CAP REFORM AND ITS IMPACT ON STRUCTURAL CHANGE AND PRODUCTIVITY GROWTH: A CROSS COUNTRY ANALYSIS

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Abstract

The recent reforms of the Common Agricultural Policy (CAP) have exposed the European agricultural sector to a new set of constraints and challenges. The decoupling of direct payments from production is expected to make production decisions more market-oriented as farmers move from mainly subsidy revenue maximization objectives toward profit maximizing behaviour. However, ex-post analyses of the productivity of farms have yet to uncover any evidence of a positive effect of the decoupling policy on farm productivity. Using the Irish, Danish and Dutch farm level data, we identify the extent to which both system and product switching after the introduction of decoupling has occurred and to what extent these changes have contributed to productivity growth in the agriculture. We find some evidence that the decoupling policy had positive significant effects on farm productivity but the product switching behaviour associated with the changes in farm decoupling rates have not led to productivity improvements.

Keywords: productivity, semiparametric estimation, farming, decoupling

JEL classifications: D24, Q12, Q18

1. Motivation:

The recent reforms of the Common Agricultural Policy (CAP) have exposed the European agricultural sector to a new set of constraints and challenges. The major CAP reform was decided in 2003. The main feature of this reform was the Single Payment Scheme (SPS) which was implemented between 2005 and 2007. The decoupling of direct payments from production is expected to make production decisions more market-oriented as farmers move from mainly subsidy revenue maximization objectives toward profit maximizing behaviour. Irish, Dutch and Danish farms present an interesting setting for studying the dynamics of farms' adjustment processes in a changing agricultural policy environment, in particular, in relation to productivity changes, given that the decoupling policy was implemented in different ways in each country. Ireland introduced a full decoupled payment policy in 2005 based on the subsidy payments made in a reference years (2000-02). Denmark also switched to decoupling in 2005, but the decoupled payments are based on a flat-rate per hectare on top of an additional amount based on the historical entitlements with 2000-02 as the reference period. In the Netherlands, the single farm payments are based on historical entitlements from 2006.

Analyses of the effects of the decoupling of agricultural policies find that decoupled payments might affect input allocation (Hennessy 1998; Howley et al. 2009). Hennessy (1998) shows using simulations that support policies that are decoupled affect the decisions of risk-averse producers when there is uncertainty (ex-ante). Howley et al. (2009) use a partial equilibrium model to project the impact of decoupled payments on Irish agricultural production. By comparing actual observed market data with projections from the model between 2005 and 2008, they find that decoupled payments continue to have a strong effect on agricultural production in many sectors, although this effect is less than if the subsidy payments were still fully coupled. Carroll et al. (2008) analyze (ex-post) the recent decoupling effect on Irish farm efficiency and find that in the cattle rearing, cattle finishing and sheep sectors decoupling has led to improvements in efficiency. However, no such evidence was found for dairy farming.

Ex-post analyses of dairy farm productivity, conducted since the introduction of the SPS, have produced weak or no evidence of any positive effect of the decoupling policy on dairy farm productivity (Carroll et al. 2008; Kazukauskas et al. 2009). One possible reason why no effect has yet been uncovered is that the policy change is too recent for farmer's to react and so loss-making farms persist in the sector (Breen et al. 2006). It is also possible, however, that more subtle changes are taking place in the sector that aggregate productivity analyses do not reveal. In this paper we explore the extent to which product switching has occurred since decoupling and whether this has the potential to contribute to aggregate productivity growth in the sector in the future.

Using the Irish National Farm Survey (NFS), Danish and Dutch micro-data, we identify the extent to which both system and product switching after the introduction of decoupling has occurred and to what extent these changes have contributed to productivity growth of the sector. The paper contributes to both the policy debate on the impact of CAP reform on the agricultural sector and to the literature on productivity estimation. First, few studies to date have analysed the ex-post effect of CAP reform on total factor productivity of the agricultural sector, particularly from a cross-country perspective. Second, this is the first study to identify switching behaviour as a productivity improving mechanism and to explicitly incorporate this mechanism into the analysis of farm productivity. Third, we modify the methodologies introduced by Olley and Pakes (1996) and De Loecker (2009) for estimating productivity for the estimation of productivity in the agricultural sector. Fourth, we present a feasible alternative for estimating productivity using these approaches where market exit data are not available.

