Organic Farming Policies and the Growth of the Organic Sector in Denmark and the UK: A Comparative Analysis

Carsten Daugbjerg, Richard Tranter and Garth Holloway

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Carsten Daugbjerg (corresponding author)[1], Richard Tranter[2] and Garth Holloway[3]

[1] Department of Political Science, University of Aarhus, Universitetsparken, DK-8000 Aarhus C, Denmark, E-mail: cd@ps.au.dk

[2] School of Agriculture, Policy and Development, University of Reading, P O Box 237, Earley Gate, Reading RG6 6AR, United Kingdom, E-mail: r.b.tranter@reading.ac.uk
E-Mail: garth.holloway@reading.ac.uk

Abstract – **There has been little systematic analysis of the extent to which organic farming policies have influenced growth in the organic sector. Analyses of organic farming policy instruments, for the most part, provide extensive and detailed reviews of instruments applied either in a single country or across countries. Hence, there is a great need to examine systematically whether there is a relationship between the introduction of organic farming policies and the growth of the organic food sector, and whether particular designs of organic farming policies are more effective than others. In this paper, we take the first step in the endeavour of analysing the effects of organic farming by undertaking an econometric analysis of the relationship between organic farming policies in Denmark and the UK and their effects on the number of farmers and growers converting to organic production.**

Topics: (1) sustainability, (2) institutions, (3) environment and resources

Key words: organic farming, policy

I. INTRODUCTION

There has been little systematic analysis of the extent to which organic farming policies have influenced growth in the organic sector. Analyses of organic farming policy instruments tend to provide extensive and detailed reviews of instruments applied either in a single country or across countries, but offer no theoretically informed considerations on what mix of policy instruments contribute most to the growth of the organic sector. For instance, Lampkin *et al.* (1999 p.vii) list the forms of state 'support' to organic sectors under four categories: payments to producers; marketing and regional development; legal definition of organic; and information provision. Other, but not dissimilar, studies have analysed the extent to which organic farming policies have motivated farmers to convert into organic production (e.g. Michelsen 2002) or affected the economic viability of such farms (Colman 2000, Häring 2003, Tranter *et al.* 2007). Häring *et al.* (2004, 25) observe that the development stage of organic farming varies significantly across European countries and argue that 'different design of subsidies for organic farming greatly influences the actual effect on organic farming development'. However, it is less clear precisely how these policy instruments bring about growth in the organic sector.

So, there is a great need to examine systematically whether there is a relationship between the introduction of organic farming policies and the growth of the organic sector, and whether particular designs of organic farming policies are more effective than others. Here, we take the first step in the endeavour of analysing the effects of organic farming policies in Denmark and the UK. We attempt to establish whether state organic farming policies affected farmers' willingness to convert to organic farming and which measures had a significant impact.

II. COMPARISON OF DANISH AND UK ORGANIC FARMING POLICIES

In this section, we provide an overview over organic farming policies in Denmark and the UK, distinguishing between four types of policy instruments: direct supply-side policy instruments, indirect supply-side policy instruments, direct demand-side policy instruments and indirect demand-side policy instruments.

A. Direct supply-side policy instruments

In both countries, direct supply side policy instruments have been pivotal in the development of organic farming policy.

Denmark: Denmark was the first country to enact a distinct law on organic farming (1987). It introduced subsidies to ease conversion from conventional to organic farming for the first three years of the conversion period. In 1989, additional conversion payments for organic livestock were introduced.

As a consequence of implementation of EC Regulation 2078/93, permanent subsidies for organic farming were introduced in 1994 (see Table 1). This scheme provided conversion subsidies, based on area, for *two* years and permanent organic subsidies. To be eligible, farmers had to farm organically for at least five years.

Table 1. Danish organic area payments, 1994-1997 (DKK per hectare)

Year	1994	1995	1996
Conversion payment	300	275	200
Permanent organic payments	750	600	450
Payment for reduced fertiliser use	650	525	400
Supplement for environmentally sensitive areas	215	215	215

Source : Bekendtgørelse no. 250, 1994.

To increase the supply of organic arable products and pig meat, the subsidy was altered in 1996 (Table 2). Additional support was provided to organic farms without milk quotas and a special subsidy to pig producers was also introduced (Strukturdirektoratet 1999, 136). In 2000, it was decided that support schemes directed at selective commodity groups had to be abolished. The market was perceived as a better means to determine the level and type of organic production. In the support scheme which came into effect in 2004, permanent organic subsidies were abolished and farmers were paid an environmental subsidy with organic farming being given first priority for this. The only remaining organic subsidy was the general conversion payment to which only non-dairy farmers were eligible. Up to 2007 there was no wish to increase organic milk production so dairy farmers were not eligible for conversion subsidies. However, in 2006 forecasts envisaged future under-supply of organic milk so dairy farmers again became eligible for conversion subsidies.

