



## Applying partial least squares to model genetically modified food purchase intentions in southern Spain consumers

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### ABSTRACT

Consumers' potential reactions towards genetically modified (GM) foods influence their commercial feasibility and determine the decisions of economic agents. This paper studies the underlying factors involved in determining consumers' choice behaviour towards GM foods in order to develop an integrated analytical framework. Reliable information about consumers' behaviour towards GM foods should lead to the design of political strategies intended to make citizens feel safe in their purchasing choices. In addition, there is an analysis of behavioural differences due to consumers' objective knowledge levels. The research was performed in southern Spain using variance-based structural equation modelling, namely the Partial Least Squares (PLS) regression technique. The results support those arguments that connect consumers' behavioural intentions, attitudes and different factors involved in determining consumer choice, because attitudes towards GM foods link consumer purchasing intentions to the perceived benefits and risks posed by GM foods. Furthermore, there are some insights into the moderating role played by the consumers' level of knowledge in their purchase intentions to GM food.

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### Introduction

At international level, genetically modified (GM) crops has increased from 1.7 million hectares in 1996 to more than 160 million hectares in 2011, making biotech crops the fastest-adopted crop technology in the history of modern agriculture (James, 2011). As a result, so-called GM foods have been marketed in the global marketplace over the last ten years. This commercialization of GM foods has prompted opposing reactions worldwide. Consumers' attitudes with respect to agro-biotechnology vary according to cultures and regions (Chen and Li, 2007) because the public's assessment of GM foods is very heterogeneous (Costa-Font et al., 2008).

The European Union (EU) is one of the areas where social resistance to GM food has been emerging due to concerns about the negative effects of Genetically Modified Organisms (GMO) on both human health and the environment (Gaskell et al., 2010). Accordingly, the distrust of European society toward transgenic food has induced an underdevelopment of crop biotechnology in the EU, where only a GM maize and potato are authorised for cultivation. Therefore, the EU provides an example of the potential for consumers' reactions to influence the commercial feasibility of

GM foods (Moschini, 2008), which could determine future decisions of farmers or agro-biotechnology industries.

Nevertheless, the resistance of European citizens to GM food is not homogeneous in all Member States and regions (Costa-Font and Gil, 2009; Gaskell et al., 2010). Past studies have focused on identifying the major characteristics influencing consumers' choice. The results have shown differences in the weights and roles played by cognitive, attitudinal and personal factors which, hypothetically, settle the behavioural process that leads to GM food acceptance. For instance, perceptions toward the potential benefits and risks of GM food (Kikulwe et al., 2011), technology (Frewer et al., 1997; Grunert et al., 2001), knowledge on GMO (House et al., 2004; Noomene and Gil Roig, 2007), gender (Frewer et al., 1997; Siegrist et al., 2000) or schooling levels (Traill et al., 2004; Canavari and Nayga, 2009) are still mixed and are not conclusive, so the findings derived from these factors cannot be generalised. Hence, knowledge about consumers' acceptance of GM foods remains limited, and recent studies such as those by Pelletier (2006), Chen and Li (2007) or Martínez-Poveda et al. (2009) have pointed out that the scientific community is still uncertain about where significant efforts should be undertaken to research consumers' acceptance of GM foods.

This paper aims to contribute to the conceptualisation of an integrated framework in order to provide a better understanding of consumers' attitudes and purchasing intentions towards GM foods and to increase the evidence concerning consumers' acceptance of GM foods. Reliable information about consumers'

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behaviour towards GM foods should lead to the design of political strategies intended to make citizens feel safe and free in adding GM foods to their purchasing choices. To do so, an empirical research was performed in southern Spain using variance-based structural equation modelling (SEM) by means of the Partial Least Squares (PLS) regression technique, and by designing a multi-group analysis focusing on objective knowledge. Spain is the EU Member State with a high GM crop-adoption rate and a great amount of cultivated hectares dedicated to GM crops (MAGRAMA, 2012). Nevertheless, there are still very few studies available to contribute to the design of a full model of Spanish consumer acceptance of GM foods. Martínez-Poveda et al. (2009) developed a model of consumer-perceived risk and Costa-Font and Gil (2009) presented a full model of Spanish consumers' purchase intentions.

This paper contributes to existing literature in at least two ways. First, this paper provides an additional model to appraise the underlying factors involved in determining consumers' choice behaviour towards GM food. This model uses some of the main constructs compiled in previous research with SEM, but we also introduce two novel constructs: one related to consumer perception of general food safety and the other related to socio-economic features as a formative construct. Second, the application of variance-based SEM by PLS technique is an original approach to study this topic. Earlier studies used covariance-based SEM models, however, PLS maximises the model's predictive capacity in high-complexity frames with emerging theories (Roldán and Sánchez-Franco, 2012). PLS, therefore, is suited to the study of consumers' acceptance of GM foods, where a vast literature exists but their conclusions can be different and even contradictory. PLS also allows greater flexibility when working with both reflective and formative indicators that allow us to incorporate socio-economic features. Finally, PLS makes no measurement, distributional or sample-size assumptions (Sosik et al., 2009), so it is very reliable to use when doing multi-group analyses.

