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# Role of financial subsidies allocated by the Common Agricultural Policy towards Irish farms

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## Abstract

In Ireland, the productive agrarian fabric is characterised by lots of farms predominately specialized in cereals, protein crops and dairy productions with a significant incidence of cows and sheep in zootechnic enterprises. Since 2004 to 2015 a quantitative research has been carried out on Irish farms belonging to the Farm Accountancy Data Network dataset with the purpose to assess the role and impact of financial subsidies allocated by the Common Agricultural Policy (CAP) towards farmer's income and technical, economic and allocative efficiency as well. The methodology has used the multiple regression model and the Data Envelopment Analysis on a constant return to scale input oriented model. Economic crises have impacted to Irish farms corroborating the theoretical framework according to which decoupled payments allocated by the first pillar of the Common Agricultural Policy have had a more positive and significant impact on farmer's income and their economic, allocative and cost efficiency than the financial subsidies disbursed by the second pillar of the CAP.

**Keywords:** allocative efficiency, cost efficiency, Data Envelopment Analysis, multiple regression model, technical efficiency

## Introduction

The Irish landscape is characterized by lots of farms specialized in cereals and zootechnic productions with a wide land capital endowment in terms of usable agricultural areas which, according to the recent outcomes in Statistical book on agriculture, forestry and fishery published by Eurostat, exceeds more than twice the European average value equal to 16 hectares.

The endowment of land capital is a fundamental constraint influencing investments and economic, technical and allocative efficiency in farms. Other authors have assessed as many variables such as farms size, ownership, social capital, age of farmers, typology of management and ageing of people living in the countryside impacted to the technical, economic and allocative efficiency in farms located in lots of European countries (Mathijs and Vranken, 2001; Mathijs and Swinnen, 2001; Latruffe et al., 2004; Latruffe et al., 2005; Guyomard et al., 2006; Davidova and

Latruffe, 2007; Bojnec and Latruffe, 2008; Bakucs et al., 2010; Latruffe, 2010; Latruffe et al., 2012; Latruffe and Nauges, 2014; Galluzzo, 2015a; 2015b). By contrast, several studies have been addressed in investigating in depth afterwards the enlargement of the European Union the impact of financial subsidies allocated by the Common Agricultural Policy on farm’s efficiency in Eastern European nations (Bielik and Rajcaniova, 2004; Latruffe et al., 2004; Bojnec and Latruffe, 2009; Davidova and Latruffe, 2007; Galluzzo, 2015b; Camelia and Vasile, 2016; Galluzzo, 2017a, 2017b;). According to these latter authors, findings have emphasized as the farm's property played an important role in smallholder farms due to their modest fragmented land size sparsely scattered in modest rural villages (Bielik and Rajcaniova, 2004; Latruffe et al., 2004; Bojnec and Latruffe, 2009; Galluzzo, 2013, 2015; Camelia and Vasile, 2016).

Since 1965, aimed at assessing the impact of the Common Agricultural Policy towards European farmers belonging to the European Countries, the European Economic Community by the Council Regulation number 79 has set up an annual survey on a sample of farmers called Farm Accountancy Data Network or FADN (European Commission, 2014). The FADN has been used in investigating in depth the technical and economic efficiency in European farms pointing out the predominant role of financial subsidies allocated by the CAP, crop specialization and farm size in improving the efficiency (Subal and Kumbhakar, 1993; Latruffe et al., 2004, 2005; Guyomard et al., 2006; Bravo-Ureta et al., 2007; Davidova and Latruffe, 2007; Veveris et al., 2007; Bojnec and Latruffe, 2008; Cesaro et al., 2009; Bakucs et al., 2010; Latruffe, 2010; Marongiu et al., 2010; Galluzzo, 2013, 2015a, 2015b; Camelia and Vasile, 2016; Galluzzo, 2014a, 2014b, 2016, 2017a, 2017b).