Table 2. Danish organic area payments 1997-2003 (DKK per hectare)

Year of five year obligation period	1	2	3	4	5
Permanent organic payments[4,6]	600	600	600	600	600
Conversion payment[5,7]	450	450			
Supplement for environmentally sensitive areas	500	500	500	500	500
Payment for farms without dairy quota	2000	2000	1200[1,3]	500[1,3]	500[1,3]
Payment for pig production[2]			2000	2000	2000
Maximum area payment	5000	5000	4000	3500	3500
Maximum payment for pig farms	5000	5000	5000	5000	5000

Source: Bekendtgørelse 226 1997; 881 1998; 883 2002; 700 2007, Direktoratet for FødevareErhverv 2002, *Økologisk Jordbrugsproduktion: Vejledning om arealtilskud 2003*.

[1] Not paid to pig farmers.

[2] This payment expired on 2 November 2002.

[3] This payment was introduced in December 1998. It was not paid for the five-year period that followed.

[4] 850 DKK until December 1998.

[5] 200 DKK until December 1998.

[6] Before 1 January 1998 this payment was not paid to permanent grass fields.

[7] Not paid to permanent grass fields.

UK: Before 1993, Tranter *et al*. (2008) argued that 'development of the European (and UK) organic sector was predominantly supply driven' growing from two broad strands - an ideological method of food production and the encouragement by scientists interested in the link between soil and health. However, since then the growth of organic farming has been largely demand led to satisfy increasingly affluent consumers (Willer, 2006); the UK government has encouraged farmers to meet this demand and, to help them through the difficult conversion years, has provided financial assistance. The Organic Aid Scheme (OAS) was the first such measure introduced in 1994 following EC Council Regulation 2078/92 allowing Member States to provide financial support for conversion under the agri-environment regulation (EC, 1992).

However, rates of payment under the OAS were relatively low compared with other countries and uptake was poor. Therefore, a new scheme was designed to encourage further conversion - the Organic Farming Scheme (OFS) which replaced the OAS in April 1999 - a move concurrent with the amendment of EC Regulation 2092/91 to include livestock. The OFS was seen as more helpful than the OAS: a one-off lump sum payment was made of €750 per holding, spread over three years for purchase of consultancy advice; and (Table 3) payment rates were much higher than under the OAS.

Table 3. Organic Farming Support Payments for England 1994-2007 (€ ha^{-1})[1]

	OAS[2] 1994-9	OFS[3] from 1999						OAP[4] 2003-
	Total	Y1	Y2	Y3	Y4	Y5	Total	Y1-5
AAPS[5] eligible land and land in permanent crops	409	368	220	82	33	33	736	49
Other improved land	82	286	172	65	25	25	573	38
Unimproved land[6]	60	41	17	8	8	8	82	8

Source: Adapted from Tranter *et al.* (2007).

[1] The exchange rate for 1 April 2002 of £1 = €1.04 has been used.

[2] Organic Aid Scheme

[3] Organic Farming Scheme

[4] Organic Action Plan amendment to OFS, ongoing support once conversion completed

[5] Arable Area Payments Scheme

[6] Such as moorland, rough grazing land and heath

The OFS was immediately successful leading to an increase of some 150,000 ha in the area of organically managed land in nine months. Indeed, the scheme was forced to close after six months when the budget allocated for the first two years was spent up (Lobley *et al.*, 2005). It reopened in January 2001.

In June 2003, on-going support after conversion was introduced for a period of five years (Table 3). It is likely that this on-going support was the cause of numbers of producers and growers rising despite the organic area falling since mid-2003.

The OFS closed to new entrants in March 2005 and replaced by Organic Entry Level Stewardship, part of the new Environmental Stewardship Scheme. The rationale for this was that organic farming provides greater environmental benefits than conventional farming. Hence, organic farmers receive €98 per ha per year (twice the conventional rate) and have to farm in a prescribed manner for five years. Payments are also available for conversion with different rates for different types of land and planned land uses (Defra, 2007e).

