The Influence of Market and Agricultural Policy Signals on the Level of Organic Farming

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Abstract

Over the last two decades, organic farming has moved from a form of agriculture on the fringe of society to a situation where its products are now stocked in many supermarkets around the world. This paper aims to analyse the relationship of market signals and agricultural policy signals on the level of organic farming, with a cross-country analysis in two key years, 1990 and 2001. Evidence is provided of the key importance of public organic agricultural extension support, organic agricultural research and development (R&D), the availability of marketing and sales outlets for organic produce and countries' environmental regulations in positively driving the adoption of organic agriculture by farmers. Empirical evidence seems to indicate that agricultural policy signals influence the level of organic farming more than market signals.

Introduction

The strength and growth of organic agriculture in the last decade and a half has surprised many commentators. It has moved from a form of agriculture on the fringe of society to one where its products are now stocked in many supermarkets around the world. It is often argued that organic agriculture is said to be the only sector of agriculture that has developed under truly free market conditions (MacRae *et al* 1990). In one sense this statement is correct, especially looking back twenty years or so, but lately numerous policies have been designed (mainly in Europe) to positively influence organic agriculture's growth. The individual importance of such policies is unclear. This paper seeks to analyse the relationship between these policies and market signals on countries share of organic agriculture.

Certified organic agriculture is now practised in more than 110 countries worldwide. In 1986 there were 0.12 million hectares of organically managed land in Europe, rising to 1.2 million hectares in 1996. Organic farming currently varies between 0.22 to 26% of total agriculture in Europe, and average annual growth is forecast at 20 to 40%. The leaders in organic agriculture are predominantly Austria, Switzerland and Scandinavian countries. Sweden is aiming for 20% of its agriculture to be organic by 2012, while Austria is aiming for 30% by the same time. Nearly 80% of the expansion in organic farming has taken place since the late 1990s (Willer and Yussefi 2005 and 2006).

There are many potential drivers of organic farming. Most economic research has concentrated on individual farmer influences (Wynen 1988, Rigby *et al* 1999, Kasterine 2001, Burton *et al* 2003), and has not always considered wider country

factors. Past research has suggested the importance of market signals (Padel *et al* 1999, Lohr and Salomonsson 2000) and agricultural policy signals (Padel *et al* 1999, Søgaard 1999, Lohr and Salomonsson 2000, Michelsen and SØgaard 2001, Watson and Atkinson 2002, DEFRA 2002, Burton *et al* 2003, König 2004, de Lauwere *et al* 2004) in influencing organic farming. This paper attempts to quantify the influence of market and agricultural policy drivers, as well as considering other political (such as corruption and freedom of a country) and ecological (environmental regulation and conditions) influences.

Methodology

The empirical analysis uses cross-country data from 61 countries for the years 1990 and 2001.[1] These are the same 61 countries that were used in Eliste and Fredrikkson (2002), who generously provided their datasets to the author.[2] Data was also obtained from Damania *et al* (2003), World Bank (2006), various Organic Agriculture Worldwide publications and Lampkin (2006). The regressions from 1990 and 2001 are compared and contrasted to see if there are fundamental differences. As at 1990, certified organic farming was present mainly in developed countries, while by 2001 the picture had changed dramatically. The differences in the measurement of some key variables meant that pooling the datasets was not possible, hence they are presented separately. The cross-country regression for 2001 is then augmented with other explanatory variables not available for the 1990 model. Ordinary least square (OLS) and tobit analysis (which is estimated via maximum likelihood estimation) was used. Table 1 defines the variables used in the models and their sources.

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1 The difficulty in obtaining data on environmental standards and agricultural policy limited the years within which the analysis was conducted.

2 Excluding Bhutan (limited organic farming information was available). Eliste & Fredriksson evaluated the influences on countries agricultural environmental stringency in 1990.