Newman and Matthews in 2006 and in 2007 have assessed in Ireland by a quantitative approach as farms specialized in milk production have had an increase of productivity and efficiency over the time with differences comparing different type of farm such as farms with sheep, crops or milk enterprises. However, these latter scholars have argued as the level of specialization in dairy farms has implied the highest level of efficiency in farms. Most recent studies aimed at investigating by a quantitative method the technical efficiency in all European Union countries using the FADN dataset have emphasized an increase of technical efficiency in Irish farms and also in other countries (Madau et al., 2017). Using the Data Envelopment Analysis method in farms belonging to the FADN, findings have pointed out as the technical efficiency correlates with the level of subsides disbursed by the European Union and with the level of land capital endowment corroborating the existence of a direct nexus between the variable farm size and technical efficiency (Zhu and Lansink, 2010).

The purpose of this research was to assess by a quantitative approach the relationships between financial subsidies allocated by the first and second pillar of the Common Agricultural Policy and the farmer’s income in Irish farms belonging to the Farm Accountancy Data Network since 2004 to 2015. By a multiple regression model has been investigated the role and function of financial subsidies, land capital expressed as usable agricultural areas, total cost, taxes, total assets and net investment on the dependent variable farm net income.

The second stage of this quantitative study has evaluated over the time the economic, allocative and cost efficiency in Irish FADN dataset, stratifying farms in function of their own predominant type of farm in accordance to the guidelines and general specifications published by the European Union in the regulation 1242/2008. In the Irish FADN dataset have been represented only 4 types of farms as milk farms and specialist dairying farms, field crop enterprises (cereals, oilseeds and protein crops), mixed farms with various crops, field crops and livestock combined and the last type of farms made by other grazing livestock enterprises (specialist cattle in rearing and fattening, cattle specialised dairying, rearing and fattening combined and sheep, goats and other grazing livestock).

## Methodology

The estimation of regressors, in order to assess the role of financial subsidies allocated by the CAP towards Irish farms, has used the software STATA 13 and in its algebraic form of matrix, the multiple regression models can be so expressed (Verbeek, 2006):

$$y = X\beta + \varepsilon$$

where y is the dependent variable and ε is the statistical error but both are vectors with n-dimensions; X is a matrix of independent variables which has a dimension n x k.

In analytical terms, the multiple regression model in its general formulation can be written in this way (Verbeek, 2006; Asteriou and Hall, 2011; Baltagi, 2011):

$$y = \alpha_0 + \alpha x_1 + \beta x_2 + \gamma x_3 + \delta x_4 + \varepsilon_j$$

y is farm net income in Irish farms part of FADN dataset

$\alpha_0$ constant term

$x_1$, $x_2$, $x_3$, $x_4$ independent variables such as financial subsidies allocated by the II pillar of the CAP and total financial subsidies allocated by the Common Agricultural Policy, total assets and taxes, usable agricultural area, total assets, net investments.

α, β, γ, δ are estimated parameters in the model

$\varepsilon_j$ term of statistic error.

The second phase of this research has assessed the efficiency by a non-parametric methodology or DEA (Data Envelopment Analysis) with the purpose to define an hypothetical function of production tightly linked to the set of variables used as usable agricultural areas, specific costs, seed costs, fertilizers costs, crop protection costs, other costs for crops, feed animal cost, overhead costs, labor input, taxes and other dues linked also to the land and buildings, environmental subsidies allocated by the CAP, Less Favored Areas (LFA) payments towards disadvantaged rural areas paid by the National Rural Development Plan, subsidies allocated by the Second Pillar of the CAP and decoupled payments linked to the first pillar of the Common Agricultural Policy.

The non-parametric linear model by the Data Envelopment Analysis has been described for the first time in 1978 (Charnes et al., 1978). The positive advantage of the DEA is due to an opportunity to arrange a hypothetical function of production made by a different combination of input and output hence, the distance from the frontier of this function is the index of technical inefficiency or technical efficiency (Bielik and Rajcaniova, 2004). In fact, along this function there are all the possible overall optimal combinations of inputs or output able to minimize costs or maximize the income.

