of the regressions of the managerial efficiency scores: the full results of Regression 2 are presented in Table 4, while in Table 5 only the coefficients and significance of the CAP payments proxies are reported but for all four regressions (Regressions 1, 2, 3, 4).

Regarding the effect of subsidies, estimation results show that the amount of CAP direct payments per total output has a significant negative impact on managerial efficiency for both COP and beef farms (Table 4). This indicates that the higher the share of direct payments in total output, the less efficient the farm, conform to the expectations based on previous studies. The effect is similar for both samples, with a coefficient of -0.347 and for -0.326 for COP and beef farms respectively. These figures show that farms receiving one euro of CAP direct payments for each euro of output produced, would experience a reduction of about 0.33 of their managerial efficiency score; in other words, as the average value of CAP direct payments per value of output is 0.5 for both samples, the average managerial efficiencies could be increased by 0.165, that is to say up to 0.86 for COP and 0.90 beef farms, if CAP direct payments were removed, all other things remaining unchanged. The negative influence of CAP direct payments is confirmed when they are entered as an absolute value per farm for the COP sample but not for the beef sample for which the effect is not significant (although such non-significant effect could be due to the fact that the total amount of payments per farm may capture other effects such as a size effect); the negative impact is also found with high significance when considering the CAP payments per hectare of land (for COP farms) or per livestock unit (for beef farms) (Table 5). When including the four components of the CAP payments together, results show that the main First Pillar payments received by the farms (area-based payments for COP farms, headage premiums for beef farms) have a negative impact, while the other type of First Pillar payments (headage premiums for COP farms, area-based payments for beef farms) have no significant effect. As for the Second Pillar aids, they also have a negative significant influence on French farms' managerial efficiency, except for LFA payments which do not play any significant role on COP farms' efficiency (Table 5).

Regarding the effect of other variables, human capital characteristics (age and education) surprisingly play no role on French farms' managerial efficiency. We tried various educational variables in the model (including variables representing agricultural education), but none of them were significant. Individual farmers do not perform better than those farming in partnership. The share of rented land in total land has no significant impact, while the share of hired labour in total labour has a negative impact for COP farms but no significant impact for beef farms. The higher the capital to labour on the farm, the less efficient a COP farm; the higher the land to labour ratio, the more efficient a COP farm and a beef farm. Finally, debts allow COP farms to perform better, may be by allowing them to purchase high quality inputs.

Table 4: Results of the regression of managerial efficiency scores including the total CAP direct payments per total output value (Regression 1)

	Marginal effects and significance for COP farms	Marginal effects and significance for beef farms
Constant	0.882 ***	0.904 ***
Age	-0.351 E-03	0.031 E-03
Dummy = 1 if university education	0.009	0.001
Dummy = 1 if individual farm status	0.080	-0.016
Share of rented land	-0.305 E-03	-0.064 E-03
Share of hired labour	-0.912 E-03 ***	-0.249 E-03
Capital to labour ratio	-2.99 E-07 ***	-1.24 E-07
Land to labour ratio	0.728 E-03 ***	0.707 E-03 ***
Debt to asset ratio	0.013 ***	0.019
Total CAP direct payments per total output value	-0.347 ***	-0.326 ***
R-squared	0.267	0.297
Number of observations	1,407	562

Notes: the dependent variables are the inverses of the efficiency scores obtained with an output-oriented DEA model (the dependent variables are therefore between 0 and 1, with greater score indicating greater efficiency).*, **, *** denotes significance at 10, 5, 1 percent level. E-*n* means x10^{-n}.

Table 5: Results of the separate regressions of managerial efficiency including various CAP direct payments in turn

	Marginal effects and significance for COP farms	Marginal effects and significance for beef farms
Regression 1		
Total CAP direct payments per farm	-4.64 E-07 **	-6.81 E-07
Regression 2		
Total CAP direct payments per total output value	-0.347 ***	-0.326 ***
Regression 3		
Total CAP direct payments per hectare of land (COP farms) or per livestock unit (livestock farms)	-0.00047 ***	-0.00034 ***
Regression 4		
Area-based payments per hectare of land	-0.00052 ***	-0.00007
Headage payments per hectare of land (COP farms) or per livestock unit (livestock farms)	0.00018	-0.00034 ***
LFA payments per hectare of land	-0.00182	-0.00042 **
Agri-environmental payments per hectare of land	-0.00093 **	-0.00047 *

Notes: *, **, *** denotes significance at 10, 5, 1 percent level. E-*n* means x10^{-n}.

5. Concluding remarks

This paper applied a five-step approach to the investigation of the relationship between public subsidies, namely CAP direct payments, and managerial efficiency for French COP and beef farms in 2000. Managerial efficiency scores were calculated using the four-step approach initially developed by Fried et al. (1999). This approach allows disentangling managerial inefficiency from other technical inefficiency components, notably what is due to unfavourable environment conditions. Then, in a five stage, managerial efficiency scores were regressed over a set of explanatory variables, including the CAP direct payments.

Two main findings emerge. First, using meteorological variables at the municipality to characterize farms' operating environment enabled to disentangle inefficiency due to bad external conditions from managerial inefficiency. Second, there is a negative relationship between managerial efficiency and CAP direct payments for both COP and beef farms. This indicates that, in these two specialisations, French farms that are more supported are less efficient, conform to expectations and to empirical results obtained in other studies. The effect is relatively strong, as managerial efficiency scores in the samples considered could be increase by 0.165 on average if CAP direct payments were removed, *ceteris paribus*.

This paper illustrates the usefulness of a five-stage approach when investigating the impact of public support on farms' performance. The illustration is performed with data for the year 2000, implying that the negative relationship between managerial efficiency and CAP direct payments that has been pointed out for French COP and beef farms holds for direct payments that were in force in 2000. Since the 2003 CAP reform however, former area and headage payments have been replaced by the so-called single farm payment (SFP), applied for the first time in 2006 in France. One important question is therefore whether the negative relationship between managerial efficiency and such a more decoupled direct payment (the SFP) still holds. An application of the five-stage approach to 2006 and later FADN data corresponding to the newly implemented SFP when they are available is thus worth undertaking.

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