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Assessing the impact of the EU Common Agricultural Policy pillar II support using micro-economic data

Buysse J. [1], Verspecht A. [1] and Van Huylenbroeck G.[1]

1 Department of agricultural economics, Ghent University, Coupure Links 653, B-9000 Gent, Belgium

J.Buysse@ugent.be

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Abstract

The paper uses the case of Flemish investment support to make a quantitative analysis of pillar II support based on micro-economic data from the FADN and the administrative dataset of the investment support fund. A dynamic panel estimation quantifies the effect of support for setting-up young farmers, structural investment support and support for investments on farm diversification, animal welfare or environmental investments.. The results show that investment support for farm diversification and structural support increase the total output and the income. Environmental investment support increase costs and decrease the farm income without a significant impact on output. The conclusion for the national debate is that the structural and the diversification investment support is effective while the environmental investment support is too low to cover all additional costs in the short run. The conclusion for the international debate is that, except for the structural investment support, the Flemish investment support is not distortive for international agricultural markets.

Keywords: Pillar II, Investment support, decoupled subsidies, dynamic panel estimation, Flanders

JEL classification: Q12, Q18, Q51, Q52.

1. INTRODUCTION

There is a slow but steady shift in the EU Common Agricultural Policy. Market based policies with coupled support are being replaced by income support policies with decoupled payments. In parallel, the pillar I budget, income support to farmers, declines in favour of the pillar II budget, rural development. The main reason for this policy change is that market policies, in contrast to rural development policies, have been considered distortive at both domestic and international level (Cagliero and Henke, 2005). In WTO terminology, subsidies are classified into "boxes" of which the green box is the most accepted. The 'green box' covers subsidies that are expected to cause minimal or no trade distortions, such as rural development policies.

The second pillar of the CAP was introduced in the Agenda 2000 and finetuned under the 2003 CAP reforms to promote sustainable agriculture and the rural development objectives. Rural development measures are divided in three main axes, competitiveness, environment and quality of life, complemented with the LEADER program with different accents in the different member states. The wide range and the complex mix of measures makes it difficult to estimate the overall economic impacts of rural development payments (Costa et al., 2009).

Costa et al. (2009) expect that many of the measures tend to increase the cost of production for farmers (shift the supply curve up). If the government funds these measures by the exact amount of their cost, in the short term there would be no effect on output and prices. In the longer term, however, the measures themselves can induce a shift in supply. Dwyer (2005) also suggests a possible impact of the second pillar on the quantity of output because it offers a wide range of funding opportunities for farmers, which may affect their farm management decisions.

Despite the systematic evaluation of rural development programmes in all EU member states, there are very few peer review published articles with an ex post quantitative analysis of rural development. Rezitis et al. (2009) have examined the technical efficiency and productivity growth of Greek livestock farms participating in the EU Farm Credit, but the analysed programme dated form before Agenda 2000. Their conclusion was that the total factor productivity growth results increase significantly for the group of program farms and not for the group of non-program farms.

The objective of the paper is help to fill the gap and to make a quantitative assessment of the impact of investment aid as one of the measures in the rural development programs. Investment aids usually cover a proportion of the total cost of a oneoff or short-term programme of investment activity on a farm (capital items) or for a farmer (training courses and other qualifications) (Dwyer, 2005). Investment aids are often linked with criteria related to environment and the sustainability of the farming practice. Therefore, the consequence of this investment may be improved agricultural productivity or it may be reduced agricultural activity (Dwyer, 2005).

The current analysis is based on a case study for the Flemish region, the northern part of Belgium. The benefit of the Belgian case is the fact that Belgium is the region with the highest share for axis 1 within the CAP Pillar II budget. The importance of the investment aid in Belgium has made it possible to compose an extensive dataset of all farm types with different types of investment aid.