Roughly speaking, fluctuations in the model from the frontier of the function of production are inefficient and the technical efficiency is described as a set of opportunities for entrepreneurs in maximizing the output minimizing in the same time inputs or vice versa (Bojnec and Latruffe, 2008, 2009). In this research, the economic efficiency has been estimated by a non-parametric model applied to a variable return to scale (VRS) input oriented model (Farrell, 1957; Battese, 1992; Coelli, 1996) using the PIM-DEA software with the purpose to assess in the input slakes and targets in Irish farms part of the FADN dataset as well.

Coelli argued in 1998 that one of the best methods in estimating the efficiency by the DEA approach in a Decision-Making Unit (DMU) is simply a ratio between all output on all input written as $u'y_i/v'x_i$, where u' and v' are two vectors of input and output weights and the linear transformation of this general theoretical framework can be expressed as this expression whose major bottleneck is to have infinite solutions (Coelli, 1998):

$\max u, v\ (u'y_i/v'x_i)$

s.t.

$u'y_i/v'x_i \leq 1$, j = 1, 2, 3, 4... N,

$u, v \geq 0$

According to this above-mentioned author the best solution is to define a constraint so that $v'x_i$ is equal to 1 or 100% and in formula it can be written as (Battese, 1992; Coelli, 1998):

$\max \mu, \nu\ (\mu', y_i)$

s.t.

$\nu 'x_i = 1$

$\nu 'y^j \mu' - \nu 'x_j \leq 0$, j = 1, 2... N

$\mu, \nu \geq 0$

In this case $\mu$ and $\nu$ are a transformation of u and v using this transformation in a duality process the model where $\theta$ and $\lambda$ is a Nx1 vector of constant hence, the minimizing function is:

$\min_{\theta, \lambda}\ \theta$

s.t.

$-y_i + Y\lambda \geq 0$

$\theta x_i - X\lambda \geq 0$

$\lambda \geq 0$

If $\theta$ for each farm is close to 1 this implies as the solution is along the frontier of the hypothetical function of production and the farm is efficient otherwise it is inefficient.

The scale efficiency, which is a comparison between constant return to scale efficiency and the variable return to scale has not estimated in this study, instead the methodology has assessed the technical efficiency as proposed by other authors (Farrell, 1957; Battese, 1992; Coelli, 1996, 1998; Madau et al., 2017). According to these scholars, the poorer is the gap between produced output and the optimal output in a fixed combination of input more efficient is the technical efficiency, which in mathematical terms can be written as:

$$TE = Y/Y^*$$

Y is the produced output in each Irish farm stratified in different type of farms and Y* is the optimal level of output.

The aim of a non-parametric input oriented model, used in this research is to minimize in a multiple-output model the multiple-input in each farms part of the Irish FADN database that is a ratio of efficiency with infinite possible solutions hence, the value of efficiency is in range between 0 and 100% (Bhagavath, 2009; Galluzzo, 2013, 2016). If h or rather the value of efficiency is close to 1 or 100% each farm or Decision Making Unit (DMU) is more efficient compared to other $DMUh_n$, but whether h is not equal to 1 or 100% there are lots of units more efficient than this unique and inefficient unit ($DMUh_1$) (Bhagavath, 2009; Galluzzo, 2013, 2016).

## Results and discussion

The analysis of quantitative relationships among some variables such as financial subsidies allocated by the CAP, farm net income, input, output and land capital has pointed out the highest direct correlation value between the variables input and produced output and by contrast the lowest value has been pointed out between the variable usable agricultural areas and financial payments allocated by the second pillar of the Common Agricultural Policy (Table 1) corroborating the hypothesis according to which the decoupled payments are directly correlated to the variables endowment of land capital (usable agricultural areas) and economic size in terms of European Size Unit (ESU) equal to 1,000 euro for each ESU.

In general, small farms with modest agrarian areas have had an indirect correlation to the financial subsidies allocated by the first pillar of the CAP; hence, financial subsidies allocated towards small farms have been fundamental in a perspective of rural growth emphasizing the role of subsidies allocated by the Common Agricultural Policy in financially promoting an integrated process of development of rural spaces. Outcomes have corroborated the hypothesis according to which the larger is the land capital the higher is the level of direct payments allocated by the first pillar of the CAP.

