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Understanding innovation in a dynamic agricultural business environment: a multivariate approach

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ABSTRACT

Researchers have identified a number of drivers of innovative capacity in rural areas such as farmers' participation in social and commercial networks; farmers' participation in collaborative alliances; farmers' level of education; and farm-size. The present article extends this traditional research with the objective of determining whether these drivers also favour innovative capacity in turbulent market conditions (i.e. dynamic business environments) caused by policy changes. A probit analysis based on a proposed model of innovation revealed that not all these drivers were significant. Moreover, it was found that the capacity to innovate was also influenced by psychological variables.

KEYWORDS: Networks; Innovation; Dynamic Business Environments; Policy Change

1. Introduction

The capacity to innovate or innovative capacity (IC) is defined by Wang and Ahmed (2007) as "a firm's ability to develop new products and/or markets, through aligning strategic innovative orientation with innovative behaviours and processes (p. 38)". Researchers have recognised that firms who have this capacity can develop profitable innovative activities allowing them to create wealth and competitive advantage in dynamic environments (see, for instance, Lawson and Samson, 2001; and Wang and Ahmed, 2007). It is for this reason that a number of investigators have studied and identified important drivers that help firms to develop IC in dynamic environments. Some of them correspond to participation in social and commercial networks; participation in collaborative alliances; individuals' willingness to change; and managers' level of education; among others (see Section Two for a formal description of these drivers).

It is interesting to note that most of the academic works studying the capacity to innovate in dynamic environments have only linked market dynamism with technological improvements. However, little attention has been paid to policy reform as a destabiliser of the business environments. In this respect, Eisenhardt and Martin (2000) describe two types of markets: (i) moderately dynamic markets; and (ii) high-velocity markets. These authors explain that "moderately dynamic markets are ones in which change occurs frequently, but along roughly predictable and linear paths. They have relatively stable industry structures such that market boundaries are clear and the players (e.g. competitors, customers, complementers) are well known (p. 1110)". In contrast, "high-velocity markets are ones in which market boundaries are blurred, successful business models are unclear, and market players (i.e. buyers, suppliers, competitors, complementers) are ambiguous and shifting (p. 1111)". Researchers in general have analysed moderately dynamic and high-velocity markets in terms of the nature of the development of new manufacturing processes and technological improvements. The reason is because it was originally recognised the need for an expanded paradigm to understand how competitive advantage can be achieved in dynamic markets by high-technology industries (Teece *et al.*, 1997). For example, industries characterised by an accelerated technological improvement such as Asian manufacturers have been linked to high-velocity markets (Burgelman, 1996). In contrast, industries characterised by a predictable and frequent change in terms of new product development processes such as the computer industry have been associated with moderately dynamic markets (Eisenhardt and Tabrizi, 1995).

The fact that the traditional research on IC in dynamic business environments has mainly linked market dynamism with technological improvement but not with policy changes has an important implication. That is, high-velocity markets have been associated with accelerating technological improvements. However, a policy change can be considered as single exogenous shocks rather than an accelerating change. As a consequence, the drivers of IC identified by the

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traditional research could not necessarily be applied to help farmers to develop IC in turbulent conditions post-policy reforms. For example, it is possible that relevant information obtained from social and commercial networks cannot diffuse at the needed speed to quickly generate highly profitable innovative responses to a policy shock. This is because the acquisition of new information not only depends on the existing network, but also on the ability of firms to improve the depth, quality and diversity of inter-organizational networks (Conway, 1997; and Macpherson *et al.*, 2004). Therefore, an existing network in a pre-reformed condition could not have the links needed to obtain relevant information to develop profitable innovative activities in response to a policy change, and these links could not necessarily be formed at the needed speed. This is supported by recent evidence obtained in the UK. For example, a significant number of sugar beet farmers of the West Midlands region in the UK (ESBF) innovated in low profitable crops (e.g. oilseed rape and oats) in response to the Sugar Regime reform introduced by the European Union on 20th February 2006 even when participating in different commercial networks (May *et al.*, 2011). Moreover, these farmers were also producers of other traditional crops such as wheat and barley when the reform was implemented. As a consequence, they used the same machinery and similar agricultural practices in the production of the new traditional crops adopted to replace sugar beet. They also used the same commercialisation channels to sell these new crops (i.e. free market and contract with specific retailers). This implies that the introduction of these crops did not involve innovation in terms of technology or marketing practices.