B. Indirect supply-side policy instruments

Denmark: In 1984 the National Association for Organic Farming agreed with the Smallholders' Union on the provision of an organic advisory service. Once an organic extension service had been integrated into the established advisory service, the Smallholders' Union utilised its parliamentary contacts to have state financial support for employing organic farming advisors.

In 1996, funding was provided for additional advice to farmers who were considering converting to organic farming and, in 1997, a scheme was introduced in which the state provided for 90% of the cost of conversion advice 12 months before and after conversion. In the mid-1990s, the state also provided funding for teaching and information activities for organic farming and the publication of organic farming manuals. Furthermore, compulsory courses were introduced at farming colleges (Strukturdirektoratet 1999, annex 1, 6-10).

An important component of Danish organic farming policies has been state-funded research. In 1992, 50 million DKK for an organic research programme for 1993-1997 was allocated (Strukturdirektoratet 1999). In 1996 the Danish Research Centre for Organic Farming was established to coordinate research. The most recent programme had a budget of 200 million DKK for 2005 to 2011 (http://www.foejo.dk/forskning/index.html).

The Product Development Scheme provided increased funding for organic product innovation projects in relation to production and processing. Innovation projects for processing organic produce were also eligible for increased support under the Food Technology Research Programme (Strukturdirektoratet 1995, 154-55).

UK: Some financial, technical and marketing advice was belatedly made available in the UK from June 1996. As a result of the poor uptake of the OAS, the Government introduced the Organic Conversion Information Service (OCIS) which supplied free, on-farm, technical advice and information on conversion. By 2001, 6,500 farmers had received a half-day visit under OCIS and 2,400 farmers also made use of the follow-up full day consultancy (Defra, 2002b). The OFS, introduced in April 1999 gave a one-off lump sum of €750 per holding, spread over three years, for the purchase of consultancy advice.

Due to budgetary constraints, Defra closed the OCIS on 31 December 2006. However, they said they intended to re-open it in the future (Defra, 2006). Finally, a further measure introduced by Government to aid organic farming was the publication of the 'Action plan to develop organic food and farming in England' (Defra, 2002b) to identify what was needed to ensure stable and strategic growth for the organic sector.

The Government has funded research on organic production since 1991 when their spend was some £500,000; in the 10 years after this it rose five times to around £2.5 million a year (Costigan, 2002). In an investigation for Defra, the Elm Farm Research Centre et al. (2005) found that: 'total funding in UK organic food and farming R&D between January 2000 and March 2005 was in the region of £45 million with the majority coming from the public purse (90%)'. Most of this was experimental with crops research being the most heavily funded area.

C. Direct demand-side policy instruments

Neither Denmark nor the UK apply direct demand-side policy instruments. However, in Denmark, it has been suggested that state, regional and local government canteens should only use organic produce. So far, government has refused to introduce such regulations.

In the UK, Defra (2004) reviewed their original 'Action plan' to check on progress two years on. They put forward ideas on how there should be an increase in public procurement of organic food and measures for the whole UK increasing the level of indigenous sourcing of organic produce to 70% of the total by 2010. The major UK certification body announced their expertise and availability for the provision of advice on public procurement of organic food matters (Soil Association 2006b).

D. Indirect demand-side policy instruments

Denmark: The Law on Organic Farming of 1987 set up state certification and labelling for organic farming. The state label is the sole national organic label and can only be applied by enterprises producing, processing, packaging or labelling organic produce in Denmark. The introduction of the state label meant that only state-certified farms would be allowed to sell organically labelled products and receive state support. This caused some aggravation within the National Organic Farming Association (Nielsen 2005, 76-78) but, as the state label became a success, the Association's dissatisfaction vanished. In 2002 and 2004, state funding was provided to information campaigns about the national state label and the EU label. Farmers do

not pay for certification and inspection; the costs of operating the system are part of the involved agencies' annual budget.

In addition to providing conversion subsidies, the 1987 Law on Organic Farming also granted financial support for development initiatives related to processing, marketing and distribution of organic food. From 1996-99, the state spent 100 million DKK subsidising market research, product development and marketing of organic produce. After 1999, the state continued providing such support but funds allocated for these activities declined from a peak of 97 million DKK in 2000 to 10 in 2005, but were increased again in 2007 to 40 million DKK. Between 1997 and 2000, the state allocated 20 million DKK for training and other conversion activities in state, regional and local government canteens which wanted to use organic produce (Strukturdirektoratet, 1999, 28). After 2000, this programme was retained as part of the Innovation Act (Bekendtgørelse no. 318, 2001 and Bekendtgørelse no. 865, 2006). The School of Organic Sales received support to provide advice to these institutions and, since 1998, the Veterinary and Food Safety Agency has launched information campaigns on organic food directed towards consumers, retailers and processors (ibid., 26, see www.dffe.dk)