Table 1. Correlations among economic variables investigated in Irish farm part of Farm Accountancy Data Network (FADN) dataset

| | Economic size | Usable Agricultural Areas | Total output | Total input | Farm net income | Total asset | Common Agricultural Policy payments | Rural Development Plan payments |
|---|---|---|---|---|---|---|---|---|
| Economic size | 1 | 0.5* | 0.9* | 0.9* | 0.8* | 0.4* | 0.2 | -0.5* |
| Usable Agricultural Areas | 0.5* | 1 | 0.5* | 0.6* | 0.4* | 0.5* | 0.8* | -0.7* |
| Total output | 0.9* | 0.5* | 1 | 0.9* | 0.9* | 0.4* | 0.3* | -0.4* |
| Total input | 0.9* | 0.6* | 0.9* | 1 | 0.8* | 0.4* | 0.4* | -0.4* |
| Farm net income | 0.8* | 0.4* | 0.9* | 0.8* | 1 | 0.4* | 0.3* | -0.4* |
| Total asset | 0.4* | 0.5* | 0.4* | 0.4* | 0.4* | 1 | 0.6* | -0.4* |
| Common Agricultural Policy payments | 0.2 | 0.8* | 0.3* | 0.4* | 0.3* | 0.6* | 1 | -0.4* |
| Rural Development Plan payments | -0.5* | -0.8* | -0.5* | -0.4* | -0.4* | -0.4* | -0.3* | 1 |

*P≤0.05
Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

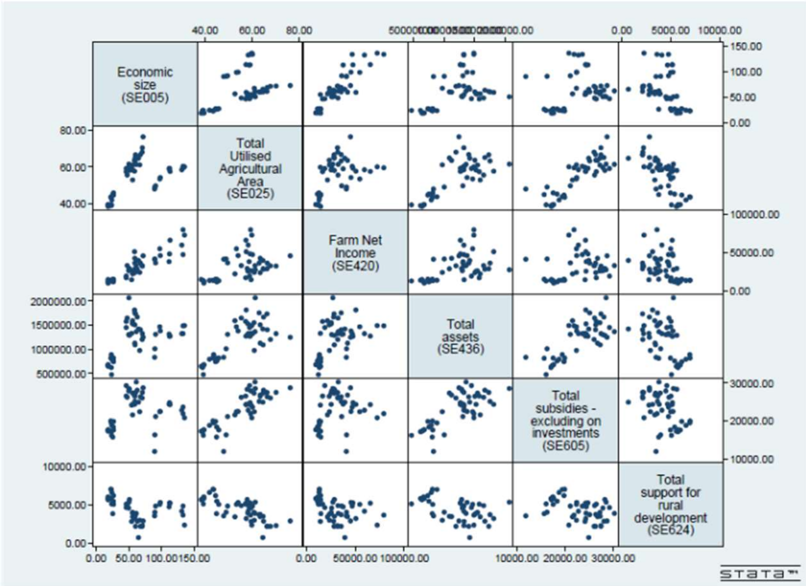
Outcomes in the multiple regression model have pointed out as the level of net investments and financial subsidies allocated by the second pillar of the Common Agricultural Policy did not effect on the level of farm net income (Table 2). The level of $R^2$ and adjusted $R^2$ equal to 0.95 and 0.94 have implied as the multiple regression model fits well with the target of analysis because it has been able to explain more than 90% of the variance. The independent variables usable agricultural area, total costs and total assets correlate directly to the level of income in farms part of the Irish FADN dataset. Taxes and total subsidies allocated by the Common Agricultural Policy have had an indirect correlation with the level of farm's income. Findings have underlined as the wider are the farms in terms of usable agricultural surface the higher is the level of farmer's income. Taxes have acted indirectly on the level of income for farmers; hence, the financial subsidies did not impact positively on the income towards Irish farmers. Furthermore, a modest allocation of financial subsidies disbursed by the CAP is typical of large size farms. Farm size is a decisive key in stimulating investments and efficiency towards farms. The scatter box graph has underlined a direct correlation among the variables economic size in terms of European Size Unit, usable agricultural surface and farm net income (Figure 1); unclear seems to be the relationship between economic size and financial subsidies allocated both by the first and also by the second pillar of the CAP.