The objective of the present article is to gain an understanding of the factors that favour IC in turbulent market conditions generated by policy reforms. In particular, it is argued that in these conditions the capacity to innovate is affected by a number of factors including behavioural considerations that affect farmers' willingness to change. In order to test this hypothesis, a holistic multivariate model of innovation that integrates possible drivers of innovation in dynamic business environments was designed and applied to a sample of ex-sugar beet farmers of the West Midlands region of the UK (ESBF). The reason for using this study case is because the market condition in this region after the Sugar Regime reform was considered as turbulent in terms of the definition of high-velocity markets of Eisenhardt and Martin (2000) given above: (i) the market boundaries of sugar beet in the West Midlands region was blurred because the sugar beet factory in this region was closed; (ii) successful business models to adjust in response to the closure of the factory were unclear; and (iii) market players were ambiguous and shifting (the principal buyer of sugar beet in the West Midlands region disappeared; and sugar beet competitors replaced sugar beet with other alternatives). The aim was to use this model to explain why these farmers adopted a low profitable innovative strategy to adjust in response to the Sugar Regime reform.

The paper is organised as follows: Section 2 provides a literature review on drivers of IC that have been identified by different researchers. These drivers were used as explanatory variables in the empirical analysis of this investigation. Section 3 shows the proposed holistic multivariate model; Section 4 explains the methodology used in the research; results are presented in Section 5; and finally, Section 6 concludes the paper.

2. Drivers of Innovative Capacity

According to Delmas (2002), the capacity to develop IC depends on the ability to absorb and assimilate relevant external information. Some researchers argue that this information can be found in networks related to new markets and within the supply chain (Macpherson *et al.*, 2004; Wang and Ahmed, 2007; and Harryson *et al.*, 2008). It is for this reason that participation in formal and informal social and commercial networks (i.e. interaction and communication with suppliers, customers and retailers in the market place) has been considered as playing an important role in the development of IC in rural areas (Boahene *et al.,* 1999; and Virkkala, 2007). For example, farmers can be informed about new profitable crops adopted by producers in other areas when socialising with retailers in the market place. They can also be informed about market opportunities by farmers who are linked with specific retailers. This was confirmed by a farmer in the sample who innovated in a highly profitable crop before the SRR. This farmer (who had his farm in the West Midlands region) had a collaborative alliance with a partner located in Nottinghamshire. This alliance allowed them to produce a joint volume of carrots that was demanded by a retailer located in this county. Having contact with this retailer offered the farmer a useful channel to identify potential market opportunities and also to identify new crops adopted by growers in Nottinghamshire.

Researchers have also identified other factors that could eventually affect farmers' capacity to innovate in dynamic business environments. In particular, two different types of tactical alliances have been found to help firms to adjust in these environments because they can be formed relatively quickly in response to technological change. One of them, referred to in this article as *informational tactical alliance*, corresponds to alliances that facilitate the diffusion of the information that is needed to innovate in turbulent conditions. According to Hagedoorn and Duysters (2002), these alliances can help firms to increase negotiation power. This, in turn, allows these individuals to enter in new markets and to obtain the information that is needed to innovate. For example, retailers can offer access to markets of highly profitable crops only to farmers who are able to guarantee a determinate volume of production. Informational tactical alliances can help farmers to get access to these markets by pooling their production and, in this way, to obtain relevant information that could be used for innovation (e.g. learn from retailers about technologies adopted by other producers to increase the productivity of the farm or to produce other highly profitable crops). The other type of tactical alliance, referred to in this article as *investment tactical alliance*, corresponds to alliances that help farmers to innovate in dynamic environments in activities that demands high capital expenditure (e.g. shared ownership of expensive machinery used for the production of

highly profitable crops). The reason is that these alliances offer the opportunity to spread the risk of this form of investment (Stiles, 1995).

Another factor that has been identified as a driver of IC is farm size. For example, Boahene *et al.* (1999) found that large-scale farmers had more access to bank loans and this strongly increased their chance of innovation in response to exogenous shocks in comparison to small-scale farmers.