Table 1: Variable Definition and Data Sources

Variable	Definition and Source	Sign
OAP01 & OAP90	Organic farming land share as a % of total agric. land in 1990 & 2001 Sources: Yussefi and Willer (2002 & 2003), Willer and Yussefi (2000, 2001 & 2005), De Castro *et al* (2001), Lampkin (2006), SŐL (2006), Häring *et al* (2004), Lampkin *et al* (1999)	
Agricultural Policy Signals		
STANDARDSYRS90 STANDARDSYRS01	Time the country had national organic standards in place Source: As above	+
LEGALYRS90 & LEGALYRS01	Time the country had legal standards defining "organic" Source: As above	+
SUBSIDYYRS90 & SUBSIDYYRS01	How many years the country had subsidies for organic farming Source: As above	+
EXTENSIONYRS90 EXTENSIONYRS01	Time the country had extension support for organic farming Source: As above	+
R&D01	A dummy variable for organic agricultural research funding Source: As above	+
Market Signals		
OECD90 & OECD01	Dummy variable for membership of OECD Sources: Eliste & Fredrikkson (1999 & 2002) and OECD website	+
GDPPC90, GDPPC90 & GDPPC290, GDPPC201	Gross domestic product per capita Gross domestic product per capita squared (LGDPPC = GDP logged) Source: World Development Indicators (2006)	+
SUPERMKTYRS90 & SUPERMKTYRS01	Time the country had organic product presence in supermarkets Source: As above	+
Other		
STRING ESI01	Index of stringency of environmental regulations for agric. sector in 1990 Environmental sustainability index 2001 (higher levels indicate better environ.) Sources: Eliste & Fredrikkson (1999 & 2002) (datasets provided),World Economic Forum *et al* (2001)	+ +
LEAD90 & LEAD01	Lead content allowed per gallon of gasoline Sources: Damania *et al* (2003), Lovei (1998), Thomas (1995), UNEP(2003)	-
FREE90 & FREE01	Two indexes from Freedom House (Political Rights and Civil Liberties) are added together for a measure of how free a country is, for 1990 and 2001. Sources: Eliste & Fredrikkson (1999 & 2002) and Freedom House (2006)	+
CORR90 CORR01	Corruption measure by International Country Risk Guide (higher levels indicate lower corruption) Source: Eliste & Fredrikkson (1999 & 2002) Corruption perception index for 2001 (higher levels = lower corruption) Source: Transparency International (2001)	-
ARABLELAND90 & ARABLELAND01	Share of agric. land (sum of arable and pasture land) from total land area Sources: Eliste & Fredrikkson (2002), World Development Indicators (2006)	-
ORGFARMS87 & ORGFARMS96	Organic agricultural farms present in 1987 and 1996 Sources: as above	+
XGS90 & XGS01	Exports of goods and services as a percentage of GDP Source: World Development Indicators (2006)	+
FERT90 & FERT01	Fertiliser use per hectare in grams Source: World Development Indicators (2006)	-
BSE01	Dummy variable for if a country has experienced BSE as at 2001 Source: FSA (2001)	+

The dependent variable used was the share of organic farming land as a percentage of total agricultural land (OAP90 and 01). Such a specification was considered more

indicative of the importance of organic farming in a country than alternatives such as the number of organic farms or the hectares of organic farming land.

Table 1 illustrates the expected signs of the explanatory variables. It was hypothesised that the share of land under organic farming would be positively influenced by:

- *Market signals*: The time organic produce was available in supermarkets, the gross domestic product per capita of countries and OECD membership);
- *Organic agricultural policy signals*: the time subsidies/extension support/R&D expenditure/national standards/legal regulations had been available;
- *Environmental conditions*: the stringency of environmental regulations in the agricultural sector or the environmental sustainability index;
- *Farming signals*: the presence of a food scare such as bovine spongiform encephalopathy and the number of organic farmers operating; and
- *Other policy signals*: the share of goods and services as exports and the level of freedom in a country.