Section 2 presents the methodological approach used for estimating productivity. Section 3 discusses the main results and Section 4 concludes.

2. Methodology:

In this section we develop an empirical model to estimate individual productivity levels for each farm in our sample. We closely follow De Loecker (2009) and Olley and Pakes (1996) models . We start by assuming a Cobb Douglas production function in logarithms:

$$\ln y_i = \beta_0 + \sum_{k=1}^{K} \beta_k \ln x_{ki} + e_i \qquad \textbf{(1)}$$

where y_i is the farm's output level, x_{ki} is a vector of k production inputs (capital, labour etc) and e_i might represent management quality differences between farms, measurement errors, or sources of shocks caused by weather, machine breakdowns etc. Marshak and Andrews (1944) were the first to highlight that direct OLS estimation of equation (1) is problematic due to simultaneity bias. The problem is that the choice of inputs is related to the farm's productivity level. If the farmer has prior knowledge of his productivity, which is embedded in $e_{i,}$ when making these input choices, the input choices will be correlated with e_i.

There is a second endogeneity problem present when using OLS to estimate equation (1). If farms have some knowledge of their productivity level (e_i) prior to exiting the sector, farms that continue to produce will be a selected group which will be partially determined by fixed inputs such as capital. The farms with a higher capital stock are expected to have a smaller probability of exiting the sector. This endogeneity problem can cause a downward bias in the coefficients on fixed inputs such as capital (Ackerberg et al. 2007).

The third problem that arises when using OLS to estimate the production function given in equation (1) is that demand shocks (both observed and unobserved) across individual farms will be captured in the unobserved productivity/error term. The presence of such shocks will cause two problems: first, the coefficients of the production function will be biased (omitted variable problem); and second, the estimated productivity term will capture demand variations as well as productivity differences. Failing to control for these demand shocks across individual producers may lead us to infer relationships between productivity and policy changes that are merely reflecting variations in exogenous demand factors (De Loecker 2009).

Olley and Pakes (1996) method tackles the simultaneity bias by assuming that the productivity term follows a first order Markov process and investment decisions are used as a proxy for this term. The OP method addresses the selection bias problem by estimating the probability of exit using firm/farm market exit data.

The third endogeneity problem associated with the relationship between estimated productivity and policy impacts is addressed in De Loecker's (2009) model. In order to single out the productivity response to a policy change we control for the observed demand shifters and unobserved demand shocks as proposed in the De Loecker model.

The production function to be estimated is:

$$\ln y_{it} = \beta_0 + \beta_l \ln l_{it} + \beta_d \ln d_{it} + \beta_k \ln k_{it} + \beta_a \ln a_{it} + \sum_s \beta_s D_{is} + \sum_m \beta_m (sh_{imt} p_{mt}) + w_{it} + \xi_{it} + u_{it} \quad \textbf{(2)}$$

where y_{it} is the farm's output level, l_{it} and d_{it} are labour and direct cost inputs respectively, which can be adjusted in one period; k_{it} and a_{it} are capital and land variables which are quasi-fixed and which can be adjusted in two periods; w_{it} is the productivity term which is observable by farmers but not observable by the econometrician; ξ_{it} is unobserved demand shocks; D_{is} are farm system dummies controlling for technology differences; $sh_{imt} p_{mt}$ are the constructed demand shifters for individual farms and u_{it} is a white noise term.

De Loecker (2009) notes that the usage of farm product mix information in estimating productivity has important advantages. First, it enables us to construct segment specific demand shifters. Second, the disaggregated product mix information can be used to proxy for unobserved demand shocks.

We construct the individual demand shifters $sh_{imt} p_{mt}$ as the product of the agricultural product price and the farm's revenue share from the specific agricultural product ($sh_{imt} p_{mt} = revenue\_share_{imt} * price\_chage_{mt}$). The observed demand shift for an individual farm will thus depend on the market price and the how important that price is for the farm's revenue generating capacity.