Capacity to innovate in dynamic conditions can also be affected by less obvious channels related to socioeconomic and behavioural characteristics affecting farmers' strategic decisions. This is because IC also depends on "behavioural innovativeness" which refers to individuals, teams and managers' incentives to change or willingness to change (Wang and Ahmed, 2004). Willingness to change, in turn, is influenced by socioeconomic and behavioural considerations (Morgan, 1986; and Metselaar, 1997). For example, a farmer who values family farm tradition is probably less willing to innovate in new non-traditional technologies or enterprises. Regarding socioeconomic factors, researchers have identified farmers' education as a relevant one. According to Knight *et al.* (2003), farmers' education affects their attitudes toward risk. In particular, these researchers found that farmers who received formal education (i.e. years of schooling of the household head including primary and secondary education) were more willing to innovate because they were less risk averse.

Regarding behavioural factors affecting willingness to change, the present research adopted two approaches that have been used to study behavioural aspects of farmers' strategic behaviour: the multiple goals approach and the theory of planned behaviour. The multiple goals approach argues that farmers consider economic and non-economic goals when making their decisions (see for instance Gasson, 1973; and Solano, *et al.*, 2001). The theory of planned behaviour, on the other hand, was proposed by Ajzen (1985) and establishes that intention is a good predictor of behaviour, and that intention is determined by attitudes, subjective norms and perceived behavioural control. That is, a person will have an intention (motivation) to behave in a particular way when she/he has a positive attitude towards this behaviour (i.e. attitudes), when the people who are important to him/her think that he/she should perform this behaviour (i.e. subjective norms), and when the person has the conviction that she/he will successfully execute a behaviour leading to a particular outcome (i.e. perceived behavioural control). Researchers have used the theory of planned behaviour to identify the underlying determinants of farmers' behaviour (Beedell and Rehman, 2000; Zubair and Garforth, 2006). In the case of innovation, it is possible that farmers' willingness to change also depends on their goals, attitudes towards different aspects of the farming activity, perceived behavioural control, and subjective norms.

In summary, there are eight main factors that were identified as potential drivers of innovation in dynamic environments: (*i*) participation in networks; (*ii*) formation of tactical alliances; (*iii*) farm size; (i*v*) farmers' level of education; (*v*) farmers' goals; (*vi*) farmers' attitudes towards different aspects of the farming activity; (*vii*) farmers' perceived behavioural control; and (*viii*) subjective norms. Following Morgan (1986), Metselaar (1997) and Wang and Ahmed (2004), the last five factors would affect farmers' capacity to innovate through willingness to change.

While these drivers have not been linked to turbulent conditions caused by policy changes, they were considered as potential explanatory variables in the empirical analysis developed in the present investigation.