The dataset for the analysis is based on the FADN sample linked with the administrative dataset of the administration responsible for the investment aid (VLIF). The panel dataset contains 865 farms over a period of eight years (2000-2008) including farms with and without access to investment funds and has information about sales, costs, production, investment and investment support.

The paper is organised as follows. The next section describes the investment support programme in Flanders with an overview of the dataset and the descriptive data of the different measures. The section 3 describes the econometric framework that is applied in section 4. Section 5 makes the overall conclusion.

2. INVESTMENT SUPPORT

In Europe, support for investments in agricultural holdings have been a priority since the treaty of Rome in 1957. One of the objectives of this treaty was to increase productivity, by promoting technical progress and increasing factor productivity. In 1972, the Mansholt plan led into a European Directive concerning the modernization of agricultural holdings. More recently, directive EU 2328/91 and EU 950/97 for the improvement on the efficiency and competiveness of agricultural structure were introduced to maintain the European presence on the world market. Since 2000, these modernization support is incorporated in the second pillar of the Common Agricultural policy. Member states can incorporate investment support for agricultural holdings in axis 1 of their Rural Development Plans to implement the Regulation 1257/1999 and 1698/2005.

In EU-27 the most important measure in the RDP 2007-2013 are the agri-environmental payments (measure 214) in axis 2 which are good for 23% of the European RDP total budget. Second is modernization of agricultural holdings (measure 121) with 11% of the budget. However between member states there is a great variety on budget. Belgium has most of the RDP budget going to axis 1 (58%). 27,1% of the total Belgian RDP 2007-2013 is foreseen for measure 121 (modernization) and 9,1% of the total RDP 2007-2013 is foreseen for the setting up of young farmers (measure 112).

Belgium is a federal state with three regions Flanders, Wallonia and Brussels. Agriculture became a regional authority during the last two state reforms (in 1993 and 2001). Legislative decision power for agricultural matters devolved in 2001 to the regions. However, some bodies were transferred to Flanders earlier in 1993, as for example the Flemish Agricultural Investment Fund (VLIF).

VLIF is part of the Flemish Agricultural administration. Since 1993, VLIF is responsible to organize the investment support for agricultural holdings (measure 121) and the support for investment related to the diversification into non-agricultural activities (measure 311) and the setting up of young farmers (measure 112). VLIF has also the competence for support to add value to agricultural and forestry products (measure 123) and the use of advisory services by farmers and forest holders (measure 114).

Objectives for the support on modernization and setting-up are to help the Flemish agricultural sector to be competitive, to ensure the continuation and dynamics of farming and to reach a satisfactory level of income. Therefore, the support in Flanders is organized as an open-end system: all farmers that are eligible, receive investment support for a list of subsidizable investments. To be competitive other aspects as environment, food safety, animal welfare, innovation should be taken into account. This importance to incorporate societal demands in the farm management and investments is translated in a long list of supportable investments concerning these issues.

Eligibility rules concern general issues on education or experience, viability of farms, accountancy and standards for environment, animal welfare and hygiene. For the setting up of young farmers maximum age is 40 years.

Investments which can receive investment support can be classified in five groups: structural investments (measure 121), investments that improve environmental quality (or reduce negative externalities) (measure 121), investments that improve animal welfare (measure 121), investments that stimulate diversification (measure 121 or 311), investments that occur during take-over of farms (measure 112). 0 provides an overview of the farms receiving the different types of support both for a sample of farms of the FADN and the complete population of the administrative dataset of the VLIF Table 1 shows that in terms of share of farms participating in the different measure the FADN sample is representative. The support for setting up of young farmers is underrepresented in the FADN.