Table 2. Main findings in the multiple regression model. Dependent variable farm net income

| Variable | Coeff. | Std. Error | T value | Significance |
|---|---|---|---|---|
| Usable Agricultural Areas | 729.8 | 243.3 | 3 | ** |
| Total cost | 0.7 | 0.1 | 6.7 | *** |
| Taxes | -70.7 | 29.8 | -2.4 | * |
| Total assets | 0 | 0 | 2 | ** |
| Net Investments | 0.1 | 0 | 1.3 | n.s. |
| First and second pillar Common Agricultural Policy total subsidies | -1.6 | 0.6 | -2.4 | * |
| Rural Development Plan payments | 0.3 | 0.7 | 0.3 | n.s. |

n.s.-not significant, P>0.05, *P≤0.05, **P≤0.01, ***P≤0.001.

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm




Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Figure 1. Scatter plot of some economic variables in Irish farms part of FADN dataset

Table 3. Main findings of technical, cost and allocative efficiency in field crops farms

| Year | Efficiency | Cost Efficiency | Allocative Efficiency |
|---|---|---|---|
| 2004 | 100 | 61.7 | 61.7 |
| 2005 | 76.5 | 50.6 | 66.1 |
| 2006 | 100 | 71.9 | 71.9 |
| 2007 | 100 | 100 | 100 |
| 2008 | 57.2 | 45.3 | 79.2 |
| 2009 | 63.9 | 28.8 | 45.1 |
| 2010 | 100 | 75.1 | 75.1 |
| 2011 | 100 | 66.9 | 66.9 |
| 2012 | 100 | 51 | 51 |
| 2013 | 86.3 | 47.1 | 54.6 |
| 2014 | 100 | 56.4 | 56.4 |
| 2015 | 100 | 65.1 | 65.1 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 4. Main findings of efficiency in milk Irish farms

| Year | Efficiency | Cost Efficiency | Allocative Efficiency |
|---|---|---|---|
| 2004 | 100 | 100 | 100 |
| 2005 | 100 | 84.6 | 84.6 |
| 2006 | 90 | 64.4 | 71.5 |
| 2007 | 100 | 88 | 88 |
| 2008 | 79 | 59.9 | 75.8 |
| 2009 | 63 | 48.2 | 76.5 |
| 2010 | 85.8 | 59.4 | 69.2 |
| 2011 | 100 | 78.5 | 78.5 |
| 2012 | 72 | 50.6 | 70.3 |
| 2013 | 94.3 | 59.2 | 62.8 |
| 2014 | 100 | 87.6 | 87.6 |
| 2015 | 100 | 82.1 | 82.1 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 5. Main findings of cost and allocative efficiency in another grazing typology of farm

| Year | Efficiency | Cost Efficiency | Allocative Efficiency |
|---|---|---|---|
| 2004 | 100 | 100 | 100 |
| 2005 | 100 | 84.3 | 84.3 |
| 2006 | 99.4 | 75.3 | 75.7 |
| 2007 | 100 | 74.2 | 74.2 |
| 2008 | 97.2 | 65.8 | 67.7 |
| 2009 | 100 | 66.3 | 66.3 |
| 2010 | 73.9 | 53 | 71.8 |
| 2011 | 100 | 79.8 | 79.8 |
| 2012 | 94 | 66 | 70.1 |
| 2013 | 77.5 | 50.5 | 65.1 |
| 2014 | 88.9 | 61.1 | 68.7 |
| 2015 | 100 | 76.9 | 76.9 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Addressing the attention on the analysis of efficiency in Irish farms specialized in milk production, findings have underlined in 6 years out of 12 optimal values of efficiency close to 100% (Table 4); even if the values of cost and allocative efficiency have been lower than the threshold of 100% in 11 years out of 12 with the unique exception of the year 2004 and partially in 2005 when both values have been close to the optimal threshold equal to 100%.