UK: In 1987, the Ministry of Agriculture, Fisheries and Food founded the UK Register of Organic Food Standards (UKROFS) to set baseline organic standards and to approve and monitor the work of certification bodies (Defra, 2002a). UKROFS standards were the minimum standards which applied in the UK and were based on EC regulation 2092/91 (EC, 1991). UKROFS was succeeded in July 2003 by the Advisory Committee of Organic Standards which provides government departments with advice on key areas relating to organic production (Defra, 2007a). The Soil Association is by far the most important certification body in the UK certifying over 80% of all organic food being sold in the UK. They inspect and license over 4,400 organic producers and manufacturers (Soil Association 2006a).

E. Comparison of organic policy instruments between Denmark and the UK

Table 4 compares Danish and UK organic farming policy instruments. It shows that such policy measures were introduced 7 years earlier in Denmark than in the UK and that the Danish government applies a greater variety of policy instruments. Indirect supply-side policy instruments play a much greater role in Denmark than in Britain, and did so early on in the rise in the organic sector. Also, with the exception of state accreditation of certification and labelling, the Danish state is significantly more involved in creating demand for organic produce through the introduction of a variety of indirect demand-side policy measures. The importance given to demand-side and indirect supply-side policy measures becomes clear when comparing the funding for conversion and permanent organic subsidies provided to farmers with those granted to development projects. From 1988-94, 58% of the outlays under the Law on Organic Farming were spent on such measures and only 42% on conversion and permanent subsidies for farmers. Within the first two years after the introduction of subsidies for organic

Table 4. A comparison of organic farming policy typology between Denmark and the UK

Supply-side policy instruments (push)		Demand-side policy instruments (pull)	
Direct	Indirect	Direct	Indirect
Denmark: • Conversion subsidies introduced in 1987. Additional conversion subsidies for arable and pig farmers introduced in 1996. • Permanent organic subsidies introduced in 1994. UK: • Conversion subsidies introduced in 1994; increased in 1999. • On-going organic subsidies introduced in 2003	Denmark: • Subsidies for organic extension introduced in 1984. • Support for education of organic farmers introduced in 1995. • Grants for organic research introduced in 1992 . UK: • Limited subsidies for technical assistance introduced in 1996. • Free conversion advice introduced in 1996. • Further subsidy of technical advice in 1999.	Denmark: • None UK: • None	Denmark: • State certification and labelling introduced in 1987; fully operational in 1989. • State sponsored market research and marketing campaigns from 1988. UK: • State accreditation of certification schemes and labels in 1987. • Limited subsidies for marketing advice introduced in 1996.

farming, approximately 50% of the outlays went to development projects (Strukturdirektoratet 1995, 162). However, as a result of the conversion waves of the mid- and late 1990s, farm subsidies consumed most of the budget for organic policy from 1997 onwards.

III. Assessing the impacts of organic policy milestones empirically

Organic policy measures, or milestones, have been considerable both in terms of complexity and in terms of their intentions in both countries. And, while no clear thematic developments emerge about their general direction, their coverage and their precise influence on decisions by producers to switch from conventional to organic production, the availability of data concerning the timing of events and the numbers of producers in the organic and non-organic subsectors, raises considerable scope for nuanced empirical enquiry.

Table 5 presents the data we used where it can be seen that, in both study countries, the number of organic producers and growers grew by at least 20 times in around 20 years. Thus, there does appear to be some relationship between the ever-increasing numbers of organic producers in both the Danish and British agricultural sectors and the cumulative impacts of the separate policy measures or milestones as we eyeball the series in Table 5. Whether these trends are part of any systematic factors in either sector, or collectively, is the matter we now take up in detail.

IV. Methodology

We interpret the data in three ways, where each is linked with an over-arching common theme - that the possibility exists that the separate policy milestones have incrementally contributed to the growth of the organic farming sectors in the UK and Denmark. In order to assess this conjecture, we incorporate the data using three alternative estimation vehicles. The first is a simple linear regression with a binary variable indicating the range of time over which each milestone was enacted or in operation. Several of the policy milestones continue in coverage throughout the endpoint of the range of the time series in question, which is the period of monthly observations from 1989:1 to 2007:1 (217 in total); others existed for shorter periods. At interest, then, is the set of stepped response functions that we manufacture for the purpose of measuring a linear response in the regression relationship with numbers of organic producers as the right-hand side response.