Table 1: Number of farms and average amount of support per farm indicated per type of investment support in the study period 2000-2008

	FADN 2000-2008				VLIF 2000-2008				
	Number of farms	%	Av. support (€)	st.dev (€)	Number of farms	%	% excl. starting up	Av. support (€)	st.dev (€)
# farms	1149								
with support	483	100%			12399	100%	11421		
structural	455	94%	21.545	30.088	10636	86%	93%	26.476	41.479
diversification	51	11%	42.235	66.205	973	8%	9%	43.188	81.283
environmental	221	46%	22.630	44.586	5101	41%	45%	26.710	53.509
animal welfare	25	5%	11.152	14.471	821	7%	7%	18.576	21.452
setting up	18	4%	43.781	6.611	2146	17%		39.170	11.044

Source: own calculation based on FADN and VLIF data

Most important investment per category are shown in 0. Structural investments concern buildings (sheds, stys, greenhouse, …), equipment and machinery. Structural investments are the most important in terms of number of applications for investment support. However, the support rate is lower than for other types of measures. Therefore, the difference with other types of investment support is smaller in terms of the budget than in terms of number of applications.

Diversification investments are all types of investment that result in a farm-income of not primary agricultural activities (measure 121) or non-agricultural activities (measure 311). Solar energy investments provide farms with additional income as electricity producers. Three of the top 5 investment support measures deal with direct selling of farm products. This can raise the turnover by increasing the selling price but does not have a direct impact on the primary agricultural production. Investments for educational access are also considered as diversification because they can provide farms with additional income but are not directly related with the primary agricultural production. The classification is not based on the difference between measure 121 and 311 as in the first rural development program all the investment support fell under the same measure.

Environmental investments consists of investments that reduce environmental risks such as emission reduction techniques in livestock buildings and manure application, reduction techniques for energy use, fertilization and water use. Investment in animal welfare concern alternative animal housing systems or conditions.

The support for group housing of young calves is the only top 5 measure that is recorded in the VLIF dataset but not in the FADN dataset. The calve fattening sector is small and highly specialized and is underrepresented in the FADN dataset.

For all other measures, Table 2 shows again that the FADN dataset is representative for the population data of the VLIF dataset.

Table 2: The 5 most important measures of each type of investment support in the FADN and the VLIF dataset both in terms of number of applications

FADN 2000-2008	Aantal	VLIF 2000-2008	Aantal
Total of structural support	**1653**	**Total of structural support**	**36092**
Machines and building	767	Machines and building	16097
Storage and machine sheds	158	Storage and machine sheds	3841
Glasshouse	119	Glasshouse	2745
Farm pavements	104	Farm pavements	2590
Milking equipment	57	Milking equipment	1773
Total of diversification	**100**	**Total of diversification**	**1822**
Solar energy collectors	20	Equipment for dairy farm processed products	287
Equipment for dairy farm processed products	19	Solar energy collectors	265
Buildings for farm sales	11	Buildings for farm sales	174
Improvements for educational access	9	Improvements for educational access	172
Buildings for farm processed products	8	Buildings for farm processed products	150
Total environment	**376**	**Total environment**	**8576**
Manure injection	51	Manure injection	1380
Water tank	51	Water tank	1148
Energy efficiency	39	Concrete roughage silo	942
High tech pesticide spraying machines	37	High tech pesticide spraying machines	774
Concrete roughage silo	33	Energy efficiency	721
Mechanical weeding equipment(7th for VLIF)	33	Reuse irrigation water (7th for FADN)	577
Total animal welfare	**30**	**Total animal welfare**	**1088**
Improvement stable climate	11	Group housing calves	325
Deep litter stable for dairy farm	9	Deep litter stable for dairy farm	285
Group housing for sows	7	Improvement stable climate	279
Free range for fattening pigs	2	Group housing for sows	86
Free range for chickens	1	Free range for fattening pigs	34
Setting up young farmers	**18**	**Setting up young farmers**	**1886**

Source: own calculation based on FADN and VLIF data

3. ECONOMETRIC FRAMEWORK

The econometric analysis of the impact of investment support is based on the FADN dataset because the VLIF dataset does not have the detailed information about economic parameters. The FADN dataset used in the econometric analysis is supplemented with the detailed data about the type of investment support has been granted and when the administrative procedures has been started from the VLIF dataset.

