CAP Effects on Agricultural Investment Demand in Europe

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Summary

Abstract. *The paper develops a comparative analysis, among selected European Union Member States, of the investment demand, for farm buildings and machinery and equipment, of a sample of specialised arable crop farms as determined – inter alia – by different types and levels of Common Agricultural Policy (CAP) support. The empirical analysis investigates the role of long and short run determinants of investment levels as well as accounts for the presence of irregularities in the cost adjustment function due to the existence of threshold-type behaviours. Throughout the estimated models a consistent and significant long-run dynamic adjustment towards lower levels of the farms' capital stocks is detected. The effect of CAP support on both types of investments is positive, although seldom significant. The elasticities of average net investment with respect to CAP payments are employed to simulate the effects of the recently proposed, reductions in the Pillar I CAP Direct Payments (DPs). Since these reform options imply, almost exclusively, a reduction in the level of support granted through DPs, simulated effects largely respect the expectation of a worsening of the farm investment prospects for both asset types (i.e., a larger negative investment or a smaller positive one). Notable exceptions concern investment in machinery and equipment in France and Italy which improve, irrespectively of the magnitude of the implemented cuts in DPs.*

Keywords: farm investment, threshold models, simulations, FADN data, common agricultural policy

JEL Classification codes: C23, C53, D92, Q12

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1. INTRODUCTION

Farmers' decision to invest in physical capital (e.g., farm buildings, machinery and equipment) might be the result of economic considerations regarding the likely difference between the purchase and resale price of an asset (Johnson, 1956) as well as the uncertain nature of farm output price and government support (i.e., Common Agricultural Policy (CAP) provisions in the European Union (EU)) (Serra et al., 2009; Boetel et al., 2007). The latter might either influence relative prices through coupled support and/or increase the contribution of non-output related revenues to total farm income through decoupled subsidies. Both types of subsidies might relax existing budget or credit constraints (Sckokai, 2005) and/or diminish price/revenue uncertainty resulting in higher physical investment. Nonetheless, the decision to avoid investing may still be optimal if irregularities in the adjustment cost function arise.

The present contribution aims to investigate the investment decisions of a sample of farms in selected EU Member States (MSs) and to shed light on farms' future investment paths as shaped by the foreseen changes in the existing system of CAP support (European Commission, 2011). To achieve these goals, the paper – drawing on Serra et al. (2009) – firstly estimates a reduced form investment demand function for two asset classes, allowing for threshold-type behaviours compatible with a number of capital market imperfections (i.e., differences between an asset's purchase and resale price (Johnson, 1956); asymmetries in fixed capital adjustment costs (Abel and Eberly, 1994); real option (Huttel et al., 2010)). The theoretical model employed is instrumental in helping to explain the frequent occurrence – in farm level data – of zero and negative gross investment levels. The empirical analysis is carried out carefully implementing the threshold regression model developed by Hansen (1996, 1999, 2000) to endogenously and consistently determine and test whether the investment model is characterised by multiple, rather than a single, equilibria. Moreover, the elasticities of current investment levels with respect to CAP payments are calculated and used for simulating the expected changes in the investment demand due to shocks in Direct Payments (DPs) associated with CAP reform scenarios (European Commission, 2011). Although this is mainly an exercise in comparative statics, it could highlight unexpected paths of investment levels adjustment. The empirical application involves a few Member States (MSs) and aims to highlight whether, across the EU, there exists significant variability in investment behaviours, also due to the different implementation of decoupled subsidies between old and new MSs. Moreover, relying on the long time span covered by the FADN dataset, differences in the agricultural investment impact between past and existing implementation of the CAP subsidies can be highlighted.

The next section lays out the theoretical model; section 3 details the data management to construct the variables of interest while section 4 describes the empirical methodology. Section 5 presents the econometric estimates of the investment demand models as well as the simulation results. The last section provides some concluding remarks.

2. THEORETICAL MODEL

The theoretical model employed describes the process leading to the farm’s decision on the optimal level of investment. The latter originates from the objective to maximise – over an infinite horizon – the farm’s discounted value which, borrowing from Sckokai and Moro (2009), can be stated as:

$$\begin{gathered} J(\cdot)=\max_I \int_0^\infty e^{-rt}u(A,\sigma_A^2) \\ s.t. \quad \dot{k}=(I-\delta k) \end{gathered} \tag{1}$$

where $u(A,\sigma_A^2)$ is a farmer’s expected utility function defined on A, the expected farm’s wealth, and σ_A^2, the variance of the farm’s wealth. In turn, A may be specified as $A=A_0+\bar{p}y-wx-ck+S$ where A_0 is farm’s initial wealth, y is farm’s single output – obtained from the production function $y=f(x,k,I)$ defined over the quantity of a variable input adjusted at no cost x, the units of capital stock k and the level of gross investment I – priced at price p. The time derivative of the units of capital stock $\dot{k}$ measures the net change in capital stock (i.e., net investment) since I is gross investment and δ is the depreciation rate applied to the existing units of capital stock k. Assuming the market output price p is a random variable, its mean value $\bar{p}$ affects the farmer’s decision through its impact on farm wealth, while the price variance σ_p^2 is the source of uncertainty regarding the level of farm’s wealth, since $\sigma_A^2=f(\sigma_p^2)$. Moreover, the variable input x is priced at its market price w while c is the capital rental price and r is the discounting factor which can be well approximated by the interest rate. The specification of farm’s wealth A includes the amount of subsidies received by the farm S. Given our interest in evaluating and comparing the effects of different types of CAP support (i.e., coupled and decoupled payments) and the latter being mostly disbursed over two different periods, the specification of S will vary according to the years for which the data are analysed.

The Hamilton-Jacobi-Bellman equation associated to (1) can be stated as:

$$rJ=\max_I\{u+J_k(I-\delta k)\} \tag{2}$$

where J_k is the first derivative of $J(\cdot)$ with respect to capital (Sckokai, 2005; Serra et al., 2009). Assuming the existence of an interior solution, the shadow value of capital equals the marginal adjustment cost (Sckokai, 2005). In turn, the first derivative of (2) with respect to capital price yields the investment demand equation represented in implicit form as:

$$\dot{k}\left(r,A_0,\bar{p},w,c,S,\sigma_p^2,k\right) \tag{3}$$

While the capital adjustment cost function arising from (3) is strictly positive and increasing, the literature on investment under uncertainty has been increasingly interested in modelling more realistic behaviours of investment dynamics. In particular, Abel and Eberly (1994) have proposed a theoretical model that accounts for differences between the asset’s purchase and resale prices, asymmetries in the fixed capital adjustment costs and an adjustment costs function kinked, possibly, at $I=0$. While capital investment remains characterised by a non-decreasing relationship with the asset’s shadow price J_k, a threshold-type behaviour emerges. In fact, optimal investment is expected to be negative (positive) for a value of J_k smaller (larger) than a lower (upper) threshold level while it is expected to be zero for values of the asset’s shadow price between the two thresholds (Serra et al., 2009).

Applications of the Abel and Eberly (1994) extension of the traditional investment model under uncertainty appear quite rare in the agricultural economics literature. The first contribution could be traced back to Boetel et al. (2007) who investigated the effect of asset fixity, investment asymmetry and the possible existence of a sluggish regime in the demand for a quasi-fixed input in US hog production. It is interesting to note that Boetel et al. (2007) allow the constant and the coefficient for the capital stock in the previous period to vary across the three expected regimes while they circumvent the problem of the unobservable nature of the shadow price of capital assuming there exists a mapping function into farm output prices. Moreover, Boetel et al. (2007) are the first to employ the methodology suggested by Hansen (1996, 1999, 2000) to estimate an investment function exhibiting a threshold-type behaviour. Huttel et al. (2010) rely on the model in Abel and Eberly (1994) to account for additional costs relating to the financial structure of the farm, due to the existence of imperfections in the capital markets, and their possibility of yielding zero investment rates. The latter constitute an optimal reaction to the existence of investment irreversibility and uncertainty about future prospects. Serra et al. (2009) extend the contribution in Boetel et al. (2007) allowing for both the capital stock and the output price to determine regime-specific speeds of adjustment to a long and short run capital endowment, respectively. Serra et al. (2009) are interested in studying the impact of a decoupled-type transfer on investment decisions of a sample of Kansas farms. Since output prices determine a short-run adjustment in investment levels, Serra et al. (2009) suppose the existence of a function mapping the unobservable shadow price of capital J_k into the lagged value of per hectare net farm income. Although the specification of the structural value function $J(\cdot)$ would allow for obtaining the final form of the model in (3), Serra et al. (2009) avoid the many difficulties associated to its estimation subject to threshold effects by specifying its reduced-form counterpart as:

$$\dot{k} = \beta_1' x I\left(J_k \leq J_k^l\right) + \beta_2' x I\left(J_k^l < J_k \leq J_k^u\right) + \beta_3' x I\left(J_k^u < J_k\right) \tag{4}$$

where the $\beta's$ are vectors of parameters' estimates for the exogenous explanatory variables $x = \left(r, A_0, \bar{p}, w, c, S, \sigma_p^2, k\right)$, and $I(\cdot)$ is an indicator function taking value 1 if the condition in parentheses is met.

3. DATA

This paper first estimates the investment model, subject to threshold effects, and then simulates the effects of the proposed changes in DPs on a sample of farms specialised in arable crops drawn from the Farm Accountancy Data Network (FADN). Specialised arable crop farms are those classified, according to their main output, as “specialist cereals, oilseeds and protein crops (COP)”, “general field cropping” and “mixed cropping”.[1] In particular, the paper considers specialised arable crop farms in France (FR), Germany (DE), Hungary (HU), Italy (IT) and the United Kingdom (UK).

Since the empirical model employed (Hansen, 1999) has been developed only for balanced panel data sets while the FADN dataset is heavily unbalanced, two balanced panel data set has been drawn for the two periods, with coupled subsidies (2001-2004), and with decoupled subsidies (2005-2008). A four year time span appears sufficient to justify the preferred methodology while ensuring a reasonable operating sample size.