In order to solve the simultaneity bias issue we use investment decisions to control for unobserved productivity w_{it}. If the farm stays in business we assume that investment takes place. Conditional on the farm investing, the investment function can be described as $i_{it} = i_{it}(k_{it}, a_{it}, w_{it}, z_{it}, qr_{it})$. Under some weak conditions, the investment equation is a monotonically increasing function of productivity (w_{it}). We assume that not only are investment decisions dependent on capital stock and farm specific-characteristics (z_{it}) (for example, soil type etc), but they are also dependant on the introduction of the decoupling policy. To quantify the potential effect of the policy change on farm's investment decision we use a decoupling rate qr_{it} given by equation (3).

$$qr_{it} = \ln\left[1 - \frac{subsidies}{total\_farm\_output}\right] \qquad \textbf{(3)}$$

Using this decoupling rate variable as a proxy for the decoupling policy has some advantages over simply using a time dummy variable to capture its effect. Since we do not observe the farm's expectations about the implementation of the decoupling policy, the ex-ante behaviour of farms that may have pre-empted the change in the farming business environment as a result of the policy change and altered their behaviour accordingly, will not be captured by the inclusion of a simple decoupling dummy variable. Moreover, farms may delay their response to the policy change until they are convinced that the new policy is a lasting commitment. Thus, the effects of the decoupling policy on farm behaviour may be evident before the policy is actually implemented or may take some time after the intervention to be observed.

The productivity/investment relationship can be inverted by expressing productivity as an unknown function of investment, capital, land, the decoupling rate qr_{it} and farm specific characteristics $w_{it} = i_{it}^{-1}(k_{it}, i_{it}, a_{it}, z_{it}, qr_{it})$.

Following De Loecker (2009) and Goldberg (1995) we decompose the unobserved demand shock into 2 components:

$$\xi_{it} = \xi_j + \tilde{\xi}_{it}$$

where *j* refers to a product. Now we can rewrite the sum of the two unobserved shocks as follows;

$$w_{it} + \xi_{it} = i_{it}^{-1}(k_{it}, i_{it}, a_{it}, z_{it}, qr_{it}) + \sum_{j \in J(i)} \sigma_j D_{ij} + \tilde{\xi}_{it}$$

The dummies D_{ij} capture product fixed effect where *J(i)* denote the set of products. These dummies can also capture differences in farm production technologies.

Substituting this expression into the production function given in Equation (2) gives the estimating equation for the first step.

$$\ln y_{it} = \beta_0 + \beta_l \ln l_{it} + \beta_d \ln d_{it} + \sum_s \beta_s D_{is} + \sum_m \beta_m (sh_{imt} p_{mt}) + \phi(k_{it}, a_{it}, i_{it}, z_{it}, qr_{it}) + \sum_{j \in J(i)} \sigma_j D_{ij} + \varepsilon_{it}$$

where $\phi_{it}(.) = \beta_k \ln k_{it} + \beta_a \ln a_{it} + \tilde{i}_{it}^{-1}(k_{it}, i_{it}, a_{it}, z_{it}, qr_{it})$. The unknown function $\phi_{it}(.)$ is approximated by a fourth order polynomial. This model can be estimated using OLS to uncover the coefficients on the variable inputs in the production function and the joint effect of all state variables on output. The variable inputs are not affected by simultaneity bias as $\phi_{it}(.)$ fully controls for the unobservable w_{it}; ε_{it} is a white noise term which does not affect the input coefficients as by assumption it is not observable by the farm before the investment decision is made.

The next task is to estimate the effect of capital and land on output. We assume that the productivity term follows an exogenous first order Markov process, i.e. productivity terms are serially correlated, and so current farm productivity carries information about the future productivity of the farm. Thus, current productivity is a function of past productivity. The second stage is the estimation of the capital and land coefficients using non linear least squares techniques, while approximating the function $g(.)$ by a series polynomial.

$$\ln y_{it+1} - \hat{\beta}_0 - \hat{\beta}_l \ln l_{it+1} - \hat{\beta}_d \ln d_{it+1} - \sum_{j \in J(i)} \hat{\sigma}_j D_{ij} - \sum_s \beta_s D_{is} - \sum_m \beta_m (sh_{imt} p_{mt}) =$$
$$= \beta_k \ln k_{it} + \beta_a \ln a_{it} + g(\tilde{i}_{it}^{-1}(.)) + \kappa_{it} \qquad \textbf{(4)}$$

where $\hat{\tilde{i}}_{it}^{-1}(.) = \hat{\phi}_{it}(.) - \beta_k \ln k_{it} - \beta_a \ln a_{it}$ and $\hat{\phi}_{it}(.)$, $\hat{\beta}_0$, $\hat{\beta}_l$, $\hat{\beta}_d$ are estimated in the first stage. If no farms exit the sector, we can estimate consistent coefficients on capital and land in this production function using the non-linear least squares (NLLS) estimation technique.