Irish farms specialized in other typology of grazing have had the same values of efficiency assessed in dairy farms above mentioned with positive findings in 5 years out of 12 with a lower value in cost efficiency than in allocative one (Table 5). Table 6 shows results assessed in mixed specialized farms. In general, findings have corroborated as a mixed typology of farms are more efficient than the field crop one, even if the value of efficiency has been under the optimal threshold in 5 years out of 12 with outcomes of cost efficiency poorer than the allocative one which is quite sensitive to the economic recession occurred in 2008 and in 2009.

Table 6. Main findings of cost and allocative efficiency in Irish mixed specialised farms

| Year | Efficiency | Cost Efficiency | Allocative Efficiency |
|---|---|---|---|
| 2004 | 100 | 100 | 100 |
| 2005 | 100 | 72.7 | 72.7 |
| 2006 | 100 | 76.5 | 76.5 |
| 2007 | 100 | 90.6 | 90.6 |
| 2008 | 55.2 | 41.7 | 75.5 |
| 2009 | 64.5 | 46.5 | 72.1 |
| 2010 | 100 | 65.1 | 65.1 |
| 2011 | 97.6 | 68.5 | 70.1 |
| 2012 | 100 | 71.7 | 71.7 |
| 2013 | 79.6 | 49.8 | 62.5 |
| 2014 | 93.9 | 58.2 | 62 |
| 2015 | 100 | 61.1 | 61.1 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

The analysis of slacks in Irish farms part of the FADN dataset specialized in field crops have pointed out in 4 years out of 12 some inputs able to improve the efficiency towards agrarian enterprises in particular during the economic crises in 2008-2009 (Table 7). The worst year has been investigated in 2009 due to an excess of inputs such as the usable agricultural areas, the labour input and financial subsidies allocated by the European Union in the first pillar of the Common Agricultural Policy.

Table 7. Slacks investigated in field crops farms

| Year | Labour input | Usable Agricultural Areas | Total specific cost | Seed cost | Fertilizer cost | Crop protection cost | Feed animal cost | Total Common Agricultural Policy subsidies | Less Favored Areas subsidies | Rural Development Plan payment |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 202.6 | 6.5 | 3,305.7 | 0 | 967.6 | 831.2 | 0 | 2,812.2 | 46.8 | 645.5 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 47.8 | 1.8 | 3,702.8 | 624.5 | 2,380.9 | 719.6 | 54.5 | 1,013.9 | 0 | 687.3 |
| 2009 | 511.8 | 16.9 | 5,200.7 | 1,175.2 | 2,736.1 | 1397.7 | 0 | 6,973.2 | 0 | 1256 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 177.5 | 4.1 | 3,876.7 | 1,027.8 | 2,269 | 0 | 1,026.3 | 1,852.4 | 14.5 | 606.3 |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

The level of land capital in terms of usable agricultural areas is indirectly correlated with the level of financial subsidies allocated by the second pillar of the CAP. Direct is the relationship between farm net income and the endowment of land capital in Irish farms part of the FADN dataset. Findings have strengthened and corroborated the theoretical framework according to which the level of total assets correlates directly to the level of land capital endowment.

Outcomes in farms specialized in field crops have pointed out in 8 years out of 12 an optimal value of efficiency even in 2008 and 2009 as consequence of the European economic recession farms specialized in cereals and other crops have pointed out the lowest value of efficiency as described in Table 3. In particular, in all farms over the time of investigation, with the only exception in 2007, the cost and allocative efficiency have not been optimal with values plentifully under the theoretical threshold of 100%. Summing up, this cluster of farms has pointed out the worst result in terms of technical efficiency compared to the other type of farms stratified in the all investigated Irish FADN dataset.