Following Serra et al. (2009), investment levels may adjust as a result of short-run changes in output prices. Since specialised arable crop farms are multi-output enterprises both in crop production and in other complementary outputs (i.e., livestock and milk production), an aggregate output price index is constructed. First, the procedure requires calculating – for the products of interest – total output value as the sum of sales, the value of farmhouse consumption and farm use. Since the FADN dataset provides information on the

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[1] The reader interested in more details regarding the construction, out of the original FADN data, of the variables used in this paper is referred to Guastella et al. (2013).

related amount of output quantity, unit-value prices are calculated dividing the total output value previously constructed by the relevant quantity. The ensuing unit values suffer from two major problems: very small (and large) minimum (and maximum) values and a high incidence of missing values due to the division by zero quantity.[2] The first issue is tackled trimming each yearly price series at the bottom and top 5% to exclude outliers. The second issue has been tackled replacing, for every year, missing or zero prices with their respective averages at two different geographical levels. We exploit the FADN's representativeness at the division level[3] and perform the substitution employing average prices calculated at the division level. In case instances of zero and/or missing prices persisted after this first round of substitutions, the latter have been replaced with national yearly averages. The rationale for this procedure is to ensure we can aggregate the largest amount of price information in a single output price and exploit the longest time series available in further elaborations. Second, the newly filled-out and trimmed series of unit-value prices are multiplied by the respective output quantities to re-construct output values and circumvent the problem of inconsistent reporting of output values and quantities. In fact, once the re-constructed output values have been added up across outputs, observations with zero total output are dropped.[4] The next step builds the share of the newly re-calculated total output value for the single output of interest to the farm's total newly re-calculated output value across the outputs considered. The latter constitute the weights employed to construct the weighted average aggregate price of farm output. Once the average farm output price is calculated, it is turned into a price index dividing by the variable's value for the first farm in the sample for the base year.[5]

The price index is employed to derive farm level expected output price index (*expoutpi*) and its variance (*varoutpi*) drawing on Chavas and Holt (1990). The series of the price index is collapsed at the division level, for every year in the sample. To minimise the loss of useful information, the missing division identifiers are recoded to the closest neighbouring one. The original Chavas and Holt (1990) methodology is adapted to allow for only partially adaptive expectations. In fact, the expectation of the prediction error is obtained averaging the prediction errors for the preceding five years. Due to data limitations in HU, this informative base is restricted to only three years and *varoutpi* is not calculated since, otherwise, we would be left only with a two years' sample.

The model's explanatory variables include an aggregate measure of the farm's input prices calculated employing a procedure similar to the one outlined for obtaining the output price index. The basic information for the farm's expenditure on different inputs is drawn from the FADN while EUROSTAT supplies the input price indexes. In fact, the former does not provide any information on the quantity of inputs employed which, otherwise, would allow for calculating unit-value prices of every input. To ensure consistency of the estimating dataset, base 2000 indexes are the common reference for extracting the price indexes to be associated to the relevant FADN input expenditure data. The procedure to obtain an aggregate price for the farm's inputs requires calculating the share of each of the farm's cost expenditure items, to total farm input expenditure and using them to weigh the relevant EUROSTAT price index. Note that the occurrence of negative shares leads to the associated farm dropping out of the sample. The ensuing values divided by the one obtained for the reference farm, already identified upon calculating the output price index, yield the series of the aggregate price index (*inppi*).

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[2] This occurs since sales might originate from the stocks of products carried over from the previous accounting year rather than out of current year production.

[3] Although some differences exist, the FADN division is roughly the EU NUTS2 region.

[4] This procedure implies more importance is attributed to the reporting of output quantities than the "original" output value(s).

[5] The first farm in the sample is selected to ensure that a long time series of price indexes is obtained while the same farm is still in the sample at a later stage of the dataset manipulation. In turn, the output price index has base in the year 1999 for FR, 2000 for DE, 2004 for HU, 1996 for IT and the UK.

Due to the focus of this paper, particular attention is paid to the determination of the "quantity" of capital net investment (*inv*) and stock (K_{-1}) for farm buildings and machinery and equipment.[6] The FADN records information for these asset classes differentiating between their Opening Valuation, Investment before subsidies, Subsidies on Investment, Sales, Depreciation and Closing Valuation. The investment subsidies relevant to this study are the direct payments (DPs) for the "Modernisation of agricultural holdings" which are disbursed conditional on the investment being carried out. Since they might be interpreted as a rebate on investment costs, they are modelled as a reduction in the cost of capital.

To obtain *inv*, a unique measure for the farm net value of investment (*uninv*) in the relevant asset is computed by subtracting asset's depreciations and sales from gross investment. Upon calculating the depreciation rate as the ratio of depreciation to the asset's opening valuation, any observation featuring higher values of the former compared to the latter is dropped since, otherwise, this would give rise to depreciation rates larger than one. Missing values originating from the ratio of zero depreciation to zero opening valuation of each capital item are recoded to zero for economic consistency and to avoid further reductions in sample size. Since the value of depreciation does not appear to be recorded reflecting standard accounting practises and displays quite extreme occurrences, the sample's median value of the calculated depreciation rates in any given year is attributed to each farm we have data for (*meddepr*). The share of investment subsidies (*shinvsub*), out of the value of gross investment, is cleaned up from unrealistic values (i.e., greater or equal to 0.9) as well as is recoded to zero in case the farm has not reported any gross investment and, hence, was not entitled to any investment subsidy. The rental price of the concerned type of capital (*rprc*) is calculated as:

$$rprc = [pi * (1 - shinvsub)] * \left(\frac{rirate}{100} + meddepr\right) \tag{5}$$

where *rirate* is a measure of the national real interest rate calculated as the difference between the yield of a government bond of a reasonable length and a measure of the nation's inflation rate (growth rate of a consumer price index).

Note that *pi*, the EUROSTAT price index for the cost of FB is the simple average of the one for maintenance of buildings and buildings from Table 2. Once the *rprc* has been calculated, the "lagged" stock of capital (K_{-1}) is obtained as the ratio of the asset's opening valuation to the relevant *rprc*.[7] The regime-dependent coefficient for K_{-1} is expected to range in the [-1; 1] interval determining the rate of adjustment of current capital stock to its long-run equilibrium. In turn, negative values would suggest farms disinvest to reach a lower long-run stock of capital while positive ones should suggest farms are under-capitalised and are required to invest in capital assets to reach their long-run equilibrium. Similarly, the *inv* in the relevant asset class is obtained as the ratio of *uniinv* to its *rprc*.

The *rprc* of every asset class we are interested in is employed to standardise the value of the *expoutpi*, *inppi*, coupled and decoupled subsidies, farm wealth and lagged income employed in the empirical models for the investment in FB and ME. The square of the relevant *rprc* is employed to standardise the *varoutpi* in each model.

Following Serra et al. (2009) investment demand depends upon a measure of lagged wealth in thousands of constant Euros (*wealth*) and per hectare income (*income*). The former is a measure of the farm's total assets, excluding the opening valuation for FB and ME, minus the farm's total debts. Once

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[6] The reader should be able to verify that this "quantity" of capital is, in facts, the value in real Euros of capital items.

[7] While we are aware this is not a truly "lagged" value, relying on this value helps preserving sample size in the very unbalanced FADN dataset.

again, the “lagged” nature of *wealth* is instead the difference between the opening valuations of both components. Income is defined as the difference between the value of total output, the re-calculated expenditure on inputs and the reported value of the depreciation on the concerned assets. The result of this difference is turned into its per hectare counterpart dividing by the total farm’s utilised agricultural area and then is lagged one period. The amount of subsidies the farm receives, in thousands of Euros, is the sum of total subsidies on crops and on livestock for coupled support (*coupsub*) and decoupled payments for decoupled support (*decsub*).

The means, standard deviations and unit of measurement of the variables employed to estimate the models for the investment demands for FB and ME are collected in Table 1 and 2, respectively.

Table 1 Summary statistics for the model of investment demand for FB

	2001–2004¥				2005-2008				
Variable	**FR**	**DE**	**IT**	**UK†**	**FR**	**DE**	**HU**	**IT**	**UK**
inv	-16.09	8.31	-279.74	-96.81	-80.28	411.67	437.34	-97.20	40.04
	(958.93)	(4435.26)	(366.82)	(1064.73)	(1030.59)	(6074.28)	(6981.55)	(5339.84)	(1444.48)
income	17.74	66.67	177.17	18.80	29.39	79.75	37.95	144.38	21.140
	(30.572)	(77.15)	(277.97)	(25.33)	(52.64)	(102.64)	(70.52)	(333.20)	(29.71)
K_{-1}	1389.75	9105.00	6788.76	2054.94	1817.75	7410.71	6850.77	9335.36	1749.01
	(2839)	(18785)	(9524)	(3498)	(5578)	(14074)	(23760)	(33574)	(2912)
expoutpi	0.0732	0.111	0.1313	0.0330	0.0895	0.1353	0.1773	0.1473	0.0415
	(0.0503)	(0.016)	(0.0166)	(0.0068)	(0.0370)	(0.0524)	(0.0778)	(0.0457)	(0.0103)
inppi	6.1010	11.980	13.9636	4.5212	6.7500	13.7662	12.9972	14.9314	5.9491
	(3.6121)	(0.655)	(0.9531)	(0.5080)	(2.3755)	(2.5000)	(3.5125)	(1.7147)	(1.2712)
varoutpi	0.9940	1.088	1.2620	0.1990	2.0060	5.3100	§	7.7200	0.5140
	(22.7930)	(1.140)	(0.7010)	(0.2730)	(2.9160)	(6.3160)		(12.9920)	(0.3500)
coupsub	2.6655	7.424	3.1291	3.3945	§	§	1.2947	§	§
	(2.4225)	(12.550)	(5.6061)	(2.9097)			(3.1297)		
decsub	§	§	§	§	1.6938	6.0378	2.6892	2.7190	2.9112
					(2.4008)	(8.6204)	(5.1027)	(7.7950)	(2.4886)
wealth	3.0135	71.990	80.1332	58.3491	3.8531	84.2990	9.9175	122.0474	62.1945
	(9.0275)	(93.502)	(164.1416)	(61.2950)	(9.2979)	(95.8574)	(30.0271)	(326.4338)	(70.9741)
n	1636	1180	280	404	1400	1212	828	2280	384

Source: authors’ calculations based on manipulated EU-FADN - DG AGRI data. **Notes to Table 1:** *inv*, *income*, K_{-1}, *coupsub*, *decsub* and *wealth* are measured in constant Euros, *inppi*, *expoutpi* and *varoutpi* are index numbers, the summary statistics for the series *inppi* and *varoutpi* are presented multiplied by 100 and 10,000, respectively, to avoid computational issues when estimating the model in Matlab; § denotes Not Applicable; ¥ the countries analysed over the period 2001-2004 do not include HU since, back then, it was not part of the EU; † the UK sample to analyse the role of *coupsub* covers the period 1997-2000.