Where we have exiting farms we also have to correct for the selection bias that this introduces. In this case, the current productivity level depends not just on the previous productivity level, but also on the farm's decision to stay in business. This leads us to the following production function in place of Equation (3):

$$\ln y_{it+1} - \hat{\beta}_0 - \hat{\beta}_l \ln l_{it+1} - \hat{\beta}_d \ln d_{it+1} - \sum_{j \in J(i)} \hat{\sigma}_j D_{ij} - \sum_s \beta_s D_{is} - \sum_m \beta_m (sh_{imt} p_{mt}) =$$
$$= \beta_k \ln k_{it} + \beta_a \ln a_{it} + \varphi(\tilde{i}_{it}^{-1}(.), \hat{P}_{it}) + \kappa_{it}$$

where $\hat{P}_{it}$ is an estimated probability of farm survival. OP uses actual market exit data to control for this term and models the probability of farm survival as a function of capital, land, investment and farm specific variables. In the absence of market exit data, we use disinvestment information as a proxy for a farms' probability of staying in business P_{it}. We assume that the probability of staying in business is not only a function of ϖ_{it} (which is the productivity threshold for exiting farming) but also of farm specific characteristics z_{it}. We estimate the probability of survival using a probit model:

$$DISINVEST_{it} = \sum \theta_z z_{it} + \Gamma_{it}(k_{it}, a_{it}) + \varsigma_{it}$$

where $\Gamma_{it}(k_{it}, a_{it})$ is a fourth order polynomial function by which we capture the ϖ_{it}; $DISINVEST_{it}$ is a dummy variable for the disinvestment decision. The predicted values of the probit model ($DISINVEST_{it} = \hat{P}_{it}$) are used to proxy the probability of survival. The capital and land coefficients can be estimated in the last step using NLLS. Similar to the first stage, $\varphi(.)$ is approximated non-parametrically by a fourth order polynomial. The estimated coefficients and Equation (2) are used to calculate the productivity term:

Once the farm specific productivity estimates are uncovered they are used to identify the extent to which the decoupling policy reform has impacted on farm productivity by regressing the estimated farm productivity terms on policy variables and controls.

$$tfp_{it} = \exp(\ln y_{it} - \hat{\beta}_l \ln l_{it} - \hat{\beta}_d \ln d_{it} - \hat{\beta}_k \ln k_{it} - \hat{\beta}_a \ln a_{it} - \sum_s \hat{\beta}_s D_{is} - \sum_m \hat{\beta}_m (sh_{imt} p_{mt}))$$

3. Data

Irish, Danish and Dutch farm data are obtained from Teagasc (the National Farm Survey) for the 2001-2007 period, the Institute of Food and Resource Economics (FOI) for the 2001-2006 period and the Agricultural Economics Research Institute (LEI) for the 2002-2007 period, respectively. Farms are selected to obtain a representative sample for each agricultural sector.

Farm output for Ireland and the Netherlands is deflated according to EUROSTAT price indices. The value of output is chosen over quantity data due to the fact that output differs in quality across farms. The deflated value of output takes into account such quality differences (Carroll et al. 2007).

Labour, capital, direct costs and land are used as the production inputs. Family, casual and hired labour are used as the labour input. The value input was chosen over a labour unit variable to control for quality differences. The quality of casual and hired labour is quite different across farms. These labour quality differences are reflected in different wage rates. The direct cost input includes expenses on concentrates, feeds, fuels, electricity, vet services/medicines and other miscellaneous direct costs. The capital input in Ireland and the Netherlands includes the estimated value (by farmer) of machines and buildings. In Denmark, buildings and machinery depreciation is used as a proxy for the capital input. All variables in the case of Ireland and the Netherlands are deflated using price indices which are available from EUROSTAT except for the Irish farmers' labour input variable which is deflated by the agricultural average wage rate (AAWR).

The Danish data used in the present paper only include full-time farms, defined as farms with a standard labour requirement of 1,665 hours or more. The prices used for deflating the Danish variables in this paper are taken from the yearly Agricultural Price Statistics from the Institute of Food and Resource Economics (LEI). For more detailed price indices and for information on the construction of the variables see Rasmussen (2008).