A concern in this context is the fact that only 18 response points exist for the various months. As detailed in the methodological appendix, we treat the missing values as latent data in the linear regressions. On the right-hand side marketing-sales assistance for organic producers is missing at one point, so we use the average of the preceding and following periods.

Table 5. Area of organically managed land, number of organic producers and organic policy milestones, Denmark and UK, 1989-2007

Year	Organic land area ('000 ha)	Organic producers and growers	Organic policy milestones
United Kingdom			
Oct 89	18.3	557	
Apr 93	30.4	655	EC Reg 2092/91 became effective 23 Jul 92
Feb 94	30.7	715	Organic Aid Scheme (OAS) introduced 1 Aug 94
Apr 95	45.2	828	
Apr 96	48.2	865	Organic Conversion Information Service (OCIS) introduced 1 Jul 96
Apr 97	50.8	828	
Apr 98	81.9	1064	
Apr 99	276.0	1568	OAS closed & Organic Farming Scheme (OFS) introduced 1 Apr 99. OFS closed 1 Oct 99. EC Reg 2092/91 amd to include livestock 1 Jul 99
Jan 00	425.9		
Dec 00	527.3	2865	
Dec 01	679.6	3691	OFS reopened 1 Jan 01
Jun 02	699.9	3865	
Dec 02	724.5		
Mar 03	741.2	4104	Ongoing support under Organic Action Plan introduced 1 Jun 03
Jan 04	695.0	4072	
Jan 05	674.5	4321	Organic Entry Level Scheme introduced 1 Apr 05 & OFS closed 31 Mar 05
Jan 06	619.9	4285	OCIS closed 31 Dec 06
Jan 07	619.8	4639	
Denmark			
			15 Jan 88: organic area conversion subsidies are introduced
1989	9.6	401	15 Jan 89: livestock subsidies introduced
1990	11.6	523	
1991	18.0	672	
1992	18.6	675	
1993	20.0	640	1 Jan 93: extension & advisory service introduced
1994	21.1	676	16 Apr 94: permanent organic subsidies introduced; livestock subsidies abolished
1995	40.9	1050	
1996	46.2	1166	
1997	64.3	1617	27 Mar 97: special conversion subsidy for pig producers introduced; and for farms without dairy quota introduced
1998	99.2	2228	
1999	146.7	3099	
2000	165.3	3466	
2001	173.5	3525	
2002	178.4	3714	2 Nov 02: special conversion subsidy for pig producers abolished
2003	168.0	3510	1 Nov 03: special conversion payment for farms without dairy abolished; a basic scheme for permanent and conversion subsidies retained; dairy farmers no longer eligible to conversion subsidies
2004	160.2	3166	
2005	150.8	3036	
2006	144.3	2794	

Table 6. Empirical results

Coefficients	OLS-UK			OLS-Denmark			Seemingly Unrelated Regressions		
1	-0.12	0.03	0.19				**0.23**	**0.26**	**0.29**
2	-0.17	0.01	0.20				-0.03	0.01	0.05
3	-0.11	0.04	0.18				-0.03	0.01	0.05
4	-0.04	0.08	0.20				-0.01	0.03	0.07
5	**0.19**	**0.32**	**0.45**				-0.03	0.02	0.07
6	**0.31**	**0.51**	**0.70**				-0.06	-0.01	0.05
7	-0.17	-0.04	0.09				-0.00	0.04	0.09
8	**0.06**	**0.28**	**0.50**				**0.01**	**0.08**	**0.15**
9				-0.19	-0.00	0.19	-0.07	0.12	0.32
10				-0.07	0.11	0.29	-0.04	0.15	0.34
11				-0.20	-0.02	0.16	-0.03	0.04	0.10
12				-0.00	0.24	0.49	-0.03	0.17	0.37
13				-0.15	0.03	0.22	-0.11	-0.03	0.05
14				**0.10**	**0.34**	**0.59**	-0.02	0.07	0.17
15				**0.33**	**0.46**	**0.61**	**0.05**	**0.11**	**0.17**
16				-0.02	0.28	0.58	-0.13	-0.04	0.06
17				**0.06**	**0.18**	**0.30**	-0.04	0.01	0.06
18	**0.06**	**0.09**	**0.14**				**0.00**	**0.01**	**0.01**
19				**0.06**	**0.09**	**0.14**	**0.01**	**0.01**	**0.02**
20							-0.00	-0.00	0.00