Table 2 Summary statistics for the model of investment demand for ME

	2001–2004¥				2005-2008				
Variable	**FR**	**DE**	**IT**	**UK†**	**FR**	**DE**	**HU**	**IT**	**UK**
inv	-164.06	-259.73	-361.37	-394.90	-44.79	17.77	-42.56	-358.04	236.52
	(1240.19)	(1304.44)	(893.26)	(1548.50)	(1157.67)	(1487.67)	(1782.96)	(873.16)	(1661.81)
income	10.2005	20.6730	76.3971	16.5257	15.2264	25.3539	10.9587	58.7533	19.4698
	(18.6680)	(23.9800)	(119.9770)	(23.1052)	(27.7006)	(32.7532)	(19.9063)	(135.2087)	(27.5666)
K_{-1}	3162.74	4403.044	3295.404	7493.17	2953.22	4265.42	3598.49	3642.09	7417.64
	(3486.74)	(4550.81)	(3075.22)	(6459.61)	(3000.45)	(5069.59)	(6100.80)	(5151.64)	(9291.71)
expoutpi	0.0418	0.0344	0.0567	0.0288	0.0464	0.0429	0.0507	0.0601	0.0383
	(0.0233)	(0.0046)	(0.0086)	(0.0041)	(0.0118)	(0.0161)	(0.0168)	(0.0175)	(0.0076)
inppi	3.5119	3.7124	6.0274	3.9783	3.5236	4.3613	3.8056	6.0989	5.4913
	(2.5031)	(0.1226)	(0.6568)	(0.1959)	(0.2615)	(0.6768)	(0.4905)	(0.5111)	(0.8767)
varoutpi	0.2050	0.1050	0.2370	0.1440	0.4880	0.5350	§	1.2380	0.4340
	(2.1320)	(0.1110)	(0.1360)	(0.1840)	(0.4640)	(0.6290)		(2.0220)	(0.2770)
coupsub	1.5336	2.2969	1.3665	2.9874	§	§	0.3923	§	§
	(1.6030)	(3.8759)	(2.5443)	(2.5275)			(0.9500)		
decsub	§	§	§	§	0.8538	1.8932	0.7898	1.1143	2.7054
					(0.8176)	(2.5908)	(1.4555)	(3.2463)	(2.2978)
wealth	1.6221	22.3253	34.9133	51.5233	2.0072	26.7501	2.8917	50.0360	57.6573
	(4.7398)	(28.9849)	(72.5745)	(53.8386)	(4.8646)	(30.3583)	(9.0746)	(133.8025)	(65.2601)
n	1636	1180	280	404	1400	1212	828	2280	384

Source: authors' calculations based on manipulated EU-FADN - DG AGRI data. **Notes to Table 2:** *inv*, *income*, K_{-1}, *coupsub*, *decsub* and *wealth* are measured in constant Euros, *inppi*, *expoutpi* and *varoutpi* are index numbers; the summary statistics for the series *inppi* and *varoutpi* are presented multiplied by 100 and 10,000, respectively, to avoid computational issues when estimating the model in Matlab; § denotes Not Applicable; ¥ the countries analysed over the period 2001-2004 do not include HU since, back then, it was not part of the EU; † the UK sample to analyse the role of *coupsub* covers the period 1997-2000.

4. THE EMPIRICAL MODEL

Following Serra et al. (2009), the empirical estimation of the model in (4) is based on the threshold regression framework proposed by Hansen (1996, 1999, 2000), who developed the statistical and asymptotic distribution theory and clarified the procedure to implement the model on a balanced panel dataset. According to Hansen (2000), threshold models can be employed to estimate models of separating and multiple equilibria, to investigate the opportunity to empirically split the estimating sample on the basis of continuous variables and to parsimoniously estimate functions in a non-parametric fashion. Moreover, the same framework can accommodate, as special cases, more complex models such as mixture, switching, Markov switching and smooth transition models. Due to the possibility of different behaviours of capital investment, both in the short and long run, this methodology appears particularly suited to test the existence of different investment regimes.

Multiple thresholds may exist, thus multiple regimes/behaviours/equilibria. The empirical (i.e., dataset dependent/specific) identification of the "real" number of thresholds appears a matter of iteratively estimating and testing for the presence of one more threshold, Nonetheless, the maximum number of allowed thresholds is restricted to two such that the related empirical evidence can be associated to the existence of, respectively, the disinvestment (Dis), zero-investment (ZInv) and investment (Inv) farm behaviour. Therefore, the structural equation for the farm's demand for the relevant type of investment (y) in the double-threshold model can be written as:

$$y_{it} = \mu_i + \beta_1' x_{it} I(q_{it} \leq \gamma_1) + \beta_2' x_{it} I(\gamma_1 < q_{it} \leq \gamma_2) + \beta_3' x_{it} I(q_{it} > \gamma_2) + e_{it} \tag{6}$$

where the indexes i and t represent the farm and time, respectively, x_{it} is the vector of the model's non time-invariant covariates and $\beta's$ the related regime-dependent coefficients' vector, μ_i is a farm-specific effect and e_{it} an independent identically distributed (iid) error term with zero mean and finite variance σ^2.

The model's coefficients are regime-dependent because of the indicator function $I(\cdot)$ being one if the threshold variable q_{it} satisfies that implied conditions with respect to the values of γ_1 and γ_2, with $\gamma_1 < \gamma_2$. and zero otherwise. The equality between the slopes in the β vectors is a testable proposition which, if violated, supports the existence of a significant threshold effect identifying different regimes and, in turn, different investment behaviours. Note that, as in Hansen (1999) and Serra et al. (2009), some of the coefficients in the β vector might be restricted to be equal across the regimes such that the role of the related covariates x_{it} is regime-independent. In the present application, the only regime-dependent variables are K_{-1} and *expoutpi*, expressing the pattern of long and short-run adjustment of capital quantities, respectively. Moreover, following Hansen (1999), and contrary to Serra et al. (2009), the threshold variable q_{it} – in our case *income* – is included in the vector of model's covariates.

4.1. Estimation and testing

Hansen (1999) details the estimation and testing procedure for the model in (6) as well as provides a reference to Hansen's original computer code.[8] The estimated model slightly differs from (6), since we follow Hansen's suggestion of de-meaning the data with their unit specific time means, in order to remove the farm specific effect. In line with much of the literature applying Hansen (1999) threshold regression model (Boetel et al, 2007), the original Matlab code has been amended to allow for two regime-dependent variables and to run a formal test of heteroschedasticity of the remainder error. Despite the standard approach to estimation, a few related issues are worth discussing.

The procedure starts by grid searching for the optimal and unknown value of a first threshold $\hat{\gamma}$, in the sample of observations with ordered and unique values of the threshold variable q_{it}, by minimising the concentrated sum of squared errors of the associated OLS regressions. In turn, this implies estimating a a two-regimes model. Hansen (1999) remarks that it is undesirable for the optimal threshold value $\hat{\gamma}$ to separate too few observations in one of the two subsamples. Further, Hansen (2000) notes that a monotonic transformation of the threshold parameter would render it unit free and constrain it in the [0,1] interval, although the pointwise test statistics appear to be very sensitive to the extreme values of the transformed interval. To overcome both problems, borrowing from the changepoint literature[9], Hansen (2000) seems to endorse Andrews (1993) suggestion to restrict the range of the transformed threshold parameter to [0.15, 0.85], therefore eliminating the smallest and largest 15% of the values of the distinct (unique) values assumed by the threshold variable q_{it}. This appears a well-established choice of the trimming parameter (Hansen (1999), Dang et al. (2012)) we comply with.

To test for the significance of the threshold value $\hat{\gamma}$, we use a likelihood ratio statistic LR_1 which, under the null hypothesis of no difference between the slope parameters in the two regimes, features an unidentified value of the threshold γ. Moreover, the asymptotic distribution of the same statistic is non-standard and depends on the sample moments such that it cannot be tabulated. Hansen (1996) proves that a bootstrap procedure obtains a first-order approximation of the asymptotic distribution of LR_1 such that the *p*-values constructed from the bootstrap itself are asymptotically valid. Hansen (1999) is the reference for a recommended implementation of this bootstrap procedure. Once the bootstrap procedure has been written, the researcher is left with choosing the number of repetitions to carry out. Andrews and Buchinsky (2001; 2002) provide Monte Carlo simulations for a three step procedure to select the "optimal" number of

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[8] Matlab, Gauss and R code for the Hansen (1999) model can be found at http://www.ssc.wisc.edu/~bhansen/progs/joe_99.html

[9] It should be noted that the threshold regression literature builds on the findings and results obtained by the changepoint literature.

bootstrap repetitions to obtain a statistic of interest (i.e., standard error, confidence intervals, tests and *p*-values) - bootstrapped from a finite number of repetitions - which is close to the ideal one (i.e., the one obtained running an infinite number of repetitions). Drawing on this applied and simulation work and given our interest in both bootstrapped confidence intervals and *p*-values, 5,000 repetitions were run.[10,11]

Lastly, the estimates of β appear to depend on the threshold's estimate $\hat{\gamma}$. Yet, Hansen (2000) demonstrates that this link is not of first-order asymptotic importance, resulting in $\hat{\beta}$ being asymptotically normal with an estimable – and possibly heteroschedastic – covariance matrix. Hansen (1999) suggests that large differences between conventional and heteroschedastic robust OLS standard errors provide evidence in favour of a correction. Nonetheless, a more formal test for the heteroschedastic behaviour of the OLS remainder error term should be run and the ensuing evidence should determine the nature of the presented standard errors. Contrary to much of the extant literature which adheres to Hansen (1999) "qualitative" recommendation, of which Savvides and Stengos (2000) constitute an exception, before presenting the model's estimates a version of the White (1980) test for heteroschedasticity of the remainder error was run. The test entails an ancillary regression of the square of the OLS residuals on the square of the explanatory variables. In case the null hypothesis of homoschedasticity is rejected, heteroschedastic robust standard errors are obtained, and presented, employing the Eicker (1967) - Huber (1967) - White (1980) estimator.