4. Preliminary results

4.1. Farm system switching

Tables 1 and 2 outline the number of farms that switch IN or OUT of the various systems in the agricultural sectors in Ireland and the Netherlands, respectively[1] The pattern of switching between the farming systems has not changed significantly in the aftermath of the implementation of the decoupling policy was implemented.[2]

[INSERT TABLE 1 ABOUT HERE]

There are common patterns among countries when we consdier the sorts of products which are dropped from production and the sorts of products which are added to production. After decoupling, no farmer from our sample added milk production to its production mix. Quite a few Irish, Dutch and Danish farmers abandoned milk production completely after the decoupling policy was introduced. In recent years farmers have tried to be innovative. They have added products to their production activities which are usually classified as 'other' products, such as horses, forestry, vegetables, seeds etc. Another strand of the products added to farm activities were products associated with bio-fuels such as oilseeds, wheat, etc.

[INSERT TABLE 2 ABOUT HERE]

4.2. Identifying the effect of the decoupling policy on productivity

Since it may be difficult to identify the effect of the introduction of the decoupling policy using a single dummy variable (see discussion in Section 2)[3], we consider a variety of different specifications. First, we identify the extent to which decoupling has impacted on the productivity of farmers using the following regression:

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[1] This information is not available for Danish farmers.
[2] These numbers are not completely comparable as since 2005 a new methodology was used to assign farms to a certain sector in the NFS.
[3] For example, a simple dummy variable capturing the implementation of the decoupling policy may be confounded by changing macro-economic factors, weather, environmental factors, etc..

$$\ln TFP_{it} = \alpha + \beta * qr_{it} + k_1 * ADD_{it} + k_2 * DROP_{it} + k_3 * SWAP_{it} + \\ + p_1(qr * ADD_{it}) + p_2(qr * DROP_{it}) + p_3(qr * SWAP_{it}) + \sum_{k=1}^{K} c_k Control_{kit} + e_{it} \quad (5)$$

where ADD_{it}, $DROP_{it}$ and $SWAP_{it}$ are variables indicating the switching behaviour of farm *i* (adding, dropping and swapping products, respectively) at time *t*; and qr_{it} is the decoupling rate (the ratio of total subsidies to gross output – see Equation (3)). Our control variables are: the output dummies (controlling for the unobserved demand shocks and the technological differences); the farming system dummies (controlling the technological differences); the observed demand shifters (the product of price change and the specific output share in farm production); time dummies (controlling for the omitted annual weather and macro-economical variables); and the different interactions between the decoupling rate and the farming system dummies (to ensure that the decoupling dummy does not simply capture technological differences), the interactions between the farming system dummies and time dummies (to control for the fact that the changes in macro-economic and other external factors such as weather conditions can have different impacts on different farm systems). We use the fixed effects panel estimation technique to control for the observed and unobserved time invariant farm specific fixed effects (including age, farm location, soil quality etc).

Our aim is to test whether the decoupling policy has had a positive and significant effect on farm productivity. Positive and significant coefficient estimates for p_1, p_2 and p_3 will provide strong evidence that the introduction of the decoupling policy improves farm productivity and that the productivity transmission mechanism is through farms switching from producing one type of product to a different mix of products as a result of the implementation of the policy. If we find that only the coefficient estimate for β is positive and significant, then we can conclude that the decoupling policy has a positive and significant effect on farm productivity but the productivity improvement mechanism is uncertain. In this case, productivity improvements could come from different sources such as a new more competitive agricultural product market environment, the increase in the share of more profitable products in the total production mix, etc. We check the robustness of the results by using different measures to capture the decoupling policy.

The regression results are presented in Table (3). We estimate the regression (Equation 4) using the fixed effects panel model (column 1). We also estimate the same regressions but using difference in qr_{it} (Equation 6, column 2):

$$\ln TFP_{it} = \alpha + \beta * \Delta qr_{it} + k_1 * ADD_{it} + k_2 * DROP_{it} + k_3 * SWAP_{it} + \\ + p_1(\Delta qr * ADD_{it}) + p_2(\Delta qr * DROP_{it}) + p_3(\Delta qr * SWAP_{it}) + \sum_{k=1}^{K} c_k Control_{kit} + e_{it} \quad (6)$$

and the lagged difference in qr_{it} (Equation 7, column 3):

$$\ln TFP_{it} = \alpha + \beta * lag\Delta qr_{it} + k_1 * lagADD_{it} + k_2 * lagDROP_{it} + k_3 * lagSWAP_{it} + \\ + p_1(lag\Delta qr * lagADD_{it}) + p_2(lag\Delta qr * lagDROP_{it}) + p_3(lag\Delta qr * lagSWAP_{it}) + \sum_{k=1}^{K} c_k Control_{kit} + e_{it} \quad (7)$$