Organic farming would be negatively influenced by:

- *Farming signals*: intensive environmental pressure (such as average fertiliser used) and extensive environmental pressure (such as share of agricultural land from total land area);
- *Policy signals*: the level of corruption in the country; and
- *Environmental regulations/:* the lead amount allowed in gasoline.[3]

[3] This paper follows the methodology of Damania *et al* (2003) in using lead allowed in gasoline as a proxy for the stringency of environmental regulations in a country.

Empirical Results

Five specifications of the 1990 model are provided in Table 2.

Table 2: Results for Share of Organic Farming as a Percentage of Total Agricultural Land in 1990

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Variable	*OLS*	*OLS*	*OLS*	*Tobit*[b]	*OLS*
C	-0.14	-0.03	-0.09	-1.14	1.09
	(-1.31)	(-0.40)	(-2.56)***	(-4.00)***	(1.53)
GDPPC90	-0.00	-	-	-	
	(-0.33)				-
GDPPC902	0.00	-	-	-	
	(1.52)				-
LGDPPC90	-	0.02	-	0.28	-0.29
		(0.99)		(3.75)***	(-1.57)
STRING	0.00	-	-	-	
	(1.89)*				-
LEAD90	-	-0.02	-	-0.11	-0.14
		(-1.43)		(-2.67)***	(-2.72)***
SUPERMKTYRS90	0.07	0.08	0.06	0.08	0.06
	(3.90)***	(3.46)***	(2.38)**	(5.52)***	(2.25)**
EXTENSIONYRS90	0.05	0.07	0.06	0.07	0.06
	(2.77)***	(3.52)***	(3.96)***	(4.82)***	(2.16)**
STANDARDYRS90	-0.02	-0.00	-	-0.01	0.00
	(-1.37)	(-0.27)		(-0.94)	(0.05)
SUBSIDYYRS90	-0.03	-0.06	-	-0.11	0.00
	(-0.55)	(-0.41)		(-1.25)	(0.01)
LEGALYRS90	0.03	0.04	0.04	0.04	0.04
	(1.79)*	(1.44)	(1.72)*	(1.86)*	(1.63)
FREE90	-0.00	-	-	-	
	(-0.05)				-
OECD	-0.02	0.11	-	0.02	0.04
	(-0.27)	(1.62)		(0.28)	(0.30)
CORR90	0.00	0.02	0.03	0.05	0.08
	(0.24)	(1.37)	(2.80)***	(1.98)**	(1.90)*
XGS90	0.00	-0.00	-	0.00	0.00
	(0.29)	(-0.23)		(0.24)	(0.42)
ARABLELAND90	-0.00	-0.00	-	0.00	-0.01
	(-1.53)	(-1.32)		(-1.77)*	(-3.10)***
FERT90	-0.00	-0.00	-	-0.00	-0.00
	(-1.51)	(-2.22)**		(-4.15)***	(-0.27)
ORGFARMS87	-0.00	-0.00	-	-0.00	0.00
	(-1.53)	(-1.35)		(-1.93)**	(0.36)
Obs	**61**	**61**	**61**	**61**	**28**
Adj. R-squared	0.79	0.74	0.69	0.85	0.62
Durbin-Watson stat	2.00	1.84	1.61		2.56
F-statistic	15.74	14.18	35.14		4.36
Prob (F-stat)	0.00	0.00	0.00		0.00
Log Likelihood				12.75	

Notes: a Models 2 to 5 use White heteroskedasticity-consistent standard errors and covariance
b Models 1-3 and 5 present t-statistics in brackets, Model 4 has z statistics
*** Significant at 1% level
** Significant at 5% level.
* Significant at 10% level

Diagnostics of the original specification (Model 1 in Table 2) indicated some problems. Model 2 represents the preferred specification, with no presence of multicollinearity and using White heteroskedasticity-consistent standard errors and covariance.[4] Model 3 is the restricted version of model 2 (using the methodology suggested by Hendry 1980), model 4 represents tobit regression and model 5 is OLS on a subset of the database, using only countries that had non-zero share of organic farming. The fits of the 1990 models are reasonable, with the adjusted R^2 ranging from 0.62 to 0.85.