Hansen (1999) posits that the procedure to estimate the initial threshold value model should be iterated to allow for the estimation of the additional threshold value for the double threshold model in (6). This is a consequence of the (multiple) changepoint literature's result that the sequential estimation of a single threshold model yields consistent estimates for the multiple threshold one. In the first stage, a single threshold value (model) is estimated yielding the minimized sum of squared errors $S(\gamma)$. Fixing the first threshold's estimate, a second threshold's estimate can be obtained by minimising the concentrated sum of squared errors of the three-regimes model in (6).

4.2. Simulation strategy

The results from estimating the threshold regression model in (6) are employed to obtain the simulated percentage changes in average net investment levels under different policy reform scenarios.

Following the Hansen (1999) approach to the classification into the identified regimes of the farms included in the sample, the regime and year specific means for the level of inv in the asset and for the policy variables of interest are computed (*coupub*, *decsub*). In turn, with this information and the values of the estimated coefficients for the effect of subsidies on the inv in FB and ME from (6), the regime and year specific elasticity of inv with respect to the CAP payments $\xi_{i,j}^{sub}$ is calculated as:

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[10] Andrews and Buchinsky (2001) express disconcert finding that the number of bootstrap repetitions carried out in most econometric applications is much smaller than the one required to achieve a sufficiently accurate simulated statistic of interest. Most likely due to a large dataset employed and more limited computing power, than available today, Hansen (1999) – in his Matlab code we modify to suit our needs – selects 300 repetitions for his bootstraps, which might be deemed small by Andrews and Buchinsky (2001; 2002) standards.

[11] Moreover, Hansen (2000) also remarks that the construction of the threshold's confidence interval rests on the assumption that the error term in the estimated model is homoschedastic, or at least that conditional heteroschedasticity is not regime dependent (Hansen, 1997), otherwise, critical values need to be corrected. While this appears one of the model's stringent assumptions, the empirical literature applying threshold regression models seems to have largely overlooked the issue of regime dependent heteroschedasticity. Notable exceptions are the empirical application in Hansen (1997) and the promising theoretical model accounting for both regime dependent heteroschedasticity and endogeneity of the threshold variable in Kourtellos et al (2013). At the moment we have been unable to comply with the recommendation in Hansen (2000) but future extensions will tackle both the existence of regime dependent heteroschedasticity and endogeneity of the threshold variable.

$$\xi_{i,j}^{sub} = \beta^{sub} * \frac{\overline{sub_i}}{\overline{Inv_\iota}} \tag{7}$$

where $\beta^{sub} = \frac{\partial Inv_i}{\partial \overline{sub_i}}$, with *sub=c,d* for coupled and decoupled support, subscripts *i* and *j* identifying the year and the regime. Note that since β^{sub} is the only stochastic element in equation (7), its statistical significance will, in turn, determine the statistical significance of the calculated and related $\xi_{i,j}^{sub}$.

The 2008 elasticity values calculated using (7) are then employed to simulate percentage changes in the average, regime specific, net investment levels - in both FB and ME - due to the implementation of the reform scenarios of the CAP's DPs envisaged in European Commission (2011) as follows:

$$\Delta\overline{\iota nv_j} = \xi_{2008,j}^{d} * \Delta d_s \tag{8}$$

where $\Delta\overline{\iota nv_j}$ is the percentage change variation in average net investment level in the asset class of interest in regime *j*, $\xi_{2008,j}^{sub}$ is the most recent, regime-specific, calculated elasticity[12] and Δd_s is the expected percentage change in DPs collected in Table 11, where the subscript *s=1,…4* identifies the columns of interest.

5. RESULTS

5.1. *Threshold models' estimates*

Table 3 and 4 collect the results from estimating the threshold regression model for investment in FB and ME in FRA, DE, HU, IT and the UK in presence of coupled and decoupled support, respectively, aiming to distinguish between the Dis, ZInv and Inv behaviour when two estimated threshold values yielded significant threshold effects. In case only one were significant, as in Abel and Eberly (1994) only the more common Dis/Inv behaviour is detected.

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[12] It appears reasonable to simulate the expected variations in investment levels starting from the most recent value of the elasticity of investment to decoupled CAP subsidies available.

Table 3 Estimates for the threshold investment models during the existence of coupled support (2001-2004).

	FR		**DE**		**IT**		**UK**	
	FB	**ME**	**FB**	**ME**	**FB**	**ME**	**FB**	**ME**
Regime-indep.								
inppi	358.0707***	-107.8006	-411.4871**	904.1538***	4.6058	328.0619	424.0656*	25.3139
	(101.8039)	(95.5483)	(187.1292)	(298.3131)	(16.9884)	(220.1820)	(255.5108)	(535.6026)
varoutpi	-44.4970***	67.6293	-121.6622	-755.2638**	-2.7284	-222.0963	-62.5688	279.5438
	(10.6224)	(59.6204)	(81.6572)	(368.1210)	(22.3605)	(413.0873)	(99.1689)	(334.5365)
coupsub	-4.3330	54.4573	595.9798***	541.5990***	-32.3735***	146.9623	199.3998**	320.4714
	(102.0790)	(170.9632)	(99.3995)	(55.5250)	(9.0984)	(96.6772)	(81.8289)	(269.5284)
wealth	31.4534*	77.5576**	18.2594*	25.4877*	0.1943	-0.9786	20.1043*	-12.8530
	(16.1728)	(30.4643)	(10.0692)	(14.8948)	(0.2605)	(3.0314)	(10.3869)	(19.1931)
income	-4.4661*	-1.4252	3.7162	-6.3046*	0.0086	-0.6148	-4.4220*	4.2557
	(2.4538)	(3.5815)	(2.8390)	(3.4143)	(0.0810)	(1.3441)	(2.2976)	(7.4252)
K_{-1}	§	§	§	§	§	§	§	-0.5704*** (0.1804)
expoutpi	§	§	§	§	§	§	§	29,583.5858 (29,265.4275)
Regime-dep.								
K_{-1} *Dis*	-0.2664***	-0.6193***	-0.4617***	-0.5000***	-0.0203***	-0.0499	-0.8853***	§
	(0.0949)	(0.0564)	(0.0995)	(0.0516)	(0.0047)	(0.0356)	(0.1369)	
K_{-1} *ZInv*	§	-0.4992***	-0.6851***	-0.4169***	§	§	§	§
		(0.0485)	(0.1062)	(0.0526)				
K_{-1} *Inv*	-0.4807***	-0.5627***	-0.3411***	-0.2829***	-0.0389***	-0.2417***	-0.6920***	§
	(0.0895)	(0.0640)	(0.0608)	(0.0708)	(0.0033)	(0.0813)	(0.1884)	
expoutpi Dis	5,632.1705	15,426.8277***	47,165.3703***	-7,057.3986	-847.4395	-4,107.6015	-14,759.9722	§
	(3,619.9064)	(4,764.1437)	(14,492.8949)	(15,815.2835)	(1,592.8180)	(13,161.5586)	(19,036.7487)	
expoutpi ZInv	§	12,514.4971**	56,311.1715***	-8,052.5394	§	§	§	§
		(5,186.1710)	(15,181.1422)	(15,525.6148)				
expoutpi Inv	10,500.8845**	23,283.1538***	39,995.3939***	-16,090.3710	-461.1140	-1,928.2455	-20,680.4681	§
	(4,581.6743)	(6,366.3156)	(14,724.8169)	(15,620.4561)	(1,529.5201)	(13,221.8401)	(20,137.3392)	
Thresholds[¥]								
γ_1	6.8161	2.1246***	54.5174***	6.9888**	11.9697***	37.0353**	14.6218***	§
	[6.5043; 19.9178]	[1.8557; 2.1246]	[53.6037; 54.5174]	[4.1944; 33.2024]	[11.9697; 32.2014]	[32.2584; 46.5037]	[13.5337; 16.5211]	
γ_2	31.5807***	14.5619**	106.0978***	21.8451***	334.1524	134.2202	29.0886	§
	[28.1491; 31.5807]	[11.7269; 14.9436]	[106.0978; 108.1543]	[21.3678; 22.1395]	[48.5538; 355.2406]	[4.8418; 154.5264]	[6.8238; 29.2584]	
Diagnostics								
R^2	0.2153	0.6144	0.4138	0.3252	0.5496	0.1962	0.5707	0.2482
Het Test	15.0235*	119.9096***	44.5959***	30.8945***	6.0287	98.0160***	35.2768***	64.5537***

Source: authors' estimation on EU-FADN - DG AGRI data employing a modified version of the Matlab code provided by Hansen on his website. **Notes to Table 3**: estimation carried out in Matlab R2011b; Eicker (1967) -Huber (1967)-White (1980) heteroschedasticity robust standard errors in parentheses when the White test for heteroschedasticity is statistically significant at conventional levels; *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level based on two tailed tests; ¥ estimates are based on results from the refinement estimators (14) and (16) when two thresholds are statistically significant, 95% confidence intervals in square brackets.

Table 4 Estimates for the threshold investment models during the existence of decoupled support (2005-2008).