The paper is structured in the following way. The next section develops the theoretical framework and presents the analytical model that was developed. Then the research method is discussed. The results of the research are shown in section 'Results'. Finally, the paper offers the main discussions and conclusions.

## Theoretical framework and model development

### behavioural intentions

Diverse approaches are applied to study the behaviour of consumers. Fishbein's multi-attribute attitude model (1963), and later

Fishbein and Ajzen (1975), provided a widely accepted framework for the analysis of consumers' attitudes, intentions and choices (Kim, 2009), i.e., in the examination of different aspects of consumers' behaviour, understood as the exchange process involved in acquiring and consuming goods and services (Mowen and Minor, 2001). Based on the model of Fishbein and Ajzen (1975) and the Theory of Planned Behaviour (Ajzen, 1991), which established links among behavioural intentions (purchase intentions), attitudes and beliefs, other conceptual models have been designed in order to describe the process that leads to the acceptance of GM foods (Bredahl, 1999, 2001; Verdurme and Viaene, 2001, 2003; etc.). The multi-attribute model developed in this study was inspired by previous research, particularly research on the framework devised by Bredahl (2001) and Verdurme and Viaene (2001) and further developed by Han (2006), Saher et al. (2006), Chen and Li (2007), Chen (2008), Costa-Font and Gil (2009), Kim (2009, 2010), and Martínez-Poveda et al. (2009). Bredahl (2001) and Verdurme and Viaene (2001) posited that perceived risks and benefits are responsible for defining the attitudes of consumers towards GM foods, which in turn influence their purchase intentions. In accordance with this line of thinking, the above authors also assumed that attitudes towards GM technology and trust in institutions have an influence on perceptions of risks and benefits (see Fig. 1). In addition, socio-economic features are relevant variables for explaining purchase intentions (Hoban, 1998; Veeman et al., 2005; Ganiere et al., 2006; Kimenju and Degroote, 2008; Kim, 2009). Finally, we consider the importance of consumers' perceptions about food safety in the EU to ascertain how their level of trust in current food quality, technology or general food regulations affects their perceptions of GM foods (Verdurme and Viaene, 2003; Chen and Li, 2007).

Therefore, we first consider the link between the individual attitudes towards GM foods mentioned in the Theory of Planned Behaviour and integrated by Bredahl (2001) and Verdurme and Viaene (2001), namely that positive attitudes improve purchase intentions. Secondly, according to Kim (2010), some socio-economic characteristics – such as age, schooling level, size of household and income – affect the decision-making process concerning intentions of whether or not to purchase GM foods. The first two hypotheses are as follows:

**Hypothesis 1.** GM food purchase intention increases according to positive attitudes towards GM foods (H1).

**Hypothesis 2.** GM food purchase intention is influenced by the socio-economic characteristics of consumers (H2).

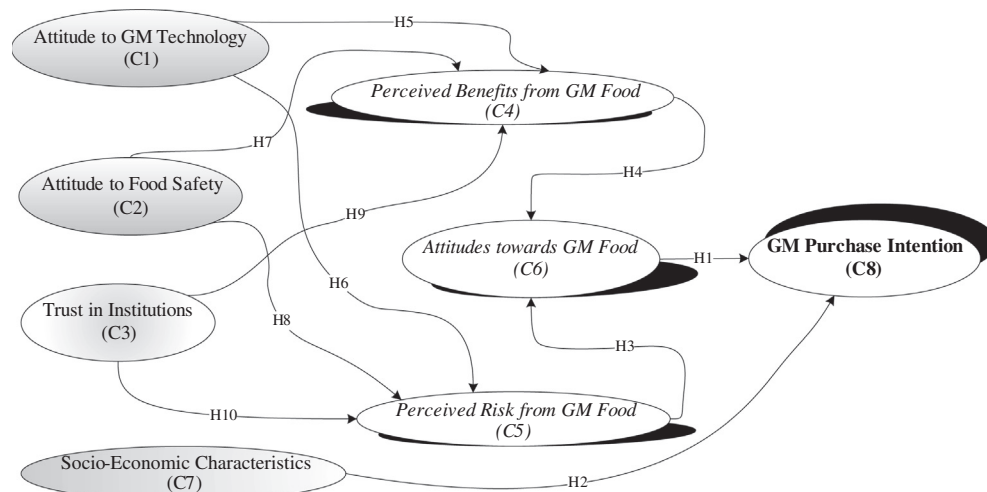


Fig. 1. Conceptual model for consumers' purchase intention of GM food.

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