CAP Reform and its impact on structural change and productivity growth: a cross country analysis

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Motivation

- From 2005 a new financial support mechanism was introduced **decoupling** farm subsidies from production decisions.
- The decoupling of direct payments is expected to change farmers' production decisions from subsidy revenue maximization objectives to profit maximizing behaviour.
- It is expected that this change will encourage a production **switching** behaviour among farmers and increase **total factor productivity (TFP).**

Research question

- The objective of this paper is to conduct a detailed, micro-focused investigation of the implications of the recent policy changes on structural change in agricultural production systems in Ireland, Denmark and the Netherlands focusing on total factor productivity change.

Cross Country Data

- The Irish, Danish and Dutch farm level data are obtained from Teagasc (the National Farm Survey), Institute of Food and Resource Economics (FOI) and the Agricultural Economics Research Institute (LEI), respectively.

- Farms are selected to get a representative sample for each agricultural sector. The datasets contain micro level information about inputs, outputs, socio-economic and other variables.

Methodology for estimating policy effect on productivity

- **Stage 1**: development of empirical model for estimating farm productivity based on Olley/Pakes (1996) and Jan De Loecker (2009).

- **Stage 2**: we regress the estimated productivity on decoupling rate (policy variable), the production switching identifying variables and the set of the control variables.

Stage 1 – Methodology: endogeneity issues

$$\ln y_i = \beta_0 + \sum_{k=1}^{K} \beta_k \ln x_{ki} + w_i + e_i$$

- Issues estimating productivity using OLS and other methodologies:

  - simultaneity bias;

  - selection bias; and

  - observed and unobserved shocks.

Stage 1 – Methodology: key constructed variables

- The policy variable (decoupling rate) is constructed as the ratio of direct farm subsidies and farm gross output:

$$qr_{it} = \ln\left[1 - \frac{subsidies}{total\_farm\_output}\right]$$

- The observed demand shifters $sh_{imt}p_{mt}$ is constructed as the product of a certain product revenue share in total farm production and a certain product price change at time t.

$$sh_{imt}p_{mt} = revenue\_share_{imt} * price\_chage_{mt}$$

Stage 1 – Methodology: addressing simultaneity issue

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

In order to solve simultaneity bias issue we use the investment decision to control for unobserved productivity:

$$i_{it} = i_{it}(k_{it}, a_{it}, l_{it}, w_{it}, z_{it}, qr_{it}) \qquad (1)$$

$$w_{it} = i_{it}^{-1}(k_{it}, i_{it}, a_{it}, l_{it}, z_{it}, qr_{it}) \qquad (2)$$

Stage 1 – Methodology: capturing unobserved shocks

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

$$\xi_{it} = \xi_j + \tilde{\xi}_{it} \qquad (3)$$

$$w_{it} + \xi_{it} = i_{it}^{-1}(k_{it}, i_{it}, a_{it}, l_{it}, z_{it}, qr_{it}) + \sum_{j \in J(i)} \sigma_j D_{ij} + \tilde{\xi}_{it} \qquad (4)$$

$$\ln y_{it} = \beta_0 + \beta_d \ln d_{it} + \sum_s \beta_s D_{is} + \sum_m \beta_m (sh_{imt} p_{mt}) + \phi(k_{it}, a_{it}, l_{it}, i_{it}, z_{it}, qr_{it}) + \sum_{j \in J(i)} \sigma_j D_{ij} + \varepsilon_{it} \qquad (5)$$

$$\phi_{it}(.) = \beta_k \ln k_{it} + \beta_a \ln a_{it} + \beta_l \ln l_{it} + \tilde{i}_{it}^{-1}(k_{it}, i_{it}, a_{it}, l_{it}, z_{it}, qr_{it}) \qquad (6)$$

Stage 1 – Methodology: addressing selection bias issue

$$\ln y_{it+1} - \hat{\beta}_0 - \hat{\beta}_d \ln d_{it+1} - \sum_{j \in J(i)} \hat{\sigma}_j D_{ij} - \sum_s \beta_s D_{is} - \sum_m \beta_m (sh_{imt} p_{mt}) =$$

$$= \beta_k \ln k_{it} + \beta_a \ln a_{it} + \beta_l \ln l_{it} + \varphi(\tilde{i}_{it}^{-1}(), \hat{P}_{it}) + \kappa_{it} \qquad (7)$$

- The farm disinvestment information as the proxy for market exit probability:

$$DISINVESTMENT_{it} = \sum \theta_z z_{it} + \Gamma_{it}(k_{it}, a_{it}, l_{it}) + \varsigma_{it} \qquad (8)$$

- After estimating all input elasticities we can estimate total factor productivity (TFP):

$$tfp_{it} = \exp(\ln y_{it} - \hat{\beta}_l \ln l_{it} - \hat{\beta}_d \ln d_{it} - \hat{\beta}_k \ln k_{it} - \hat{\beta}_a \ln a_{it} - \sum_s \hat{\beta}_s D_{is}) \qquad (9)$$