The coefficients on the policy variable (qr_{it}) in column 1 of Table 3 suggest that the decoupling policy had a positive and significant effect on farm productivity in all analysed countries. As the decoupling rate qr_{it} in levels might also capture the technological differences across farms, even after controlling for the technological difference across the farm systems with the different dummies and variable interactions, we use the second specification where the policy variable is the difference in qr_{it}. The second specification findings show that the first specification results are robust for the Irish and the Dutch farm samples. These findings also support the idea that the decoupling policy had a positive effect on productivity immediately after the policy implementation, as the difference in qr_{it} captures just the annual change in the decoupling rate. The third regression specification (column 3) attempts to find evidence that the decoupling policy has had a persistent effect on productivity. However, we find no significant effect in any of the three countries. This may be due to the fact that we only have a few years of post-decoupling data and by lagging the decoupling policy variable we lose one of the decoupling policy years.

The positive and significant effect of the decoupling policy cannot be explained by the system switching channel as hypothesised in this paper. . This is evidenced by the fact that the interaction between the decoupling policy variable qr_{it} and the switching variables ADD_{it}, $DROP_{it}$ and $SWAP_{it}$ are found to be insignificant in most cases. Moreover, there is some evidence to suggest that the adding and dropping of products from the farm product mixes associated with changes in the farm specific decoupling rate may have even had a negative significant effect on productivity (for example, in the Netherlands in specification 1 and for the Netherlands and Ireland in specification 2). This result can be explained by the possibly high production adjustment costs which may be incurred after severe changes in production technologies. In contrast, we find a positive and significant effect of swapping, associated with the change in the decoupling rate ,on productivity for the Dutch farms (column 2). The swapping process might be less “painful” for farms in the short term and might produce positive results sooner as this kind of change requires lower capital and technology adjustment costs.

[INSERT TABLE 3 ABOUT HERE]

Another possible explanation as to why we struggle to find a significant relationship between productivity improvements and changes in farm system and product switching behaviour associated with changes in the rate of decoupling is farmers in these countries are simply very conservative and unwilling to alter their production behaviour as a result. In time, however, this may change. The extensive literature explaining behavioural changes due to innovations may therefore be relevant in this case. Young (2007) emphasizes that the adoption to new information (namely, innovation) should be examined in conjunction with other information about the specific nature of the process. The classic Bryce Ryan and Neal C. Gross (1943) study of the diffusion of hybrid corn in the 1920s and 1930s among Farmers in the USA shows how long it takes to adopt new technologies, what the adoption path is and what the driving forces behind the behavioural changes are. Ryan and Gross (1943) stress that natural conservatism (i.e. inertia) was one of the main factors why farmers delayed in adopting innovations which could increase their profit substantially. Using a farm survey, they reveal that, at least two-thirds of the farmers had heard about the advantages of the new technology (hybrid corn) but just less than one-tenth had adopted by 1931. It may be the case that this finding, although dated may also explain the slow behavioural changes associated with the decoupling policy found in this paper. One of the possible explanations as to why we find a positive and significant effect of decoupling policy on productivity but that product switching behaviour due to this reform does not lead to productivity improvements is that farmers start their adjustment by trying to reduce their costs without changing their production pattern, as significant changes in production patterns require high initial costs and a lot of new knowledge.

Thus, we can conclude that the positive productivity effect of the decoupling policy is transmitted through other factors such as increased competition in the agricultural product markets, increased specialisation in more profitable goods, etc. These channels will be explored further in future work.