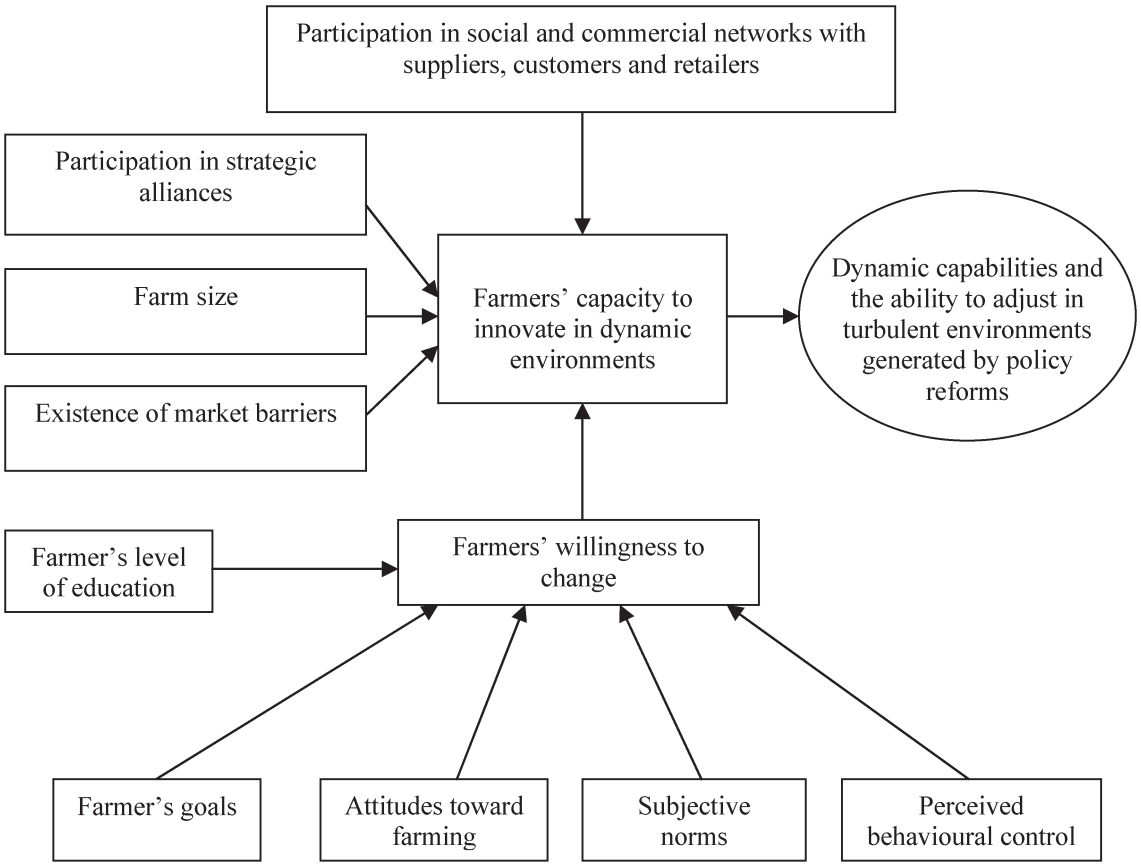
3. The proposed multivariate model

A farmers' decision making framework that integrates the multiple goals approach and the theory of planned behaviour was developed by Bergevoet *et al.* (2004). This integrative framework is referred to as a multivariate model. The multivariate model proposed in this paper extends the contributions of Bergevoet *et al.* (2004) with the objective of determining whether farmers' capacity to innovate in turbulent environments generated by policy changes is explained by the eight factors described in the last section. This model is presented in Figure 1. As shown in this figure, willingness to change was considered as a mediating variable between IC and behavioural variables. This model was designed to test the following hypotheses:

H1: Farmers' capacity to innovate in turbulent business environments caused by policy changes is affected by farmers' participation in social and commercial networks.
H2: Farmers' capacity to innovate in turbulent business environments caused by policy changes is affected by farmers' participation in collaborative alliances.
H3: Farmers' capacity to innovate in turbulent business environments caused by policy changes is affected by farms' size.
H4: Farmers' capacity to innovate in turbulent business environments caused by policy changes is affected by farmers' level of education.
H5: Farmers' capacity to innovate in turbulent business environments caused by policy changes is influenced by farmers' goals.
H6: Farmers' capacity to innovate in turbulent business environments caused by policy changes is influenced by farmers' attitudes towards different aspects of the farming activity.
H7: Farmers' capacity to innovate in turbulent business environments caused by policy changes is influenced by farmers' perceived behavioural control.
H8: Farmers' capacity to innovate in turbulent business environments caused by policy changes is influenced by farmers' attitudes toward subjective norms.

4. Material and methods

According to DEFRA (2011) statistics, the number of sugar beet growers in the West Midlands region in 2005 was 592. 48 ex-sugar beet farmers of the West Midlands region (ESBF) were sampled which correspond to 8.1 per cent of this total and had a 100% response rate. This sample was collected over a period of six months starting in January 2008. Farmers were visited by the authors in their working place and were asked to fill a questionnaire during the visit. The data collection method was based on a combination of cluster,



Source: Developed by the author based on Bergevoet *et al*. (2004) and Wang and Ahmed (2007)

Figure 1: Multivariate model of innovation in dynamic business environments
Source: Developed by the author based on Bergevoet *et al*. (2004) and Wang and Ahmed (2007)

stratified and snowball sampling techniques. The reason for using them was that there was not a list of ESBF available in the public domain. Before adopting these techniques, different unsuccessful attempts to obtain a random sample were made. The first attempt was to send a letter to the British Sugar Corporation requiring a list of ESBF. However, this Corporation did not reply. A second attempt was to approach the British Sugar Corporation by email requiring the list of ESBF. Since no reply was obtained, it was decided to look for other sources. One of them was the National Farm Union (NFU) located in Telford. This Union did not have a list of ESBF. However, the head of the NFU send an extensive invitation to the members to participate in the project by means of the NFU newsletter. Unfortunately no farmer responded the invitation. Finally, it was estimated the cost of sending an invitation to all the farmers of the West Midlands Region. Since the number of farmer holdings in this region is approximately 27,200, it was found that the cost of this strategy was prohibitively high given the budget of the project.