Five specifications of the 2001 model are presented in Table 3. Model 1 represents the original OLS specification, model 2 the OLS specification with no problems,[5] model 3 represents model 2's specification with additional explanatory variables, model 4 is the restricted version and model 5 is tobit regression. The fits of the 2001 models are again reasonable, with the adjusted R^2 ranging from 0.62 to 0.68.

Analysis of the results indicates some quite different drivers of the share of organic farming across the world, as between 1990 and 2001.

[4] Zero-order correlations and the condition index indicated problems with multicollinearity in Model 1. Problems were with GDPPC, GDPPC2, STRING and FREE. It was resolved by logging GDPPC, substituting LEAD90 for STRING and dropping FREE. Endogeneity was tested for using a version of the Hausman test that was proposed by Davidson and MacKinnon (1993), with all possible endogenous variables tested for and no presence of endogeneity found. Heteroscedasticity was found and corrected for, and no autocorrelation was found.

[5] Again, severe multicollinearity was found in Model 1. Problems were with GDPPC, GDPPC2, ESI01, CORR and FREE. Problems resolved with combinging GDPPC, ESI01 and CPI01 into one variable, and dropping FREE. No presence of endogeneity or autocorrelation found, but heteroscedasticity was found and corrected for.

Table 3: Results for Share of Organic Farming as a Percentage of Total Agricultural Land in 2001

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	OLS	*OLS*	*OLS*	*OLS*	*Tobit*[b]
C	-2.86	-0.74	-0.69	-1.34	-0.99
	(-1.42)	(-1.57)	(-1.29)	(-1.60)	(-1.79)*
GDPPC01	-0.00	-	-	-	-
	(-1.80)*				
GDPPC012	0.00	-	-	-	-
	(1.64)				
ESI01	0.07	-	-	0.03	-
	(1.95)*			(-1.60)	
CORRGDPESI	-	0.00	0.00	-	0.00
		(2.41)**	(2.14)**		(2.58)***
SUPERMKTYRS01	0.10	0.10	0.08	-	0.08
	(1.56)	(1.38)	(1.40)		(1.50)
EXTENSIONYRS01	-0.02	-0.02	0.01	-	0.02
	(-0.23)	(-0.15)	(0.09)		(0.19)
STANDARDYRS01	0.06	0.03	0.03	-	0.04
	(1.27)	(0.62)	(0.67)		(0.93)
SUBSIDYYRSD01	0.19	0.14	0.14	0.17	0.13
	(1.81)*	(1.10)	(1.25)	(2.21)**	(1.28)
LEGALYRS01	0.01	0.01	-0.05	-	-0.06
	(0.15)	(0.13)	(-0.45)		(-0.60)
OECD	-0.67	-1.24	-1.61	-	-1.57
	(-0.87)	(-1.67)	(-1.72)*		(-1.90)*
FREE01	-0.08	-	-	-	-
	(-0.87)				
CPI01	0.06	-	-	-	-
	(0.28)				
XGS01	0.01	0.01	0.01	-	0.01
	(1.22)	(0.84)	(0.98)		(1.10)
ARABLELAND01	0.01	0.01	0.01	-	0.01
	(0.58)	(0.90)	(0.56)		(0.85)
FERT01	0.00	-0.00	-0.00	-	0.00
	(0.31)	(-0.81)	(-0.04)		(0.11)
ORGFARMS96	0.00	0.00	0.00	0.00	0.00
	(5.00)***	(3.81)***	(4.15)***	(2.82)***	(4.87)***
BSE	-	-	-0.12	-	-0.21
			(-0.12)		(-0.24)
R&D	-	-	1.73	1.68	1.72
			(2.15)**	(2.51)***	(2.45)***
Obs	**61**	**61**	**61**	**61**	**61**
Adjusted R-squared	0.64	0.62	0.66	0.67	0.68
Durbin-Watson stat	2.49	2.63	2.56	2.58	-98.8
F-statistic	8.07	9.90	10.13	32.55	
Prob(F-statistic)	0.00	0.00	0.00	0.00	

Notes: a Models 2 to 5 use White heteroskedasticity-consistent standard errors and covariance
b Models 1-4 present t-statistics in brackets, Model 5 has z statistics
*** Significant at 1% level
** Significant at 5% level.
* Significant at 10% level.