Table 8. Slacks investigated in milk specialized Irish farms

| Year | Labour input | Usable Agricultural Areas | Total specific cost | Seed cost | Fertilizer cost | Crop protection cost | Feed animal cost | Total Common Agricultural Policy subsidies | Less Favored Areas subsidies | Rural Development Plan payment |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 803.9 | 9.8 | 6,264.4 | 119.8 | 1946.9 | 56.8 | 2,859 | 4,144 | 465.8 | 984.3 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0.31 | 9,366.5 | 78.1 | 1,473.6 | 88.3 | 8,577.3 | 177.5 | 107.3 | 363 |
| 2009 | 136 | 3.7 | 5,255.3 | 86.5 | 467.5 | 30.6 | 5,550.2 | 1,807.8 | 0 | 151.1 |
| 2010 | 292.7 | 7.1 | 13,040.7 | 174.6 | 1,247.2 | 25.7 | 10,974.9 | 3,337.8 | 0 | 666.9 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 536.1 | 8.1 | 8,365.8 | 0 | 816.6 | 0 | 10,400.2 | 3,950.8 | 291.7 | 1,269.6 |
| 2013 | 745.8 | 10.4 | 2,2748.7 | 143.7 | 3,480.5 | 0 | 22,362.1 | 5,055.8 | 312.8 | 1,172.4 |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 9. Slacks investigated in other grazing specialized farms part of FADN dataset

| Year | Labour input | Usable Agricultural Areas | Total specific cost | Seed cost | Fertilizer cost | Crop protection cost | Feed animal cost | Total Common Agricultural Policy subsidies | Less Favored Areas subsidies | Rural Development Plan payment |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 3.1 | 861.6 | 23.1 | 241.4 | 14.9 | 559 | 1,885.9 | 193.6 | 920 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 4.6 | 3,893.9 | 0.4 | 444.6 | 29.3 | 3,230 | 2868.2 | 359.4 | 1304.6 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 49.4 | 3.2 | 1,695.5 | 0.2 | 94 | 0 | 1,557.5 | 1291.7 | 37.9 | 385.7 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 43.4 | 4.1 | 3,652.5 | 15.7 | 401.3 | 0.6 | 2,687 | 1,304.4 | 0 | 166.1 |
| 2013 | 117.6 | 4.1 | 4,716.4 | 67.6 | 957 | 24.1 | 3,461.1 | 1,051.9 | 0 | 115.6 |
| 2014 | 120.1 | 5.2 | 4,375.2 | 23.2 | 590 | 34 | 2,076.2 | 881.9 | 0 | 43 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Table 10. Slacks investigated in mixed specialized farms part of FADN dataset

| Year | Labour input | Usable Agricultural Areas | Total specific cost | Seed cost | Fertilizer cost | Crop protection cost | Feed animal cost | Total Common Agricultural Policy subsidies | Less Favored Areas subsidies | Rural Development Plan payment |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0.9 | 3,563.9 | 149.1 | 1,826.2 | 313.8 | 1,774.6 | 118.3 | 0 | 165.1 |
| 2009 | 102 | 0 | 42.6 | 263.8 | 504 | 111.8 | 1,179.8 | 638.4 | 100.4 | 0 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 283.8 | 6.7 | 6141.9 | 0 | 2,153.3 | 0 | 3,539.2 | 3,568.4 | 251.6 | 1,511.1 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 0 | 5.9 | 8,373.5 | 469.3 | 2,558.6 | 149.8 | 4,446.9 | 0 | 178.1 | 211.7 |
| 2014 | 87.8 | 0.5 | 4,853.8 | 355.4 | 1,014.6 | 0 | 2,731.8 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Farms specialised in dairy production have underlined in 5 years out of 12 some significant slacks in the input oriented model of efficiency (Table 8). In 2006 and 2013, findings have had the worst results with an excess of some inputs in particular focusing the attention towards financial subsidies allocated by the CAP, specific cost correlated to level of production (costs of seeds and fertilizers) and payments disbursed by the National and European authorities in order to promote the rural development throughout the second pillar of the CAP.