The sample cluster was selected considering the most relevant counties of the West Midlands region in terms of the number of ESBF. They corresponded to the counties of Shropshire, Worcestershire, Herefordshire, Staffordshire and surrounding areas accounting for 48%, 15%, 14%, 12% and 11% of the total sugar beet farm holdings in 2005, respectively. The sample considered relatively similar proportions for these counties in terms of the number of farmers that participated in the investigation accounting for 46%, 15%, 13%, 15% and 13%, respectively. A similar approach was adopted by the Rural Business Unit of the University of Cambridge and The Royal Agricultural College (2004) but in terms of regions rather than counties. The sample stratification was made considering the size of the farm in terms of the number of hectares. It was not possible to find official statistics on this variable. Nonetheless, a criterion was established based on the opinions of the 10 farmers that formed the pilot sample. The precaution was taken to include a balanced number of farmers to the classes defined by this measure. Table 1 shows the sample distribution for each county considering these criteria.

The snowball technique was developed separately in each relevant county. As a result, it was possible to find a number of ESBF that is consistent with the sample cluster strategy defined above. Given the difficulty of gathering data from primary sources, given the small population of ESBF, and given the limited budget supporting the present research, the sample used in this study was considered as appropriate in this context.

A questionnaire was used to collect the relevant data on: (*i*) farmers' capacity to innovate after the incorporation of the Sugar Regime reform (SRR); (*ii*) the importance that farmers attributed to tactical alliances

Table 1: Sample distribution of farm sizes for each county ***Table B1: Sample distribution of farm sizes for each county***

	FARM SIZE (Percentage)		
COUNTY	Small $< = 200$ ha	Medium $200 < 600$ ha	Large $> = 600$ ha
Shropshire	30	52	18
Worcestershire	37	50	13
Herefordshire	17	66	17
Staffordshire	0	83	17
Rest	40	40	20
Whole sample	**27**	**56**	**17**

as tools to reduce market risk after the SRR; (*iii*) the importance that farmers attributed to tactical alliances as tools to increase negotiation power after the SRR; (*iv*) farmers' participation in networks after the SRR; (*v*) farm size; (*vi*) different statements on farmers' goals, attitudes toward farming, perceived behavioural control, and subjective norms; and (*vii*) farmers' level of education (i.e. formal agricultural training such as Bachelor degrees or diplomas obtained from either colleges of universities). A five point Likert scale was used for questions included in (*ii*), (*iii*) and (*vi*). A dummy variable was used to reflect farmers' education. Likewise, a dummy variable was adopted to reflect farmers' participation in networks. The statements on farmers' goals, attitudes toward farming, perceived behavioural control, and subjective norms included in (*vi*) were adopted and adapted from Willock *et al*. (1999) and Bergevoet *et al*. (2004). The questionnaire was pretested with ten farmers in a previous pilot investigation. The statements included in the questionnaire are presented in the Appendix.

A probit analysis was used to identify the drivers that explain farmers' capacity to innovate in dynamic business environments. The reason is because capacity to innovate was captured using a binary choice: I am able to innovate vs. I am not able to innovate. These individuals were explained by the authors of this article the meaning of innovation used in the research. This meaning was based on the definition provided by Wang and Ahmed (2007) for production innovativeness. Product innovativeness is defined by these authors as the novelty of new products introduced to the market in a timely fashion. Using this definition, farmers had to report that they were able to innovate. The authors of the present article ensured that all participating farmers applied the same definition of innovation during the survey. Farmers who responded that they had the capacity to innovate after the implementation of the SRR were assigned a value equal to one. In contrast, farmers who responded that they did not have this capacity were assigned a value equal to zero. The variable p_i summarises this information. That is, $p_i = 1$ for farmer i means that this agent responded that he/she had the capacity to innovate after the implementation of the reform. Conversely, $p_i = 0$ for farmer i means that this agent responded that she/he did not have the capacity to innovate. The probit model is presented as follows (see Dougherty, 2007, and Davidson and Mackinnon, 1993):

$$p_i = \int_{-\infty}^{Z} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}Z^2} dZ \quad (1)$$

where Z is a linear combination of the importance that farmers attributed to tactical alliances as tools to reduce market risk ($TA1$); the importance that farmers attributed to tactical alliances as tools to increase negotiation power ($TA2$); farmers' participation in networks (Net); farm size ($Size$); farmers' level of education (Edu); and statement reflecting behavioural considerations associated with farmers' goals, attitudes toward farming, perceived behavioural control, and subjective norms (B_i). Considering all these variables, the linear combination Z was defined as:

$$Z = \beta_0 + \beta_{SA1} TA1 + \beta_{SA2} TA2 + \beta_{Net} Net + \beta_{Size} Size + \beta_{Edu} Edu + \sum_i \beta_i B_i \quad (2)$$

The probit model was estimated using Maximum Likelihood.