As our analysed countries have chosen different strategies for the implementation of the decoupling policy, we have a chance to compare the outcomes of these different implementation strategies on productivity. Ireland introduced a full decoupled payment policy in 2005 based on the subsidy payments made in pre-determined reference years (2000-02). Denmark also switched to decoupling in 2005, but the decoupled payments are based on a flat-rate per hectare payment on top of an additional amount based on historical entitlements with 2000-02 as the reference period. In the Netherlands the single farm payments are based on historical entitlements from 2006. It seems that having the full decoupling based on the historical entitlements has a higher productivity improvement payoff. Since Irish farmers were more dependent on the direct subsidies than the Dutch and Danish farmers before the decoupling policy implementation it is no surprise that the coefficient of the qr_{it} is the highest for Irish farms (columns 1 and 2). Irish farmers had the biggest scope for productivity improvements post-decoupling (see Appendix 1). When we use the second regression specification (with the policy variable included as the first-difference of qr_{it}) we find that the significant effect of the decoupling policy on productivity only holds for Irish and Dutch farmers. One of the possible reasons for this result might be that the flat-rate per land unit system is very similar to the direct subsidy payment system in its nature. Farmers do not have to experience the huge administrative and psychological changes while adapting to the new policy. Thus, presumably, the Danish farmers might have thought less about the goals of this reform and how the new policy may have changed their farming incentives than their fellow farmers in Ireland and the Netherlands.[4]

[4] The fact that we have just two years data (till 2006) can be another explanation for the insignificant results for Danish farms.

Conclusions

Using the Irish National Farm Survey (NFS) and Danish and Dutch micro-data, we identify the extent to which both system and product switching after the introduction of decoupling has occurred and to what extent these changes have contributed to productivity growth of the sector.

We find strong evidence to support the fact that the decoupling policy has had positive and significant effects on productivity but product switching behaviour due to this reform is not the source of these productivity improvements. The productivity transmission mechanism due to the implementation of the CAP reform is still unclear. Possible channels for these productivity improvements include reductions in production costs due to the increased competition in the agricultural product market, increased specialization in more profitable products, etc. These channels will be explored further in future work.

A possible explanation for the inertia of farmers observed in this paper is that farmers may have started their behavioural adjustment to the introduction of the decoupling policy in less significant and less expensive ways before implementing more drastic reforms such as changing production pattern.

As our analysed countries have chosen different decoupling policy implementation strategies we have a chance to compare the outcomes of these different implementation strategies on the productivity improvement. The flat-rate per land unit system is very close in its nature to the direct subsidy payment system (in particular for tillage farms), thus Danish farmers have not experienced the huge administrative and psychological changes obvious to Irish and Dutch farmers post-decoupling Thus, we find some evidence that the implementation of the decoupling policy based on the historical entitlements was more effective than the flat-rate per hectare approach in terms of productivity improvements in the initial aftermath of the implementation of the decoupling policy.

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Tables and Figures

Table 1. System switching in the Irish agricultural sector, 2003-2007.

IN	2003	2004	2005	2006	2007	Total
Specialized dairy	15	16	13	10	18	87
Dairy other	16	29	18	26	20	130
Cattle rearing	14	28	20	29	28	136
Cattle finishing	29	21	37	55	44	199
Sheep	7	5	13	19	9	61
Cereals	9	3	0	1	10	27
Total	90	102	101	140	129	640
OUT	2003	2004	2005	2006	2007	Total
Specialized dairy	10	23	13	11	19	89
Dairy other	31	28	34	32	41	188
Cattle rearing	22	12	16	36	22	114
Cattle finishing	12	25	20	30	26	138
Sheep	9	13	11	17	19	76
Cereals	6	1	7	14	2	35
Total	90	102	101	140	129	640

Note: IN refers to the destination of the switching farm, for example, in 2005 13 farmers in the sample switched to the specialized dairy farming system.

OUT refers to the origin of the switching farm, for example, in 2005 13 farmers in the sample switched from the specialized dairy farming system to another farming system.

Table 2. System switching in the Dutch agricultural sector, 2003-2007.

IN	2003	2004	2005	2006	2007	Total
Other systems	10	10	11	13	9	53
Specialized dairy	14	6	5	6	6	37
Dairy other	12	9	12	11	14	58
Cattle	3	0	5	8	4	20
Livestock other	3	3	4	6	5	21
Cereals	6	4	3	4	5	22
Horticulture	0	4	2	2	1	9
Total	48	36	42	50	44	220
OUT	2003	2004	2005	2006	2007	
Other systems	10	11	7	17	11	56
Specialized dairy	1	7	10	8	8	34
Dairy other	16	9	12	9	12	58
Cattle	4	4	3	4	7	22
Livestock other	8	4	4	0	3	19
Cereals	8	1	3	10	3	25
Horticulture	1	0	3	2	0	6
Total	48	36	42	50	44	220

Note: IN refers to the destination of the switching farm, for example, in 2005 5 farmers in the sample switched to the dairy farming system.