	FR		**DE**		**HU**		**IT**		**UK**	
	FB	**ME**	**FB**	**ME**	**FB**	**ME**	**FB**	**ME**	**FB**	**ME**
Regime-indep.										
inppi	307.3357*** (53.0005)	172.5433 (132.2762)	414.2898*** (135.7757)	-210.1775 (148.9530)	-0.3557 (104.2873)	1,281.0744*** (258.3974)	689.5875** (281.5016)	286.1506** (145.4518)	-114.8194 (172.5395)	-133.1749 (224.7502)
varoutpi	40.8033 (27.0404)	-86.2871 (81.2080)	-189.6246*** (57.4738)	269.1842* (161.9029)	§	§	-21.4179 (17.9789)	-26.0962** (11.1152)	-88.1014 (335.7510)	190.6704 (337.0412)
coupsub	§	§	§	§	341.4439 (280.0737)	374.3918 (231.5646)	§	§	§	§
decsub	51.2279* (27.2202)	-121.6025 (76.4121)	435.5835*** (104.9752)	622.7084** (305.5804)	673.5537*** (188.1409)	274.1298 (329.9545)	21.8279 (21.3745)	-12.7120 (8.9094)	49.1979 (179.9548)	687.1385* (404.1334)
wealth	-6.9621 (11.3222)	8.6418 (37.2889)	-1.5339 (14.6257)	-11.7505 (12.2459)	96.9014*** (31.0677)	-9.6685 (13.7904)	0.3856 (0.3670)	0.6714 (0.4877)	9.2861 (7.3405)	2.4298 (10.7986)
income	-0.9156 (1.6169)	-1.8921 (1.5755)	26.3529*** (8.6986)	6.0514*** (2.3207)	0.5739 (1.5497)	4.9588 (3.8006)	11.2992** (5.1967)	0.5173** (0.2423)	13.9523* (8.1833)	8.6444 (5.8430)
K_{-1}	§	§	§	§	§	§	§	-0.0563*** (0.0123)	§	-0.6290*** (0.1122)
expoutpi	§	§	§	§	§	§	§	-4,400.7930* (2,627.8104)	§	14,065.1954 (16,394.0412)
Regime-dep.										
K_{-1} *Dis*	-0.3591*** (0.0301)	-0.5355*** (0.0703)	-0.2410** (0.1011)	-0.5803*** (0.0654)	-0.5748*** (0.0708)	-0.1080 (0.0828)	0.0066 (0.0432)	§	-0.2431*** (0.0896)	§
K_{-1} *ZInv*	§	-0.3883*** (0.0673)	-0.2904*** (0.0894)	-0.5210*** (0.0601)	-0.4583*** (0.0710)	-0.4068*** (0.0722)	-0.0711** (0.0281)	§	§	§
K_{-1} *Inv*	-0.2635*** (0.0216)	-0.2838*** (0.0714)	-0.0772 (0.1494)	-0.3012*** (0.0473)	-0.3611*** (0.0517)	-0.3120*** (0.0752)	-0.0837** (0.0327)	§	-0.4253*** (0.0635)	§
expoutpi Dis	-12,650.4607*** (3,019.5694)	-4,204.5030 (5,172.6417)	26,506.6541* (15,488.2088)	7,248.6988 (7,318.9936)	-2,696.3963 (4,765.7337)	-21,558.2012*** (5,234.0849)	-7,093.6948 (4,322.3438)	§	17,293.6708 (23,180.7877)	§
expoutpi ZInv	§	-7,707.3729* (4,671.5545)	8,170.6373 (8,252.5656)	12,272.5012* (6,588.7262)	-4,748.8684 (4,611.7548)	-12,116.5536** (5,159.6178)	-11,486.0585*** (3,820.5349)	§	§	§
expoutpi Inv	-11,980.0311*** (3,182.4731)	-6,196.4155 (4,680.5041)	-10,675.5064 (7,455.8190)	-1,653.1539 (6,895.1521)	-6,052.2831 (4,430.6624)	-15,420.1869*** (5,047.0552)	-22,855.8909*** (6,412.0364)	§	7,624.1822 (20,939.3009)	§
Thresholds¥										
γ_1	10.2249 [0.7690; 29.8313]	4.3943*** [3.5701; 4.6632]	16.3660** [13.9281; 21.9305]	14.7580** [10.0888; 19.5993]	6.1187*** [1.6986; 6.2218]	1.8091*** [1.7795; 1.8091]	40.2202** [39.2797; 40.2202]	§	3.6914* [2.7451; 19.0181]	§
γ_2	47.0530** [45.6733; 47.6036]	16.3243** [7.8313; 17.0944]	112.2358* [105.0486; 112.7820]	43.5636*** [43.5636; 43.6545]	34.4125*** [31.2791; 34.7213]	10.5331** [5.5490; 16.7051]	114.8387** [73.1232; 118.6542]	§	18.4681 [14.8694; 33.9366]	§
Diagnostics										
R^2	0.3136	0.2543	0.0896	0.2743	0.8190	0.3153	0.1639	0.0634	0.2286	0.3336
Het Test	11.3892	170.4870***	42.3277***	149.6563***	305.4955***	61.5894***	242.5125***	399.5303***	3.4143	76.9485***

Source: authors' estimation on EU-FADN - DG AGRI data employing a modified version of the Matlab code provided by Hansen on his website. **Notes to Table 4**: estimation carried out in Matlab R2011b; Eicker (1967)-Huber (1967)-White (1980) heteroschedasticity robust standard errors in parentheses in case the White test for heteroschedasticity is statistically significant at conventional levels; *** denotes statistical significance at the 1% level, ** at the 5% level, * at the 10% level based on two tailed tests; ¥ estimates are based on results from the refinement estimators (14) and (16) when two thresholds are statistically significant, 95% confidence intervals in square brackets.

Reading from the two tables, investment demand seems clearly characterised by a three-regime behaviour only in DE and HU, irrespectively of the actual type of investment and agricultural support under which it occurs. In FR and in the UK, the number of regimes appears to vary according to the type of investment considered: the one in FB is subject to two different behaviours in both countries, the one in ME features all three of them in FR while none in the UK. Investment behaviour in IT seems to emerge as differentiated in two regimes only when farms benefit from coupled CAP support. Here, the introduction of DPs develops one additional distinctive behaviour for the investment in FB while seems to equalise differences when farm decide their investment in ME. Investment in FB in FR and the UK is characterised, across support regimes, by the separation between the sole Dis and Inv behaviours while the same separation occurs for IT – irrespective of the asset considered – under coupled support.

The sign of the regime-dependent coefficient for K_{-1} in Table 3 and 4 provides the, somewhat surprising, and statistically precise testimony that the farms analysed in this study are over-capitalised both in their FB and ME endowments as well as over time and across all the possible regimes. Nonetheless, this finding seems to be confirmed by other recent studies (Sckokai and Moro, 2009), also employing different methodologies (Petrick and Kloss, 2012). Following Serra et al. (2009), we discuss the results' implications for the dynamic behaviour of the concerned investment models, highlighting whether the evidence suggests a path towards a non-stationary or stationary long-run equilibrium. This is determined according to whether the coefficients for the regime-dependent long-run adjustment variable (K_{-1}) are closer to 0 or 1 in absolute value, respectively.[13] The most stable and concurring evidence poses for investment in IT being on the path towards non-stationary long-run equilibria both across assets and support types. This evidence is more uncertain in FR, DE and HU while, the investment behaviours in the UK appear mostly geared towards a stationary long-run equilibrium.

The model allows for short-run adjustments in the stock of capital following fluctuations in *expoutpi*. Contrary to what has been highlighted for the coefficients of K_{-1}, the ones for *expoutpi* display significant variability in both their sign and significance levels. The dependence of investment from *expoutpi* is largely statistically insignificant, while it seems to be surprisingly negative in presence of decoupled support in FR, HU and IT across types of assets demanded. DE and the UK feature a largely positive short-run relationship between investment and *expoutpi*, although seldom significantly only in the former, under the more recent implementation of CAP support. FR, under coupled support, displayed a positive and mostly statistically significant short-run relationship between investment and *expoutpi*.

While the effect of CAP subsidies on investment in both asset types is largely positive, negative dependence from coupled subsidies arises for investment in FB in FR and IT, with the latter effect being statistically significant at 1%. Decoupled subsidies have a negative, although statistically insignificant, effect on investment in ME in FR and IT. Agricultural support of both types has a consistent positive effect on investment in DE, HU, and the UK with only the one in DE being always statistically significant. In turn, *decsub* appear to have a more significant impact on capital investment since its estimated coefficients achieve statistical significance – at conventional levels – in half of the models with a 25% increase compared to *coupsub*. The transition to a decoupled system of agricultural support does not seem to have induced many and dramatic changes in farmers' attitude towards capital investment. Exceptions may include the effect of support becoming positive and significant for FB investment in FR and for ME investment in the UK while

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[13] Note that coefficients close to (and larger than) 0.5, in absolute value, pose for a S equilibrium while a smaller (or very small ones) for a NS equilibrium.

significance is lost for FB in the UK. While remaining insignificant, the effect of CAP support turns from positive to negative for ME in FR and IT.

Roughly 70% (11 out of 16) of the estimated models are characterised by a negative coefficient for the effect of the risk of fluctuating expected output prices on both types of investments and across two types of support schemes. Nonetheless, only in roughly a third of these cases (4 out of 11) the effect is statistically significant at conventional levels. In DE and IT the estimated coefficient has the theoretically consistent negative sign with the ones for the former country being mostly statistically significant. ME investment under a regime of decoupled payments in DE is the only type of investment to be positively and statistically significantly – although at 10% – affected by a rise in the *varoutpi*. FR and the UK appear to be evenly characterised by positive and negative relationships between risk and investment. In turn, in the UK the signs of this relationship appear to vary by investment type with FB displaying a negative and ME a positive one, respectively.

Focusing on the remaining regime-independent variables, *inppi* was expected to have a negative and statistically significant effect on the level of both FB and ME investment, since a higher expenditure for inputs is likely to result in more limited financial resources available for investment spending. This expectation is realised only for FB investment in DE under coupled support. In fact, the majority of the estimated models features a positive coefficient for the impact of *inppi* on investment with statistical significance – at conventional levels – being achieved more in presence of decoupled, rather than coupled, subsidies.

A similar finding emerges for the role of *income*, above and beyond the one related to the determination of the regimes, whereby the majority of the related estimated beta have unexpected signs – with occasionally minimal statistical significance – under coupled support while conventional wisdom is restored for all countries, except FR, and investment types over the period 2005-2008. Moreover, estimated coefficients are statistically significant at the 1% level in DE and at the 5% level in IT while in the UK the one for FB achieves statistical significance of the 10% level.[14]

The positive impact of wealth on investment levels appears very consistent across countries and asset classes, especially when coupled support was in place. In fact, it is statistically significant – although at 10% and 5% – in FR and DE for both investment types and for FB in the UK. On the other hand, wealth is highly statistically significant, and positive, only when investment in FB in HU is investigated over the 2005-2008 period. In the other cases, it remains largely positive while it loses any statistical precision.

The estimated models' explanatory power appears somewhat modest, especially over the period 2005-2008, since the R^2 measure only seldom exceeds 0.5. These findings, associated with the almost ubiquitous heteroschedasticity of the remainder error, suggest that there still might be significant variability unaccounted for. Future extensions should attempt to control for additional sources of heterogeneity to limit the incidence of heteroschedasticity and, hopefully, improve the models' explanatory power.