'1. UK constant
'2. EC Reg 2092/91 became effective 23 Jul 92',...
'3. Organic Aid Scheme introduced 1 Aug 94',...
'4. (OCIS) introduced 1 Jul 96',...
'5. Organic Farming Scheme introduced 1 Apr 99',...
'6. EC Reg 2092/91 amd to include livestock 1 Jul 99',...
'7. Ongoing support under Organic Action Plan introduced 1 Jun 03',...
'8. Organic Entry Level Scheme introduced 1 Apr 05',...
'9. Denmark constant
'10. Jan 89: livestock subsidies introduced',...
'11. Jan 93: extension & advisory service introduced',...
'12. Apr 94: permanent organic subsidies introduced',...
'13. Mar 97: special conversion subsidy for pig producers',...
'14. Mar 97: special conversion subsidy for farms without dairy quota',...
'15. Mar 97 basic scheme for permanent and conversion subsidies retained',...
'16. marketing costs and expenditures',...
'17. marketing dummy for period 2001-2004')
'18. the variance parameter in the UK model.
'19. the variance parameter in the DK model.
'20. the cross-country correlation between UK and DK errors in the regressions.

V. RESULTS AND CONCLUSIONS

In the first model, we estimate separate regressions for the Danish and UK time series obtaining the results reported in Table 6. In this Table, column 1 indexes the policy milestones explained at the foot of the table; columns 2-4 report results for the OLS regression for the UK; columns 5-7 report OLS results for Denmark; and columns 8-10 report the results of estimation of a system of seemingly-unrelated regressions for the combined UK and Danish data. Within each estimation the centre column reports posterior means of the regression coefficients and the left- and right-side entries report the 90% highest posterior density (hpd) intervals. In this context, it is important to note that 90% hpd intervals that do not cross zero assert with 90% probability that the policy milestone in question has the same sign as the posterior mean. The relevant milestones in this context are emboldened. In the initial UK regression policy milestones 5, 6 and 8 are significant; and in the initial Danish regression policy milestones 14, 15 and 17 are significant. In the pooled-data regression, only milestones 1 and 8 are significant for the UK and only milestone 16 is significant fort Denmark. The other observation that is noteworthy is that the introduction of cross-country equation error affects many of the locations and scales of the relevant posterior density measures. Viewed collectively, indications are available that some of the policy milestones had their desired intentions, whereas others have not, at least with the evidence available to us at this present time. In particular, we observe rather large increments in organic entry attributable to the Organic Farming Scheme introduced (April, 1999), the amendment to EC Reg 2092/91 to include livestock (July, 1999) and the Organic Entry Level Scheme (April, 2005); and in Denmark, we observe sizable entry increments attributable to the special conversion subsidy for farms without dairy quota and the basic scheme for permanent conversion subsidies retention (March, 1997) and, importantly, the appearance of assistance for organic producers (2001-2004). Whether these conclusions remain robust to nuanced empirical enquiry remains to be seen. Presently, the statistical responsiveness of organic entry to some of the various milestones suggests that additional work is certainly warranted.

Appendix

The basic situation being considered is as follows. We observe a response z_i conditioned by the step functions in the linear regression: $z_i = \mathbf{x}_i'\beta + \square_i$, i = 1, 2, .., N; where $\mathbf{z}_i \equiv (z_i, z_{i2}, .., z_N)'$ denotes an N-vector of latent responses; $\mathbf{x}_i \equiv (x_{i1}, x_{i2}, .., x_{iK})$ denotes the K-vector of 'steps;' and $_i$ denotes a random disturbance assumed to be normally distributed with zero mean and variance given by σ^2. Stacking over respondents leads to the system: $\mathbf{z} = \mathbf{x}\beta +$, where $\mathbf{z} \equiv (z_1, z_2, .., z_N)'$; $\mathbf{x} \equiv (\mathbf{x}_1, \mathbf{x}_2, .., \mathbf{x}_N)'$ denotes the N×K matrix of the step covariates; and $\equiv (\square_1, \tilde{\square}_2, \square_M)'$ denotes the N×1 vector of random disturbances. Given the missing data assume position on the left-hand side of (2), a procedure for implementing the model follows directions outlined in Gelman, Carlin & Rubin (1992). In the case where the errors in the separate equations corresponding to DK and UK agriculture are assumed to be correlated, the system in (2) can be implemented in Zellner's (1962) seemingly unrelated regression framework.

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