Table 9 has shown as in 6 years out of 12 there has been lots of slacks in other grazing farms in particular during the years 2006 and 2008 in the inputs decoupled payments, specific costs such as feed for animal and costs for fertilizers.

Mixed farms in 5 years out of 12 have had some slacks and in 2011 there has been the worst result in terms of input used such as specific costs and financial subsidies allocated by the Common Agricultural Policy in the first and in the second pillar (Table 10).

Focusing the analysis of efficiency comparing targets to the used inputs such as usable agricultural areas (UAA), specific cost and overhead costs, findings have underlined as field crops farms have had the best results with only 4 years out of 12 characterized by the need in reducing the input (Table 11).

Table 11. Percentage of reduction over the time of some inputs investigated in Irish farms part of FADN dataset

| | Fieldcrops | | | Milk | | |
|---|---|---|---|---|---|---|
| Year | Usable agricultural areas | Specific cost | Overhead cost | Usable agricultural areas | Specific cost | Overhead cost |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | -35.8 | -37.6 | -34.6 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | -29.6 | -25.8 | -21.9 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | -45.9 | -53.6 | -49.7 | -21.5 | -36.2 | -21 |
| 2009 | -64.2 | -54.7 | -59.9 | -43.3 | -45.4 | -39.3 |
| 2010 | 0 | 0 | 0 | -26.2 | -34.7 | -27.5 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 0 | 0 | 0 | -41.4 | -38.6 | -37.9 |
| 2013 | -19.4 | -22.3 | -23.4 | -23.6 | -31.1 | -24.1 |
| 2014 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 |
| Year | Other grazing | | | Mixed farms | | |
| | Usable agricultural areas | Specific cost | Overhead cost | Usable agricultural areas | Specific cost | Overhead cost |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | -8 | -9 | -9.4 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | -13.4 | -29.1 | -8.5 | -46.3 | -55.2 | -50.4 |
| 2009 | 0 | 0 | 0 | -35.4 | -35.6 | -41.9 |
| 2010 | -34.1 | -39.3 | -34.9 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | -13.9 | -19.7 | -22.4 |
| 2012 | -15.1 | -26.2 | -14.4 | 0 | 0 | 0 |
| 2013 | -31.7 | -45.6 | -34.1 | -29.7 | -38.4 | -31.5 |
| 2014 | -22.4 | -33.2 | -21.7 | -6.9 | -16.7 | -14.6 |
| 2015 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Summing up, this cluster of farms in 2009 has pointed out the highest level of shrinking in all assessed inputs and in particular towards the usable agricultural area one.

With the exception of the other grazing cohort of farms part of FADN dataset, in all investigated typology of farms the effect of economic crises in 2008 has impacted upon the following year. Outcomes have strengthened the role of costs in implementing the technical efficiency, by their contraction, and also a reduction in terms of agrarian land has been pivotal in increasing the cost efficiency in an unstable way in all investigated clusters of Irish farms part of FADN dataset.

## Conclusions

Findings have corroborated the direct impact of productive specialization in increasing the efficiency in Irish farms. A mixed combination of crops and animals in farms do not get dramatically worse the level of technical and economic efficiency in the sample of investigated farms. Comparing outcomes in this research to other previously assessed by other scholars there has been a growth of efficiency in Irish dairy farms and in general in all Irish farms belonging to the FADN dataset. In fact, both Kelly et al. in 2012 and also Newman and Metthews in 2007 have assessed a value of technical efficiency in Irish dairy farms close to 0.771 more modest than findings estimated in this research. Furthermore, since 2007 to 2011 recent scholars have pointed out an overall technical efficiency in Irish farms both in constant and also in variable return to scale respectively close to 0.67 and 0.68 (Nowak et al., 2015) lower than the findings assessed in this study.

Summing up, the overall results of this research in type of farm specialized in dairy productions, which are one of the most widespread agricultural typology in Irish farms, although higher than some assessed in previous and above mentioned researches have been lower than outcomes assessed in terms of technical efficiency in all European countries by other authors (Madau et al., 2017) due to different variables of input used in the DEA model and in the estimation process of the efficiency.

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