Market Signals

The strongest market signal influencing the share of organic farming was the length of time supermarkets had been selling organic produce, which was highly significant in all specifications of 1990 and marginally significant in 2001.

Surprisingly, income was often not significant in the 1990 models; however the tobit model found logged GDPPC to be a positive and significant influence. Membership of OECD was not significant in 1990 and marginally significant (yet negative) in 2001. Income was also significant and negative in 2001, however the severe multicollinearity problems meant that it had to be combined with corruption and environmental sustainability indexes.

How can such a scenario of income playing a very different role in the two databases make sense? It is important to realise the fundamental changes that have occurred in the world of organic agriculture over that time period. Our dependent variable is production based, not consumption based. If information had been available for consumption of organic produce by country then it is highly likely that income would be playing a strong positive role in both years. Although the consumption of organic produce is likely to be correlated with the share of organic farming in a country, it is not necessarily the same thing. During the 1990s, many non-OECD countries started producing certified organic agriculture with the aim of exporting organic produce to developed countries. Therefore, local income per capita was not influential in influencing many countries supply of organic farming.

The level of corruption was significant and negatively related to the share of organic farming in 1990 (indicating that the higher the level of corruption the less the share of

organic farming). Such an influence may illustrate that consumers in more corrupt countries were less willing to believe they were receiving organic produce, hence less likely to pay premiums for organic produce and less likely to 'pull' organic produce supply. It may also illustrate that farmers in corrupt countries are less willing to pay for organic certification as they may believe other farmers could cheat the system. The influence of corruption disappeared in the 2001 database, though combining corruption, income and environmental sustainability together indicated that countries that were wealthy, less corrupt and had high environmental sustainability had a higher level of influence on organic farming. The influence of corruption as a variable may have disappeared in 2001 because of how the worldwide organic regulation market had changed. European private regulators of organic farming expanded their fields of operation to developing countries (for example, one organic regulator in Switzerland (IMO) currently has 12 offices, 13 contacts, and 2 partners in various countries across the world), hence consumers buying local organic produce in 2001 (or organic farmers paying certification levies) were more likely to believe the regulator is coming from a country with a strong regard for strict standards. This may help to explain why the influence of a local country's corruption level disappears.

Agricultural Policy Signals

The policy variable that was consistently significant and positive, and had one of the largest influences on the share of organic farming in 1990, was the length of time advice by publicly funded extension personnel had been available on organic farming. At the same time, the number of organic farmers' three years previously was surprisingly not significant in influencing the share of organic farming in 1990. This may indicate the importance extension officers play in providing agricultural advice

in countries where an innovation such as organic farming is still in its infancy stage. By 2001, extension support was no longer significant, though the numbers of organic farmers five years earlier is now highly significant and positive. It is possible that both these results may reflect a threshold effect, with the number of farmers in 1987 below it and the number of farmers by 1996 above the threshold.[6] Reaching a certain threshold level of organic farmers in a country may allow informational externalities, economies of scale and other externalities to be achieved, promoting greater adoption of organic farming. It may be possible that once this threshold is reached, other organic farmers are more easily able to substitute for public extension information sources, hence the insignificance of the extension variable, though the second-best nature of this variable does not allow for any certainty in this conclusion.

The expanded 2001 regression model includes a variable that outweighs all other variables in size and significance, namely a dummy variable on R&D presence in organic agriculture that had a large positive influence on the share of organic farming. Countries that conduct research on organic agriculture actively are much more likely to have a higher share of organic farming, and this is the largest influence.

The other policy variable that was significant in positively influencing the share of organic farming in 1990 was the length of time legal protection over the term 'organic' had been available, though it was not significant in 2001.