5.2. Classification into regimes and elasticity calculations

Following Hansen (1999), and differently from Serra et al. (2009), in Table 5 and 6 we provide a classification of the number of farms which belong to each of the highlighted regimes (if any) every year we have data for. This allows for recognising any change, over time and/or asset class in the most relevant

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[14] The coefficient for investment in ME is almost statistically significant, at conventional levels. Note that several coefficients are very close to conventional statistical significance suggesting that a further modelling effort may provide many more statistically significant coefficients. Additional results are available from the authors upon request.

attitude towards investment in the countries of interest. The same tables also report the yearly and regime-specific average values of *inv* and of *coupsub* or *decsub*, whenever relevant, instrumental to calculating the elasticities .

Between 2001 and 2004, farms in FR appear to be mainly and consistently Dis in FB while – once again consistently – ZInv in ME. Note that since 2002 Dis is the second most important type of investment behaviour characterising this asset class. In DE the majority of farms appears to be Dis FB over the whole period of coupled support while have ZInv in ME until 2002 and record fluctuations in the most relevant regime thereon. Inv is the regime describing, persistently, the attitude of IT farms towards a change in the quantity of FB. Over the years, the only persistent changes in the number of farms belonging to each regime occur for ME and FB in IT and the UK, respectively. In the former country, the predominant Dis behaviour turns into the Inv one. Note that a significant difference between the number of farms belonging to either regimes arises only in the year 2003. In the latter country, the prevalence of farms in the combined Inv regime in 1997 evolves in the concentration of farms into the Dis regime since 1998.

Between 2005 and 2008, the consistent predominance of the Dis behaviour, which characterised the period of coupled support, is still verified in FR for FB. The only perceivable change occurs in 2008 when a large increase, from the previous year, in the number of farms Inv is recorded. On the contrary, each of the three different investment behaviours is the most relevant, over the period 2005-2008, for ME investment in FR. Note that the ZInv one occurs twice in those years. Following the move toward DPs, the investment in FB in DE seems to have increased since the regime consistently absorbing the largest number of farms is ZInv, rather than Dis. Note that 2008 suggests a further move towards higher investment levels given the number of farms in the Inv regime has doubled, from the previous year, such that the gap with the ZInv has decreased substantially. The model for ME investment in DE turns from being characterised by a large number of farms Dis to a significant number of farms ZInv in 2008, somewhat confirming an improvement in investment dynamics. A similar phenomenon characterises HU which turns from ZInv in both FB and ME until 2006 to Inv thereon, although the second most relevant regime is now at a closer distance. IT seems to have already endured some adaptation towards lower levels of FB investment since the most populated regime – between 2005 and 2007 – is the Dis one while a resurgence of Inv occurs in 2008. Probably the most marked effect of the change in CAP support materialises for investment in FB in the UK. In fact, while Dis had prevailed – over the Inv regime – since 1998, the latter has return to consistently include the majority of UK farms investing in FB.

Table 5 Yearly classification of farms into investment regimes and average values of the investment levels and coupled support.

			#farms 2001	$\overline{Inv}$	$\overline{coupsub}$	**#farms 2002**	$\overline{Inv}$	$\overline{coupsub}$	**#farms 2003**	$\overline{Inv}$	$\overline{coupsub}$	**#farms 2004**	$\overline{Inv}$	$\overline{coupsub}$
FR	**FB**	Dis	339	-85.8388	2.7309	357	-42.2751	2.6143	356	45.1803	2.8233	338	-17.2545	2.8637
		Inv	70	-0.9388	1.7797	52	46.4072	1.7019	53	-34.6451	1.9007	71	100.0143	3.0251
	ME	Dis	88	-480.4792	1.5422	140	-160.9772	1.6732	109	-357.0226	1.5216	120	-175.7271	1.6657
		ZInv	224	-300.7790	1.5882	188	-32.8439	1.5329	220	-109.7984	1.6513	198	37.5810	1.5352
		Inv	97	-290.4564	1.1437	81	-83.1586	1.1260	80	-341.6830	1.8532	91	98.1631	1.2264
DE	**FB**	Dis	152	165.1218	9.4084	159	576.8825	8.7541	186	-90.5728	8.7105	145	-10.7442	8.8358
		ZInv	76	511.8539	8.6272	78	-1220.5550	7.5304	67	-1179.3850	6.2993	74	-199.6953	9.9075
		Inv	67	-1.8108	3.0070	58	360.5040	1.9171	42	25.5168	1.8708	76	521.4499	3.2597
	ME	Dis	71	-282.8019	2.4319	65	-510.5523	2.8352	106	-482.4994	2.7536	76	-285.3839	3.1599
		ZInv	120	-442.8172	3.3141	119	-403.0906	2.5913	103	-256.6002	2.5714	103	39.0497	2.6652
		Inv	104	-75.3888	1.0725	111	-207.6631	1.5082	86	21.9524	1.2842	116	-240.2413	1.6082
IT	**FB**	Dis	13	-232.4673	3.7006	12	-280.9582	6.0218	11	-173.2511	3.2082	6	-240.4110	8.9763
		Inv	57	-254.9004	2.7696	58	-275.1392	2.0567	59	-375.2426	3.4175	64	-249.3320	2.9351
	ME	Dis	36	-500.6398	1.8659	37	-388.3957	1.6419	24	-420.0337	2.3178	34	-330.7886	2.0897
		Inv	34	-246.7776	0.6341	33	-385.3715	0.6230	46	-316.4096	1.1263	36	-327.7776	0.9469
UK	**FB**	Dis	24	39.3872	3.7197	61	-230.4640	3.6308	62	-208.2371	4.0420	65	-129.5489	2.8296
		Inv	77	225.1431	3.8789	40	-122.4917	3.1095	39	-152.4852	2.8910	36	-309.8737	2.5075
	ME	-	101	-201.6851	3.1535	101	-401.9202	2.8446	101	-566.6652	3.2503	101	-409.3267	2.7014

Source: authors' calculations on thresholds' estimates from Table 3 and on EU-FADN - DG AGRI data. **Notes to Table 5**: values for the UK are for the period 1997 – 2001 due to data limitations.

Table 6 Yearly classification of farms into investment regimes and average values of the investment levels and CAP support.

			#farms 2005	$\overline{Inv}$	$\overline{coupsub}$	$\overline{decsub}$	#farms 2006	$\overline{Inv}$	$\overline{coupsub}$	$\overline{decsub}$	#farms 2007	$\overline{Inv}$	$\overline{coupsub}$	$\overline{decsub}$	#farms 2008	$\overline{Inv}$	$\overline{coupsub}$	$\overline{decsub}$
FR	**FB**	Dis	313	-68.0199	§	0.0103	316	-97.2210	§	2.3081	308	-142.5983	§	2.1750	249	-3.9044	§	2.4681
		Inv	37	-137.5089	§	0.0080	34	434.9408	§	1.3461	42	-289.1418	§	2.5957	101	-129.1957	§	1.9726
	ME	Dis	128	-173.9966	§	0.0057	146	-338.3541	§	1.1848	120	-221.5117	§	1.0925	35	-229.9723	§	0.8858
		ZInv	144	6.6026	§	0.0056	139	-149.6155	§	1.3755	150	52.0708	§	1.3440	153	73.8329	§	1.2264
		Inv	78	179.6021	§	0.0053	65	-155.7135	§	0.8318	80	34.0780	§	0.8439	162	232.8085	§	0.9644
DE	**FB**	Dis	56	-369.1033	§	7.4358	87	-390.3945	§	7.2177	57	449.4405	§	7.9690	27	3500.7560	§	7.4631
		ZInv	185	-370.9423	§	6.0595	175	178.5169	§	5.6156	188	213.2981	§	5.7941	166	510.9320	§	7.8235
		Inv	62	-141.7203	§	2.5951	41	1557.5980	§	2.7397	58	2510.9070	§	3.3581	110	1320.0380	§	5.9821
	ME	Dis	144	-322.5650	§	2.3359	163	33.7894	§	2.1157	141	-46.5602	§	2.2857	72	-232.6132	§	2.6059
		ZInv	116	-66.0053	§	1.2836	110	-40.0645	§	1.5594	127	181.3366	§	1.4377	154	319.2914	§	2.4877
		Inv	43	43.4546	§	0.8175	30	195.0587	§	0.8812	35	533.5139	§	1.0484	77	-9.6516	§	1.5453
HU	**FB**	Dis	36	779.5925	1.3221	1.0444	44	-314.6286	0.8422	1.7098	42	-322.1168	1.7694	2.8897	37	-332.7315	0.5206	1.9626
		ZInv	114	1994.1780	1.6970	1.7240	118	4.1907	1.5565	2.7868	51	371.0842	2.5918	5.7904	71	-33.5046	0.1598	3.9170
		Inv	57	1250.5670	1.7104	1.5048	45	-30.0638	1.1400	1.3215	114	112.4543	1.7824	3.4396	99	470.7855	0.2139	2.8659
	ME	Dis	35	-4.4098	0.4589	0.3582	41	61.9654	0.2606	0.5251	45	180.9316	0.4187	0.7248	36	332.2688	0.2543	0.6496
		ZInv	97	-412.4267	0.6660	0.6751	113	-284.6523	0.5007	0.8897	78	82.9343	0.5403	1.2089	73	-202.1463	0.0461	1.2831
		Inv	75	224.1603	0.5455	0.4921	53	-297.1134	0.4223	0.5804	84	374.0162	0.4025	0.7359	98	-99.5305	0.0641	0.8210
IT	**FB**	Dis	216	-203.9176	§	2.0198	212	399.4837	§	2.5169	227	-317.8424	§	2.6564	80	-366.8578	§	2.3278
		ZInv	167	139.7718	§	2.7742	184	95.7715	§	3.5908	207	-332.1156	§	2.9296	194	-365.0720	§	3.1328
		Inv	187	393.0961	§	2.2120	174	342.7694	§	2.5312	136	-237.0799	§	2.8713	296	-550.8514	§	2.8969
	ME	-	570	-328.4479	§	0.9417	570	-395.5967	§	1.1571	570	-333.5289	§	1.2129	570	-374.5699	§	1.1454
UK	**FB**	Dis	27	127.9110	§	2.8224	20	409.9789	§	3.2890	16	82.3340	§	1.8955	5	-327.1312	§	2.4714
		Inv	69	-179.5111	§	3.0260	76	-16.1941	§	3.0593	80	169.8991	§	2.5671	91	44.6537	§	3.1493
	ME	-	96	-36.3025	§	2.9841	96	118.3018	§	2.7465	96	435.7149	§	2.4230	96	428.3541	§	2.6680

Source: authors' calculations on thresholds' estimates from Table 4 and on EU-FADN - DG AGRI data. **Notes to Table 6**: § denotes Not Applicable.