Stage 2 - Methodology

$$\begin{aligned}
&\ln TFP_{it} = \alpha + \beta * \Delta qr_{it} + k_1 * ADD_{it} + k_2 * DROP_{it} + k_3 * SWAP_{it} + \\
&+ p_1(\Delta qr * ADD_{it}) + p_2(\Delta qr * DROP_{it}) + p_3(\Delta qr * SWAP_{it}) + \\
&+ s1 * \Delta Milk_Share + \sum x1_s (\Delta Milk_Share * farm_system) + \\
&+ s2 * \Delta Cattle_Share + \sum x2_s (\Delta Cattle_Share * farm_system) + \\
&+ s3 * \Delta Crop_Share + \sum x3_s (\Delta Crop_Share * farm_system) + \\
&+ \sum_{k=1}^{K} c_k Control_{kit} + e_{it}
\end{aligned}$$

Defining farm switching behaviour:

- Adding and dropping products from the farm production basket
- Swapping products
- The change of a certain product's share in total farm total production

Results (1)

$$\ln TFP_{it} = \alpha + \beta * \Delta qr_{it} + k_1 * ADD_{it} + k_2 * DROP_{it} + k_3 * SWAP_{it} +$$
$$+ \sum_{k=1}^{K} c_k Control_{kit} + e_{it}$$

VARIABLES			
	IE	DK	NL
Δqr (policy variable)	0.8807***	0.2708***	0.2359**
ADD	0.0152	0.0127	-0.0244
DROP	-0.0076	0.0053	-0.0236
SWAP	-0.0047	0.0316**	0.0885
Product dummies	y	y	y
Demand shifters	y	y	y
Time dummies	y	y	y
Farm system dummies	y	y	y
Time*farm_system	y	y	y
Observations	6284	2701	1255
Number of farms in sample	1411	939	430
R-squared (within)	0.256	0.233	0.194

Results (2)

VARIABLES	IE	DK	NL
Δqr (policy variable)	0.7804***	0.1583*	0.1917
ADD	0.0031	0.0103	-0.013
DROP	-0.0159	0.0002	-0.0424*
SWAP	0.0066	0.0300**	0.0537
Δqr*ADD	0.5804	0.0864	-0.6912
Δqr*DROP	0.0984	0.1179	-0.1792
Δqr*SWAP	-0.1542	0.2503*	-1.4762**
Milk_share	-0.3819	0.1335	0.2814
Milk_share*Cattle1_system	0.0156	-	-
Milk_share*Cattle2_system	0.3111	-	-1.6236
Milk_share*Sheep_system	0.7106**	-	-
Milk_share*Tillage_system	1.0556**	0.5113**	-7.0139**
Milk_share*SpecDairy_system	0.5743		-0.5795
Cattle_Share	-0.9977***	-	-0.5160
Cattle_share*Cattle1_system	0.596	-	-
Cattle_share*Cattle2_system	1.0683**	-	-0.7539
Cattle_share*Sheep_system	0.7894*	-	-
Cattle_share*Tillage_system	1.3207***	-	-3.5015
Cattle_share*SpecDairy_system	1.3153***	-	0.6757
Crop share	-0.6626**	0.0786	-3.2943**
Crop_share*Cattle1_system	1.2699	-	-
Crop_share*Cattle2_system	1.7360**	-	0.4113
Crop_share*Sheep_system	0.0829	-	-
Crop_share*Tillage_system	0.7115*	0.0191	2.9654*
Crop_share*SpecDairy_system	1.4431**	-	2.6130
CONTROLS	Y	Y	Y
Observations	5455	2701	1114
Number of farms in sample	1314	939	397
R-squared	0.286	0.251	0.386

$$
\begin{aligned}
\ln TFP_{it} &= \alpha + \beta * \Delta qr_{it} + \\
&+ k_1 * ADD_{it} + k_2 * DROP_{it} + k_3 * SWAP_{it} + \\
&+ p_1(\Delta qr * ADD_{it}) + \\
&+ p_2(\Delta qr * DROP_{it}) + \\
&+ p_3(\Delta qr * SWAP_{it}) + \\
&+ s1 * \Delta Milk\_Share + \\
&+ \sum x1_s(\Delta Milk\_Share * farm\_system) + \\
&+ s2 * \Delta Cattle\_Share + \\
&+ \sum x2_s(\Delta Cattle\_Share * farm\_system) + \\
&+ s3 * \Delta Crop\_Share + \\
&+ \sum x3_s(\Delta Crop\_Share * farm\_system) + \\
&+ \sum_{k=1}^{K} c_k Control_{kit} + e_{it}
\end{aligned}
$$

Conclusions

- 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.

- We find some evidence that changing certain product share in total farm output might be an important productivity transmission mechanism of decoupling policy.

Thank you!