The analysis uses the unbalanced panel data from the years 2000-2008. The advantage of this panel is that we use both the differences between farms as the changes in time to be able to describe the impact of investment support on the farm outcomes.

The following model specification is estimated.

$y_{nt} = \varphi_n + \tau_t + \beta_1 y_{nt-1} + \beta_2 i_{nt-1} + \beta_3 i_{nt-2} + \beta_{4m} s_{mnt-1} + \beta_{5m} s_{mnt-2} + \varepsilon_{nt}$

Where
'*n*' is the farm index,
'*t*' is the year index,
'*m*' is the index of the different types of investment support measures,
y_{nt} represents the dependent variables which is output, costs and income for the different estimations,
y_{nt-1} is the lagged value of the dependent,
i_{nt-1} is the amount of investment at farm *n* for year *t-1*,
i_{nt-1} is the amount of investment at farm *n* for year *t-2*,
s_{mnt-1} is the amount of investment support for the measure *m* at farm *n* for year *t-1*,
s_{mnt-1} is the amount of investment support for the measure *m* at farm *n* for year *t-1*,
φ_n is the estimated fixed farm effect,
τ_t is the estimated fixed year effect,
β_1, β_2, β_3, β_{4m}, β_{5m} are the estimated coefficients of the impact of investments and investment support on the dependent variable

The econometric analysis is based on three fixed effect dynamic panel estimations where the dependent variable y_{nt} represents 'total output', 'total costs' and 'family farm income' for the three estimated models.

A dynamic specification with the lagged variable y_{nt} is chosen to represent the path-dependency of the economic structure. This means that we want to capture the fact that the value of the dependent variable can be explained by its value in the previous year. The dynamic effect also captures that a shock given by a change in investment remains, at least partly, present in the dependent variable.

The model is specified as a fixed effect model rather than the random effect because the individual effects, φ_n, capture the relevant but unobserved characteristics of farms which are highly likely correlated with the other independent variables investment and investment support. This correlation of the individual effects would cause a biased estimation with a random effects model. The individual effects, φ_n, in the dynamic framework capture that the natural change in the dependent variable is farm specific.

The fixed time effect, τ_t, describe the impact of yearly variations on the dependent variable which is independent of all other independent variables. The time effect can deal with general economic or weather impact that affect all farms simultaneously.

A particular feature of the model is that we include the one and the two year lag of the independent variables investment and investment support. This way of modelling is motivated by the fact that the time lag between investment decision and its impact on the dependent variable is unsure. Investment is recorded in the FADN dataset and it is quite reliable accounted that the spending took place in the year that it is recorded in the accounting. The year of investment support correspond to the time that the administrative procedure has been started to receive the support. We think that this is the most accurate way of introducing the variable in the model but it gives no certainty about the time that the supported investment comes into action. Some farms start up first the administrative procedure and it can take another year before the actual investment is in place and ready for use while other farms make the investment and hand in the administrative forms after all costs have been made.

The one and two year lag means that both possibilities are captured in the model. The corresponding estimated coefficients should therefore not be considered additive. The one year lag capture the effect of farms with a short technical and administrative procedure of the investment and its support while the two year lag captures the effect of the longer administrative and technical procedure.

Nickell (1981) has indicated that estimating the model specified as above with standard ordinary least squares fixed effects estimator leads to biased results because of the possible correlation between the lagged dependent variable, which is used as regressor, and the error terms. Various alternative estimators have been proposed of which most are based on a generalized methods of moments estimation like Arellano en Bond (1991) or Blundell en Bond (1998). These estimators differ in the way that instrumental variables are chosen. Bruno (2005) has proposed the least squares bias-corrected estimator and its bootstrap variance-covariance matrix. Bruno (2005) has proven with a Monte Carlo analysis the better performance on smaller samples. The FADN sample is not small but the number of observations on specific independent variables is small. Therefore, we are convinced that the estimator developed by Bruno (2005) is best suited for our analysis.