5. Results and discussion

Of the farmers in the sample, 39.6% responded that they had the capacity to innovate when the Sugar Regime reform was incorporated. In contrast, 60.4% of these farmers responded that they did not have this capacity.

In order to test hypotheses H1, H2, H3, H4, H5, H6, H7 and H8, the probit model described in equations 1 and 2 was estimated. The estimated model is presented in Table 2. This table shows that the attitude *I regularly negotiate with suppliers and buyers*; the perceived behavioural control *I don't make plans because they don't work out in reality*; the subjective norm *The increasing amount of regulation interferes with my plans for the future*; and the variables *Collaborative alliances to reduce market risk*, *Collaborative alliances to increase negotiation power*, *Farmers' education* and *Farm's size* were all significant. As a result, the hypotheses H2, H3, H4, H6, H7 and H8 were supported, and the hypotheses H1 and H5 were rejected by the data. This finding suggests that the capacity to develop IC in post-policy turbulent conditions not only depends on some typical drivers identifying by the traditional research (e.g. collaboration, farm's size and farmer's education), but also on behavioural factors that were assumed to affect IC though farmers' willingness to change.

On the other hand, it is interesting to note that participation in networks was not significant. This

Table 2: Regression model for innovative capability ***Table B2: Regression model for innovative capability***

Variables	Dependent variable: *Pi* ($n = 48$)	
Intercept	−17.51**	[−2.41]
I regularly negotiate with suppliers and buyers	3.93**	[2.53]
I don't make plans because they don't work out in reality	−2.32***	[−2.70]
The increasing amount of regulation interferes with my plans for the future	1.07**	[1.97]
Collaborative alliances to reduce market risk	−2.42**	[−2.13]
Collaborative alliances to increase negotiation power	1.95**	[2.03]
Farmers' education	3.9**	[2.46]
Farm's size	−1.01***	[−2.77]
R^2	0.6	
S.E. Regression	0.33	

*$P < 0.1$, **$P < 0.05$, *** $P < 0.01$, *z*–ratios in parenthesis

implies that farmers' participation in networks did not explain farmers' capacity to innovate in the turbulent condition caused by the SRR. As mentioned in the introduction, it is possible that relevant information obtained from social and commercial networks did not diffuse at the needed speed to quickly generate innovative responses to these policy reforms.

The analysis and interpretation of the variables that were significant are provided as follows.

a) I regularly negotiate with suppliers and buyers

According to Table B2, farmers who had a more active participation in the supply chain had higher chance to develop IC in response to the SRR. This indicates that it was not network participation itself what provided these individuals the capacity to develop IC in this turbulent condition, but the intensity by which these individuals interacted with different actors in their social and commercial networks. It is possible that the information that is needed to innovate can be obtained easily when this intensity is high. This is indeed supported by some researches. For example, Conway (1997); and Macpherson *et al*. (2004) argue that the acquisition of new and relevant information not only depends on the existing network, but also on firms' ability to improve the depth, quality and diversity of inter-organizational networks.

b) I don't make plans because they don't work out in reality

According to Table B2, this variable decreased the probability of developing IC in dynamic environments. This result was reflective of farmers who did not have full control over their resources. If they had, then they would have made plans. This lack of control over resources could be coupled with a lack of capacity to innovate. In other words, this result suggests that farmers who had limited control over their resources were less prepared both to make plans and to innovate in response to exogenous shocks.