Table 7 and Table 8 present the values of the calculated elasticities of *inv* to received subsidies, for the period 2001-2004 and for the period 2005-2008, respectively. Since HU benefitted from both coupled and decoupled support as an adaptation to the EU system of agricultural subsidies, upon entry into the EU, both elasticities have been calculated and are presented.

Table 7 Elasticity of investment to coupled subsidies (2001-2004).

			$\xi^c_{2001,j}$	$\xi^c_{2002,j}$	$\xi^c_{2003,j}$	$\xi^c_{2004,j}$
FR	**FB**	Dis	0.1379	0.2680	-0.2708	0.7191
		Inv	8.2141	-0.1589	0.2377	-0.1311
	ME	Dis	-0.1748	-0.5660	-0.2321	-0.5162
		ZInv	-0.2876	-2.5416	-0.8190	2.2246
		Inv	-0.2144	-0.7374	-0.2954	0.6804
DE	**FB**	Dis	33.9581***	9.0439***	-57.3161***	-490.1210***
		ZInv	10.0451***	-3.6770***	-3.1832***	-29.5684***
		Inv	-989.6793***	3.1693***	43.6951***	3.7256***
	ME	Dis	-4.6574***	-3.0076***	-3.0909***	-5.9968***
		ZInv	-4.0534***	-3.4817***	-5.4274***	36.9649***
		Inv	-7.7049***	-3.9335***	31.6832***	-3.6255***
IT	**FB**	Dis	0.5153***	0.6939***	0.5995***	1.2087***
		Inv	0.3518***	0.2420***	0.2948***	0.3811***
	ME	Dis	-0.5477	-0.6213	-0.8110	-0.9284
		Inv	-0.3776	-0.2376	-0.5231	-0.4246
UK	**FB**	Dis	18.8312***	-3.1414***	-3.8705***	-4.3553***
		Inv	3.4354***	-5.0618***	-3.7805***	-1.6135***
	ME	-	-5.0108	-2.2681	-1.8382	-2.1150

Source: authors' calculations based on data from Table 3 and 5. **Notes to Table 7:** values for the UK are for the period 1997 – 2001 due to data limitations.

Table 8 Elasticity of investment to decoupled subsidies (2005-2008).

			$\xi^c_{2005,j}$	$\xi^d_{2005,j}$	$\xi^c_{2006,j}$	$\xi^d_{2006,j}$	$\xi^c_{2007,j}$	$\xi^d_{2007,j}$	$\xi^c_{2008,j}$	$\xi^d_{2008,j}$
FR	**FB**	Dis	§	-0.0078*	§	-1.2162*	§	-0.7814*	§	-32.3828*
		Inv	§	-0.0030*	§	0.1585*	§	-0.4599*	§	-0.7822*
	ME	Dis	§	0.0040	§	0.4258	§	0.5997	§	0.4684
		ZInv	§	-0.1031	§	1.1180	§	-3.1387	§	-2.0199
		Inv	§	-0.0036	§	0.6495	§	-3.0113	§	-0.5037
DE	**FB**	Dis	§	-8.7751***	§	-8.0532***	§	7.7233***	§	0.9286***
		ZInv	§	-7.1154***	§	13.7021***	§	11.8323***	§	6.6697***
		Inv	§	-7.9762***	§	0.7662***	§	0.5826***	§	1.9740***
	ME	Dis	§	-4.5094**	§	38.9905**	§	-30.5696**	§	-6.9760**
		ZInv	§	-12.1098**	§	-24.2372**	§	4.9371**	§	4.8517**
		Inv	§	11.7148**	§	2.8132**	§	1.2237**	§	-99.7007**
HU	**FB**	Dis	0.5790	0.9023***	-0.9140	-3.6603***	-1.8755	-6.0424***	-0.5342	-3.9729***
		ZInv	0.2906	0.5823***	126.8183	447.9107***	2.3848	10.5101***	-1.6286	-78.7439***
		Inv	0.4670	0.8105***	-12.9473	-29.6071***	5.4119	20.6017***	0.1551	4.1002***
	ME	Dis	-38.9606	-22.2671	1.5745	2.3230	0.8664	1.0981	0.2865	0.5359
		ZInv	-0.6046	-0.4487	-0.6586	-0.8568	2.4391	3.9959	-0.0854	-1.7400
		Inv	0.9111	0.6018	-0.5321	-0.5355	0.4029	0.5394	-0.2411	-2.2612
IT	**FB**	Dis	§	-0.2162	§	0.1375	§	-0.1824	§	-0.1385
		ZInv	§	0.4332	§	0.8184	§	-0.1925	§	-0.1873
		Inv	§	0.1228	§	0.1612	§	-0.2644	§	-0.1148
	ME	-	§	0.0364	§	0.0372	§	0.0462	§	0.0389
UK	**FB**	Dis	§	1.0856	§	0.3947	§	1.1326	§	-0.3717
		Inv	§	-0.8293	§	-9.2942	§	0.7434	§	3.4698
	ME	-	§	-56.4834*	§	15.9526*	§	3.8212*	§	4.2798*

Source: authors' calculations based on data from Table 4 and 6. **Notes to Table 8:** § denotes Not Applicable

Evidence in Table 7 suggests that the demand for investments has been elastic to coupled subsidies in DE and the UK while inelastic in FR and IT, irrespective of the asset class considered.[15] The evolution of the regime-specific elasticities in FR reflects a move towards a more elastic demand for FB investment in the Dis regime while the rigidity of FB investment in the Inv regime has largely remained unchanged, if very large values of elasticity are ignored. Somewhat similar to the behaviour of FB investment, and despite the significant fluctuations it is subject to, the elasticity of ME investment in FR has increased in each of the three regimes. The evolution, over time, of the elasticity of investment demand in IT appears to be remarkably similar across asset classes. The Dis one seems to feature an increasingly more elastic investment demand while the Inv one appears to be characterised by fluctuations which compensate themselves, yielding a largely stable, and smaller than one in absolute value, elasticity value. The demand for FB investments in DE is clearly elastic to a change in coupled subsidies, yet its dynamics is somewhat hard to evaluate since a few instances of large elasticity values occur. Ignoring the latter, the elasticity of FB investment to changes in coupled subsidies in the ZInv and Inv regimes have moved in opposite directions: the former has declined, in absolute value, while the latter has increased, although somewhat marginally. Aside for the elasticity of ME investment in the Inv regime suggesting the evolution towards a more rigid demand for ME investment, those for the other two regimes highlight an opposite evolution towards more elastic demands. The UK appears to have experienced a decline in the elasticity values for FB in the Inv regime. Neglecting the 2001 value of FB elasticity, its dynamics – in the Dis regime – poses for the associated investment demand becoming more elastic.

The main differences between Table 7 and 8 concern the possibility of calculating the elasticities of interest also for HU, since it joined the EU in 2005. Moreover, while for the other countries the two time spans imply that only one CAP regime is in place, in HU both coupled and decoupled support were in place, such that – in every year – two sets of elasticities can be calculated. The following commentary distinguishes between coupled and decoupled elasticities only for HU; in every other case comments should be intended to describe the relationship between investment and decoupled subsidies.

Most notably, Table 8 displays the occurrence of almost zero elastic investment demand functions. Aside for the one calculated for the ZInv regime of ME investment in FR, the 2005 elasticities to decoupled subsidies are very close to zero, across the identified regimes and irrespectively of the concerned asset class. Since this result arises for the first year of implementation of decoupled support, we might speculate that farms in FR were not prepared to adapt to the new nature of the subsidies such that they did not condition their choices to this variable. A somewhat similar evidence, although it occurs consistently for the whole 2005 – 2008 period, affects the zero-threshold model for ME investment in IT. FB and ME investment in FR appear largely inelastic, except for the ZInv regime of ME investment. While the elasticity of FB investment in the Inv regime in FR increases monotonically towards 1, the other regimes characterising the two types of investments experience a rise between the beginning and end of the period values. IT features inelastic investment demand functions for FB across all the estimated regimes which, over time, become more inelastic, except for the one for the Inv regime in FB investment whose elasticity increases for the two central years before declining just below the 2005 level. The UK elasticity values are largely unstable over time. The only clear trend emerging relates to a move towards a less elastic demand in the zero threshold model for ME. The comparison between beginning and end of the period elasticites of FB investment in the UK denote the transformation of an elastic demand into an inelastic one, and vice-versa, for the two estimated regimes, respectively. FB investment in DE appears characterised by declining values of the

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[15] While we are aware that elasticity parameters larger than, say, 20 might induce significant concerns, we cannot avoid large values of received subsidies and/or small ones of investment to yield coefficients like the ones above.

elasticity parameters with the one for FB in the Dis regime declining monotonically. ME investment demand in the Dis and ZInv regimes become, subject to somewhat unusually large values, more and less elastic, respectively. Excluding a very large value for 2008, the variation over time of the elasticity of ME in the Inv regime in DE presents a monotonic decline towards values implying an iso-elastic behaviour of the related demand functions. FB investment in HU seems characterised by a dependence from coupled subsidies which fluctuates over the years maintaining the inelastic behaviour of FB investment in the Dis and Inv regimes with the value of elasticity declining over time. On the contrary, the elasticity of FB demand in the ZInv regime becomes larger to exceed one, in absolute value. The decline, almost monotonic, in the elasticity values, over the period, also characterises the elasticity of ME investment to coupled subsidies across all the estimated regimes. The FB demand, across all the estimated regimes, is elastic to decoupled subsidies, except for 2005. ME investment demand becomes elastic only since 2007 in the ZInv and in 2008 in the Inv regimes while it actually monotonically becomes more rigid in the Dis regime.