OUT refers to the origin of the switching farm, for example, in 2005 10 farmers in the sample switched from the specialized dairy farming system to another farming system.

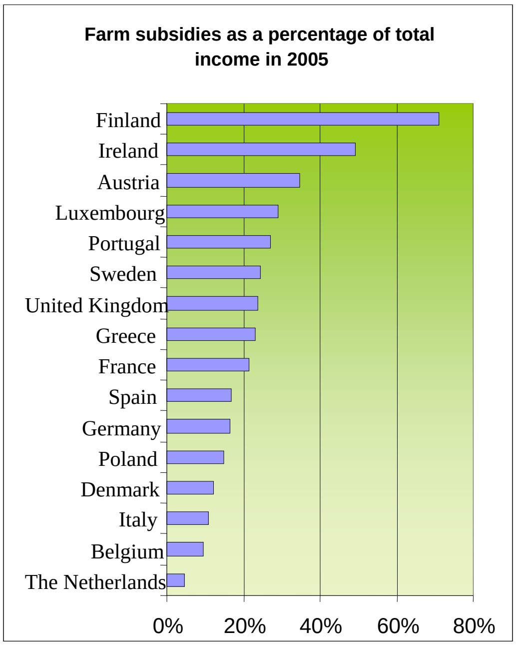
Table 3. Decoupling effect.

VARIABLES	1			2			3		
	IE	**DK**	**NL**	**IE**	**DK**	**NL**	**IE**	**DK**	**NL**
qr (decoupling rate in logs)	1.0850***	0.0614***	0.0871***	0.5072***	0.0225	0.0643***	0.044	0.0075	0.0176
	0.0511	0.0124	0.0245	0.059	0.0173	0.0216	0.0609	0.0174	0.0193
ADD	0.0147	0.0078	-0.0034	0.0108	0.005	0.0016	0.0048	-0.0075	-0.0182
	0.0181	0.0105	0.0197	0.0173	0.0103	0.0201	0.0179	0.0091	0.0219
DROP	-0.0146	-0.0285**	-0.0429**	-0.0136	-0.0313***	-0.0307	0.0014	-0.0045	0.0217
	0.0197	0.0114	0.0192	0.0178	0.011	0.019	0.014	0.0096	0.0181
SWAP	0.0298	-0.0081	0.0428	0.0097	-0.0125	0.031	-0.0031	-0.0031	0.054
	0.0315	0.0139	0.0517	0.0247	0.0132	0.0425	0.0276	0.0137	0.0609
qr*ADD	0.0407	0.0276	-0.2681*	-0.1843**	-0.0168	0.0102	-0.0226	-0.0137	-0.2082
	0.0616	0.0214	0.1418	0.0934	0.0379	0.134	0.0989	0.0321	0.1602
qr*DROP	0.062	0.0185	-0.1269	0.2721	0.0261	-0.0763**	-0.0615	0.0091	-0.0166
	0.065	0.0215	0.1277	0.1836	0.03	0.0317	0.1077	0.0263	0.0316
qr*SWAP	0.0043	0.0181	-0.7412	-0.1054	0.0686	0.6937**	0.1473	0.0633	-0.7024
	0.0759	0.0321	1.3699	0.1193	0.0553	0.2995	0.1618	0.0678	0.4465
Product dummies	y	y	y	y	y	y	y	y	y
qr*farm_system	y	y	y	y	y	y	y	y	y
Demand shifters	y	y	y	y	y	y	y	y	y
Time dummies	y	y	y	y	y	y	y	y	y
Farm system dummies	y	y	y	y	y	y	y	y	y
Time*farm_system	y	y	y	y	y	y	y	y	y
Observations	7075	3590	3319	7075	3590	3319	6284	2701	2336
Number of fc	1573	1267	1117	1573	1267	1117	1411	939	901
R-squared (within)	0.436	0.217	0.246	0.317	0.198	0.249	0.19	0.184	0.208

*Note: The panel fixed effect estimation. Robust standard errors are under coefficient estimates (*** p<0.01, ** p<0.05, * p<0.1).*

Appendix 1

Figure 1: Farm subsidies as a percentage of total farm income in 2005



Source: FADN http://ec.europa.eu/agriculture/rica/database/database.cfm