c) The increasing amount of regulation interferes with my plans for the future

According to Table B2, this variable increased the probability of developing IC in dynamic environments. A possible explanation for this result is that farmers who had faced increasing regulation had developed the skills to overcome this barrier by means of innovation. But these skills can be considered as a positive externality for the development of IC in turbulent environments caused by policy reform. It is also possible that through the process of innovation, these farmers encountered new regulatory constraints. For example, the main purpose of the Rural Development Regulation introduced in the CAP reform Agenda 2000 was to promote development and innovation in rural areas. This regulation could have motivated farmers to develop innovative activities. However, it is possible that these individuals found regulation constrains associated with the existence of rigid institutional arrangements through the process of innovation. In this respect, Dwyer *et al*. (2007) argue that the initiatives for innovation and sustainable rural development included in the Rural Development Regulation have not been sufficient to ensure their effective application because they have not been accompanied by institutional adaptation.

d) Collaborative alliances to reduce market risk

According to Table B2, this variable decreased the probability of developing IC in dynamic environments. This result is surprising and unexpected. As mentioned in the literature review, this type of alliance can help innovation that demands high capital expenditure because they offer the opportunity to spread the risks of this form of investment (Stiles, 1995). But the result obtained in the probit analysis indicates the opposite. A possible explanation for this result is that farmers who faced capital constraints were unable to invest in innovative activities, even when reducing market risk by means of the formation of strategic alliances. As a consequence, the formation of these alliances did not favour innovation. This possibility was inferred from informal conversations with the farmers in the sample. Most of these individuals argued that producing some highly profitable crops requires specific and expensive machinery. This means that they needed this technological innovation to produce these crops. But they were unable to invest in this machinery because they had capital constrains (difficulty in obtaining loans). This suggests that farmers who faced capital constraints did not have an incentive to form alliances with the purpose of developing innovation that demands high capital

expenditure. Actually, no farmer in the sample was involved in this type of collaboration.

e) Collaborative alliances to increase negotiation power

According to Table B2, this variable increased the probability of developing IC in dynamic environments. This result is consistent with the argument given in the literature review. That is, the formation of this type of tactical alliance can help firms to increase negotiation power allowing farmers to enter in new markets and to obtain the information that is needed to innovate. This was indeed verified by some farmers in the sample. For example, a farmer in the area of Worcestershire was able to replace sugar beet with beans and peas by forming an alliance with a group of farmers located in the same area.

f) Farmers' education

According to Table B2, this variable increased the probability of developing IC in dynamic environments. This finding is consistent with the result obtained by Knight *et al.* (2003). As explained in Section 2, these researchers found that education affects farmers' attitudes toward risk. As a consequence, it is possible that farmers who received formal agricultural educational training (i.e. obtained diplomas or a bachelor degree in agricultural science from colleges of universities) were more willing to innovate in the turbulent condition generated by the SRR because they were less risk averse.

g) Farm size

According to Table B2, this variable decreased the probability of developing IC in dynamic environments. This result is also unexpected. According to Boahene *et al.* (1999), large-scale farmers have more access to bank loans and this strongly increases their chance of innovation in response to exogenous shocks in comparison to small-scale farmers. However, since most of the ESBF in the sample faced capital constraints (i.e. difficulty to obtain loans either to satisfy short-term cash flow needs or to develop long-run investment activities) independently of the size of their farms, this argument does not apply to them. In addition, it is possible that the larger farms were more profitable growing the traditional crops and, therefore, faced less pressure to innovate than smaller farms. Unfortunately it was not possible to obtain data of farm profitability from the survey to support this argument. Nonetheless, research developed in different countries and in different agricultural activities has revealed the existence of a positive relationship between farm-profitability and farm-size (see, for instance, Kumbhakar, 1993; Heltberg, 1998; Gloy *et al.*, 2002; and Salami *et al.*, 2009).

6. Summary and Conclusions

Researchers have identified a number of drivers that help firms to develop innovative capacity in dynamic business environments associated with rapid technological change. The present research found that some of these drivers were not significant in explaining farmers' capacity to innovate in turbulent conditions caused by the Sugar Regime reform (SRR). In particular, the probit analysis conducted in the investigation revealed that it is not network with other farmers, suppliers and buyers itself what help farmers to develop this capacity. It is the intensity with which these individuals interact with different actors of the supply chain (i.e. networking in all directions and possible levels). It was also found that the group of farmers who reported that they faced increasing legislation (81.3% of the farmers in the sample) had more chance to innovate in the unstable business environment caused by SRR. Apparently, this is because these farmers had developed skills to overcome this barrier by means of innovation. As a result, they were better prepared to innovate in response to this exogenous shock. It is also possible that through the process of innovation, these farmers encountered new regulatory constraints.