5.3. Simulations of expected changes in investment levels

5.3.1. CAP policy reform scenarios and simulations

The CAP towards 2020 policy reform proposal is built upon three main drivers: the *Adjustment*, the *Integration* and the *Refocus* scenarios for the quantification of DPs disbursement levels in 2020 (European Commission, 2011). In turn, the *Adjustment* scenario can be implemented according to the *EU flat rate*, the *Min 80%* and *Min 90% and objective criteria* declinations. The *EU flat rate* envisages an EU-wide flat rate payment per hectare of potential eligible area (PEA). Although the *Min 80%* scenario is inherently a policy scheme disbursing a flat rate payment, it is implemented to equalise the average level of DPs in MSs to at least 80% of the EU average. In the *Min 90% and objective criteria* implementations the minimum payment reaches 90% of the EU average, while additional environmental and economic criteria are spelled out to address the financing of the extra 10% disbursed under this policy scenario. The European Commission proposal for reforming the DPs allocation among MSs in the *Integration* scenario implies that MSs receiving less than 90% of the EU-27 average DPs will experience, over the Multi-Annual Financial Framework 2014-2020, a reduction– by a third – in the gap they experience from the EU average. Lastly, the *Refocus* scenario implies a radical shift in the CAP support policies since – according to this scheme of things – DPs are scrapped altogether and the funds allocated to Pillar-II measures are doubled. Note that we are unable to simulate the changes in investment patterns due to the implementation of the policies under the *Refocus* scenario since we have not included any Pillar-II measure among the determinants of farm investment demand in (7). European Commission (2011) compares the expected level of DPs associated to each policy scenario to a 2020 status quo implying a full phasing-in (i.e., 100%) of DPs in the EU-12. In turn, European Commission (2011) calculates the percentage changes in DPs expected under each scenario as if a regional, model of disbursement was applied, while some limited provision of coupled payments was maintained (mainly for livestock production and cotton).

5.3.2. Simulations' results

Table 9 presents the percentage change in DPs in the countries of interest under the policy scenarios envisaged in European Commission (2011) which we are able to employ in our simulation effort. Close to each column of expected percentage change in the level of DPs, we present the percentage change in the average regime-dependent level of net investment arising from the application of (8).

To facilitate the interpretation of the results of this simulation exercise, we also present the ancillary columns for the sign of β^d as well as values for the $\xi^{sub}_{2008,j}$ and $\overline{inv_j}$. Except for the UK under the EU flat rate and the HU under the integration DPs reform scenarios, all the remaining policy reform options are characterized by a percentage decline in the level of DPs. In turn, the resulting sign for the $\Delta\overline{inv_j}$ (#) is opposite the one of the calculated elasticity $\xi^{sub}_{2008,j}$. To define a qualitative effect of the impact of $\Delta\overline{inv_j}$ (#) on the regime-specific average investment level $\overline{inv_j}$, we arrange the column for the directional effect (Dir. effect) which aims to define whether $\overline{inv_j}$ should decline or rise because of the policy change. A negative sign (-) of the Dir. effect in each regime, suggesting a worsening in the investment prospects of farms in a given regime, is the result of a positive percentage change in average net investment when the latter is negative (namely negative investment becoming even more negative) or of a negative percentage change in presence of positive average investment levels. A positive sign (+) of the Dir. effect in each regime, suggesting an improvement in the investment prospects of a farm in a given regime, is the result of a negative percentage change in average net investment when the latter is negative (namely negative investment becoming less negative) or of a positive percentage change in presence of positive average investment levels. Note that no sign is associated to the zero percentage change in net investment levels expected in HU if the Integration scenario were implemented.

The switch in the Dir. effect for investment in both asset classes in the UK, from (+) to (-),is essentially due to the UK expecting an increase in DPs under the EU flat rate policy reform scenario. Every other country appears to be subject to consistent Dir. effects across the reform scenarios. The generalised reduction in support levels induced by the scenarios in Table 1, leads to the expectation that the prospects for average net investment levels will worsen across countries and asset classes. This expectation is met in all cases except for ME in both FR and IT, under all policy scenarios. While unexpected, this result is worthy of some confidence since it is consistent across reform scenarios which all imply a percentage reduction in DPs.

6. CONCLUSIONS

The different organisation of the agricultural sector across the EU MSs and over time calls for a comparative analysis of the developmental effects of agricultural policies. Farms' investment decisions might be deemed an interesting area of research since they are targeted at combating the obsolescence of capital assets, which are subject to significant yearly depreciation, as well as at advancing the technological dimension of the production technique whenever a major innovative breakthrough is embodies in a commercial capital good. In turn, adapting the existing capital stock to increasing farm size or differentiation as well as benefitting from a more modern technology is likely to foster the profitability of the agricultural sector and have a broader beneficial effect on national economies.

The present contribution, allowing for the existence of uncertainty in output prices, has investigated the role of coupled and decoupled CAP subsidies in determining the investment demand for farm buildings and machinery and equipment of specialised arable crop farms in a sample of selected EU MSs. Moreover, the reduced form investment equations have been specified to account for several of the determinants considered in the literature. Applying a theoretical model of investment choice featuring irregularities in the adjustment cost function and an econometric technique capable of identifying the existence of separating equilibria, the paper has been able to investigate whether disinvestment, zero investment and positive investment in both asset classes are optimal reactions to the existence of ranges – rather than point values – of shadow asset prices.

Table 9 CAP Policy Reform Scenarios and their effects on regime-dependent levels of investment.

			Sign of β^d	$\xi^d_{2008,j}$	$\overline{inv_j}$	$\Delta\overline{inv_j}$ (1)	Dir. effect	$\Delta\overline{inv_j}$ (2)	Dir. effect	$\Delta\overline{inv_j}$ (3)	Dir. effect	$\Delta\overline{inv_j}$ (4)	Dir. effect
FR	**FB**	Dis	+	-32.3828*	-3.9044	550.51	-	388.59	-	420.98	-	64.77	-
		Inv	+	-0.7822*	-129.1957	13.30	-	9.39	-	10.17	-	1.56	-
	ME	Dis	-	0.4684	-229.9723	-7.96	+	-5.62	+	-6.09	+	-0.94	+
		ZInv	-	-2.0199	73.8329	34.34	+	24.24	+	26.26	+	4.04	+
		Inv	-	-0.5037	232.8085	8.56	+	6.04	+	6.55	+	1.01	+
DE	**FB**	Dis	+	0.9286***	3500.7560	-21.36	-	-12.07	-	-14.86	-	-3.71	-
		ZInv	+	6.6697***	510.9320	-153.40	-	-86.71	-	-106.72	-	-26.68	-
		Inv	+	1.9740***	1320.0380	-45.40	-	-25.66	-	-31.58	-	-7.90	-
	ME	Dis	+	-6.9760**	-232.6132	160.45	-	90.69	-	111.62	-	27.90	-
		ZInv	+	4.8517**	319.2914	-111.59	-	-63.07	-	-77.63	-	-19.41	-
		Inv	+	-99.7007**	-9.6516	2293.12	-	1296.11	-	1595.21	-	398.80	-
HU	**FB**	Dis	+	-3.9729***	-332.7315	39.73	-	27.81	-	31.78	-	0.00	§
		ZInv	+	-78.7439***	-33.5046	787.44	-	551.21	-	629.95	-	0.00	§
		Inv	+	4.1002***	470.7855	-41.00	-	-28.70	-	-32.80	-	0.00	§
	ME	Dis	+	0.5359	332.2688	-5.36	-	-3.75	-	-4.29	-	0.00	§
		ZInv	+	-1.7400	-202.1463	17.40	-	12.18	-	13.92	-	0.00	§
		Inv	+	-2.2612	-99.5305	22.61	-	15.83	-	18.09	-	0.00	§
IT	**FB**	Dis	+	-0.1385	-366.8578	5.12	-	1.39	-	3.05	-	0.83	-
		ZInv	+	-0.1873	-365.0720	6.93	-	1.87	-	4.12	-	1.12	-
		Inv	+	-0.1148	-550.8514	4.25	-	1.15	-	2.53	-	0.69	-
	ME	-	-	0.0389	-374.5699	-1.44	+	-0.39	+	-0.86	+	-0.23	+
UK	**FB**	Dis	+	-0.3717	-327.1312	-2.23	+	3.72	-	1.86	-	0.74	-
		Inv	+	3.4698	44.6537	20.82	+	-34.70	-	-17.35	-	-6.94	-
	ME	-	+	4.2798*	428.3541	25.68	+	-42.80	-	-21.40	-	-8.56	-

Source: authors’ calculations based on elasticities in Table 8. **Note to Table 9:** all figures expressed in percentages.

Empirical estimates suggest that the range of zero investment is clearly and consistently identified, on top of the more common disinvestment and investment ones, for Germany across asset classes and CAP support schemes and only across asset classes for Hungary. Three regimes appear to characterise also machinery and equipment investment in France, irrespectively of the type of support received. The more common differentiation between disinvestment and positive investment pertains the adjustment of the stock of farm building in France and the UK, across support types, and in Italy for both asset classes under coupled support. This evidence might help devising new regime-specific policy interventions where clear separations are detected.

Since specialised arable crop farms appear to disinvest on the way towards lower levels of long-run capital endowments, the frequent anecdotal evidence that agriculture is undercapitalised is not supported by the data. Nonetheless, except for the UK and Germany, these trajectories should lead towards non stationary long run equilibria implying the possibility of further and different future dynamics. The association between both types of investments and both types of CAP subsidies is mostly positive with the dependence on decoupled support barely more significant. The anticipated negative association between the variance of the expected output price index – accounting for some the uncertainty farmers face in commercialising their outputs – is largely apparent in the estimates, although seldom statistically significant.

The estimates for the dependence of investment levels on decoupled subsidies have been employed to calculate the associated year and regime specific elasticities. In turn, the latter have been instrumental to obtain the comparative static percentage changes in average net investment levels associated to the implementation of the currently debated reform scenarios of the CAP payments.

Simulated percentage changes in the regime-dependent investment levels are mainly consistent with the expectation that the different implementations of the announced cuts in CAP payments would lead to a deterioration (i.e., larger negative and smaller positive values) of the investment prospects of the farms analysed.

In fact, the sole investment in machinery and equipment in France and Italy appears to respond positively to the widespread reduction in support levels induced by the policy scenarios considered. In the United Kingdom, the simulated increase in the investment demand in both types of assets is due to an actual increase in the level of payments received by the UK under the *EU flat rate* implementation of the reform policy scenarios.

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