The length of time subsidies had been available for organic farming was not significant in any specification in 1990, although it was significant in the restricted

[6] Threshold levels are often discussed in the innovation literature (Rogers 2003).

regression in 2001 (model 4 in Table 3). The general insignificance of the organic subsidy variables may arise for different reasons. First of all, the second-best nature of our variables may not reflect true differences between countries, hence clouding the overall results. However, bearing in mind the weaknesses with the data, in the late 1980s subsidies were small and it is unlikely that they would have played a major role in influencing farmers to adopt organic agriculture. The greening of the Common Agricultural Policy (CAP) in the 1990s increased the subsidies available to convert to organic farming, hence increasing the importance of subsidies in farmers' decisions to adopt organic farming. Finally, the non-significant subsidy variable result in 1990 and the significant subsidy result in 2001 may reflect a common argument in the literature: those farmers who are currently adopting organic agriculture are primarily doing it for financial reasons, not environmental or health reasons which drove original adopters of organics (Wynen 1988, Guthman 2000, Rigby and Caceres 2001). It is reassuring that the cross-country analysis produces similar results to other sociological and individual innovation adoption research.

The time that national standards of organic farming had been present was not significant in any specification. There is some evidence that the presence of legal regulations may positively influence the level of organic farming, though it is limited.

Ecological and Farming Signals

Environmental regulations (STRING) were positively and significantly related to organic farming in 1990. Given STRING's correlation with other key variables, the measure of lead allowed in gasoline (LEAD90) was substituted instead in 1990. LEAD90 was significant in negatively influencing the share of organic farming in

1990. In 2001, the interaction effect of corruption, an index of environmental sustainability and income (CPI01, ESI01 and LGDPPC01) was positively related to the share of organic farming, indicating that countries with high income, low corruption and high environmental sustainability had a positive influence on organic farming. From these general results, and looking back at the general insignificance of income in 1990, it seems that environmental regulations and conditions in countries are an important positive influence on the level of organic farming, and they are more important in influencing a country's share of organic farming than the income per capita of the country.

The indicator of intensive environmental pressure (FERT) generally had a negative significant influence on organic farming in 1990, though it was not significant in 2001. The indicator of extensive environmental pressure (ARABLELAND) also had a negative significant influence on organic farming in 1990 but was not significant in 2001. Such a result may support the environmental conditions and regulations. The indicator of whether a major food scandal had occurred by 2001 (BSE01) and the share of exports as a percentage of goods and services was not significant in any model.

Conclusion

Although the final models presented in the two cross-country databases were free of data problems, other issues remain. Overall, the fit of the models can only be described as reasonable at best. The 1990 database performed better than the 2001 database. The lack of significance in both models was expected given the second-best nature of key variables (especially organic farming policy variables), data difficulties

and the relatively small sample sizes. Nevertheless, there are some interesting conclusions that can be drawn from the econometrics. Firstly, the results from the 1990 regressions and the 2001 regressions are similar in some respects, but fundamentally different in other respects. It is important to remember that organic farming went from a 'fringe' activity in 1990, practiced only by some developed countries (traditional agriculture not withstanding), to a much more widespread activity in 2001. The average share of organic farming increased over 15 fold from 1990 to 2001, with the most contributors being non-OECD countries.

Both market and agricultural policy signals played very important roles in influencing the level of organic farming, though agricultural policy signals seem to be more important. The availability (and promotion) of organic produce in supermarkets positively influences the share of organic farming in countries. It is likely that supermarkets act by both increasing consumer demand through availability and convenience, by providing contracts and decreased risk to organic farmers to grow and supply organic produce. Agricultural policy signals that seem the most important include the availability of extension support and the presence of organic agricultural R&D funding. Other evidence on the relationship between ecological and farming signals seems mixed, with the most consistent results being countries' environmental regulations and conditions do positively drive the level of organic farming.

The level of organic farming in a country is therefore influenced by both demand and supply factors, though empirical evidence emphasises the supply side driven influence more.

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