The proposed model and its estimator do not suffer from problems of sample selection and endogeneity. Sample selection is not present in our analysis because we estimate the proposed model on the complete FADN sample. This means that all farms are used to estimate the impact of investments on the total output, costs and farm income. The estimated coefficients β_{4m} and β_{5m} quantify the additive effect of investment support while controlling for all other regressors present in the model. Endogeneity is also not a problem because of the time lag between independent and dependent variables: the higher output, cost or farm income at time *t* can not affect the decision to invest or ask investment support at time *t-1* or *t-2*.

4. RESULTS

The proposed econometric model with the bias corrected estimator from Bruno (2005) is applied to the FADN sample that contains the data of 865 farms over a period of eight years (2000-2008) including farms with and without access to investment support. All data are expressed in monetary terms in euro. This means that we can not distinguish between agricultural and non-agricultural ouput.

Table 3 presents the results of the three fixed effect dynamic panel estimations with the dependent variables ‘total output’, ‘total costs’ and ‘family farm income’.

Table 3: The results of the estimated impact of investment and investment support on total output, family income and total cost

	Total output			Family income			Total cost		
	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value	Coef.	Std. Err.	p-value
β_1	**0.483**	**0.033**	**0.000**	**0.536**	**0.033**	**0.000**	**0.988**	**0.014**	**0.000**
β_2	**0.052**	**0.021**	**0.016**	**-0.037**	**0.021**	**0.083**	**0.044**	**0.010**	**0.000**
β_3	**-0.003**	**0.001**	**0.020**	-0.000	0.001	0.814	**-0.001**	**0.001**	**0.035**
$\beta_{4\text{animal welfare}}$	1.081	1.160	0.351	1.241	1.205	0.303	0.273	0.570	0.632
$\beta_{5\text{animal welfare}}$	1.114	0.710	0.117	1.254	0.735	0.088	0.260	0.367	0.478
$\beta_{4\text{diversification}}$	**1.951**	**0.139**	**0.000**	**0.615**	**0.137**	**0.000**	**1.045**	**0.056**	**0.000**
$\beta_{5\text{diversification}}$	0.594	0.595	0.319	0.154	0.587	0.793	0.298	0.247	0.229
$\beta_{4\text{environment}}$	-0.135	0.118	0.252	**-0.409**	**0.126**	**0.001**	0.096	0.060	0.112
$\beta_{5\text{environment}}$	-0.049	0.185	0.792	**-0.970**	**0.200**	**0.000**	**0.450**	**0.086**	**0.000**
$\beta_{4\text{structural support}}$	0.088	0.130	0.497	-0.005	0.138	0.972	**-0.228**	**0.062**	**0.000**
$\beta_{5\text{structural support}}$	**0.369**	**0.174**	**0.034**	**0.422**	**0.176**	**0.016**	**-0.201**	**0.079**	**0.011**
$\beta_{4\text{setting up}}$	-0.299	1.043	0.775	0.075	1.090	0.945	0.679	0.526	0.196
$\beta_{5\text{setting up}}$	-0.808	0.697	0.246	-0.668	0.723	0.356	0.025	0.336	0.940

The results show that state dependency is present in each of the three models, which is indicated by the positive and significant β_1 coefficient. The lag of the dependent can thus explain an important part of the variation of all of the dependent variables.

β_2 shows that, as expected, investments have a positive and significant effect on the total output. However, also the costs increase significantly and the family income even decreases as a result of additional investments. There can be several explanations for this unexpected negative sign. The most likely explanation is that the model measures the short term (1 year) effect of investments while for some investments it might take several years to have a positive impact on family income. A second explanation is that the profitability of the Flemish agriculture in the study period was low. As a result, the increase in investment and output does not automatically leads to increases in income.