The formation of tactical alliances to increase negotiation power also was related to the capacity to innovate in dynamic environments. This is because the formation of these types of alliances can help farmers to enter in new markets and to obtain from them the information that is needed to innovate. It appears that these alliances were formed by innovative farmers. Finally, farmers' formal education was related to the capacity of these individuals to develop innovative activities in the turbulent condition caused by the SRR. According to Knight *et al.* (2003), formal education affects individuals' attitudes towards risk. Following this argument, it is possible that this result indicates that education corresponded to a mediate variable between innovation and farmers' attitudes towards risk.

The probit analysis also revealed that capital constraints constituted an important inhibitor of innovation when farmers operated in the turbulent environment caused by the SRR. In particular, it was found that when farmers faced this limitation, the formation of tactical alliances to reduce market risk was useless to develop innovative activities because they were unable to affect investment decisions on innovation. The existence of capital constraints across farmers can explain why no ex-sugar beet farmer in the sample innovated in highly profitable crops: they were unable to invest in the specific and expensive machinery that is needed to produce these crops.

From a political point of view, policy makers could help the ESBF to innovate in response to future policy changes by encouraging the formation of tactical alliances to increase negotiation power; facilitating the interaction with different actors in social and commercial networks; promoting farmers' formal agricultural training; providing better access to capital for investment; and introducing training programmes designed to develop the skills needed to control farm's resources more efficiently. It is important to clarify, nonetheless, that generalisations from this research have to be made with caution because the sample used in the investigation was relatively small. It would be interesting, therefore, to extend this research including both larger samples and farmers operating in other industries.

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Appendix: Questions and statements used in the questionnaire

A1. Questions related to collaborative alliances

Which of the following business strategies do you think were more suitable to make your farm a successful business enterprise after the closure of Allscott? For your answers, use the following scale:

Irrelevant (1)	Not very important (2)	Important (3)	Very important (4)	Essential (5)

a) Collaborative alliances to reduce market risk
b) Collaborative alliances to increase negotiation power

A2. Statements related to farmers' goals

Please, use the scale below to best represent your **goals**:

Strongly disagree (1)	Disagree (2)	Indifferent (3)	Agree (4)	Strongly agree (5)

G1) Achieve an income as high as possible
G2) Enjoy my work
G3) Provide for next generations
G4) Have sufficient time for leisure
G5) Maintain nature and environmental value
G6) Produce a good and safe product
G7) Gaining recognition and prestige as a farmer
G8) Belonging to the farming community
G9) Maintaining the family tradition
G10) Working with other members of the family
G11) Feeling pride of ownership
G12) Enjoyment of work tasks
G13) Preference for a healthy, outdoor, farming life
G14) I enjoy having a purpose and value hard work
G15) Have independence and freedom from supervision
G16) Have the control in a variety of situations

A3. Statements related to farmers' attitudes, perceived behavioural control and subjective norms

Please use the scale below to best represent your opinion about the following statements:

Strongly disagree (1)	Disagree (2)	Indifferent (3)	Agree (4)	Strongly agree (5)

Attitudes (A)
A1) Achieve low debts on my farm
A2) My goals and objectives are clear
A3) I try to be among the highest producing farms
A4) I regularly negotiate with suppliers and buyers
A5) I like to try new things on my farm
A6) Keeping my farm up to date is very important to me
A7) In decision-making I take the environment into consideration, even if it lowers profits
A8) Off-farm income is important for sustaining our farm
A9) When making an important decision I ask for a lot of advice
A10) I take challenges more often than other farmers
A11) I use my equity capital as a risk buffer
A12) I try to minimise contract work
A13) Farming is still fun and satisfying

Perceived behavioural control (P)
P1) I'm well informed on the relevant legislation for my farm
P2) I can further lower my production costs
P3) Before I take important decisions I thoroughly inform myself
P4) When I need a new loan, I always go to the same bank
P5) I can increase the sales-price of my production
P6) Administrative obligations consume a lot of time on my farm
P7) I don't make plans because they don't work out in reality

Subjective norm (N)
N1) The way other farmers think about my farm is important to me
N2) I consider government policy unpredictable
N3) Legislation spoils the pleasure in my work
N4) The increasing amount of regulation interferes with my plans for the future