The coefficients of $\beta_{4\text{animal welfare}}$, $\beta_{5\text{animal welfare}}$, $\beta_{4\text{setting up}}$ and $\beta_{5\text{setting up}}$ are not significant probably due to the limited observations of investment support for animal welfare and the support for setting up young farmers. Therefore, we don't make any conclusions on the animal welfare and the setting up support.

The coefficients of $\beta_{4\text{diversication}}$ are highly significant in each of the three models and the $\beta_{4\text{diversication}}$ coefficients are also higher than the coefficients of the other types of support. The conclusion is that the support for investments on farm diversification effectively increases the output and family income. This results, however, does not imply that agricultural production is stimulated by rural development funds because the analysis does not make a distinction between agricultural and non-agricultural output. The clear targeting of the support to non-agricultural production rather suggests that the support increase the non-agricultural production. 0 shows that it is mostly direct farm selling and sustainable energy production. The positive effect of the support on income also indicate that the investment support is in the short run beneficial for the farmer.

The coefficients of $\beta_{4environment}$ and $\beta_{5environment}$ show that the impact of support for environmental investments is quite different from the other type of support. The cost increase and the family income decreases in the short run. There is also no positive effect on the output. These results suggest that the support does not cover the complete cost increase from the environmental investments in the short run. An explanation for the fact that farmers invest despite the negative income in the short run is that the top 3 environmental measures (manure injection, water tanks, increased energy efficiency) helps to prepare the farms for the new development of the economical and political environment:

- Meanwhile manure injection has been obliged for a lot of crops.
- The cost of non-renewable water extraction is about to double in the coming 5 years in some Flemish regions.
- Energy price are predicted to further increase.

This means that the participation in investment support might still be beneficial for the farmers in the long run. However, this is not captured in our model.

The coefficients of $\beta_{4structural}$ and $\beta_{5structural}$ show that the structural investment support helps to reduce the costs while increasing output. The net effect on family income is positive. Actually, this positive link between support and agricultural output implies that the structural investment support should not be considered as green box payments. For all other types of investment support, this conclusion can not be made based on our analysis.

5. Discussion and conclusions

The impact assessment of investment support in the Flemish agriculture can provide both methodological as policy conclusions.

Despite the increasing share of money spent on pillar II support and the institutional obligation to make policy evaluations, there are only a limited number of articles published in peer reviewed journal with an ex post quantitative assessment of rural development support. This application in this paper is a methodological contribution by illustrating how the available data can be used to make a detailed and quantitative assessment of investment support. The application has shown that panel data econometrics can quantify the impact of the support while controlling for farm and time effect and the fact that investments can also be made without support. In addition, the dynamic specification of the model is well suited for the analysis of investment because the impact of investments remain in the system. The panel structure also allows to deal with possible problems of sample selection bias and endogeneity. The application has further shown the importance to have disaggregated data because the wide variety of interventions can not be evaluated by one aggregated figure. The wide-spread application of the investment support in the chosen case study area, Flanders, have made it easier to have enough data available to do the analysis.

The policy conclusion can be divided into arguments for the national debate and for the international debate.

With respect to the Flemish policy, the general conclusion about investment support is rather positive. The diversification investment support is successful in helping farmers to find alternative sources of income. The structural investment support help to reduce the costs and keep the farming sector competitive. Only the environmental investment support seems to be too low to cover the increased costs of the farmers.

In the international debate on distortive support, a positive impact of ‘green box’ support on the agricultural output can be used as argument against the support. From the different types of investment support in Flanders, only the diversification support and the structural support have a positive and a significant impact on the output. Given the type of supported diversification measures, we think that diversification support increase non-agricultural output and not the agricultural output. The structural investment support does have an impact on agricultural output and could thus be considered to be removed from the green box.

One limitations of the study has to be mentioned. Firstly, the impact analysis focuses rather at the short run because at this moment insufficient data are available to quantify the long run impact of investment support.

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