Investments in Traceability Systems: Results from the German Food Industry

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a Problem Statement

Markets for agricultural and food products are characterized by high information asymmetries since producers, processors and retailers are in most cases much better informed about the quality of their products than consumers (HENSON/TRAILL: 1993). Often consumers are only at (prohibitively) high costs or not at all able to control important quality attributes such as food safety, nutritional value or region of origin. Such credence attributes can result in market failure due to a lack of credible information in the market (AKERLOF: 1970). As a result, attempts to protect consumers against food hazards, product adulteration and deception have gained much relevance in food supply chains (DEIMEL ET AL.: 2008). Besides the more or less voluntary certification schemes that have been established, large parts of the agrifood sector are already mandatorily regulated, especially in Europe. Therefore, in recent years, food law has been undergoing major changes in the European Union (EU) (THEUVSEN/HOLLMANN-HESPOS: 2007). General Food Law Regulation (EC) 178/2002 and the so-called EU hygiene package (Regulations (EC) 852/2004, 853/2004 and 854/2004) have strongly contributed to a much more intensive regulation of food production. The farm to fork approach laid down in Regulation (EC) 178/2002 has resulted in the obligation to secure "traceability of food … at all stages of production, processing and distribution" (Art. 18).

By now, it is a widely shared view that traceability and related concepts, such as trust and transparency, deserve more attention in agribusiness management (FRITZ/FISCHER: 2007; HANF/HANF: 2007; DEIMEL ET AL.: 2008; JANSEN/VELLEMA: 2004). According to HOFSTEDE (2003), effective information exchange is the key to improving value chain performance and competitiveness in today's complex and rapidly changing environments.

Nevertheless, the implementation of traceability systems is controversially discussed, not only in theory but also and especially in practice. One of the most common complaints is that while regulations result in a huge bureaucratic workload, they offer little advantages for day-to-day operations in the agrifood sector (SCHULZE ET AL. 2008). As a consequence, many members of the food chain did not implement a traceability system voluntarily but have been forced to do so by mandatory regulations.

While the number of in-depth analyses of trust, transparency and traceability in food systems is rising, it is still unclear what exactly determines firms' investments in traceability systems.

b Objectives

Against this background it seemed worthwhile to have a closer look at the investment behaviour regarding traceability systems in food systems. The study on hand accomplished this aim by means of empirical data from the German food industry and, as a result, provides in-depth insights into companies' investment behaviour with respect to tracking and tracing systems. The main objective of the study was to detect the investment behaviour of agribusiness companies in terms of introducing a traceability system. As other studies could show, we are confident that beyond legal commitments there are other incentives for enterprises to invest in traceability systems. These mainly comprise the use of traceability systems in internal risk-management, differentiation strategies and certifications processes. Therefore, it can be expected that despite legal obligations to meet minimum traceability requirements business investments in tracking and tracing systems vary quite substantially.

c Procedure

The analysis was conducted on the basis of data obtained from a sample of 234 food manufacturers in Germany. Between October 2005 and February 2006, about 2,800 firms were questioned via an online survey. 234 suitable questionnaires were returned (response rate about 8.6 %). The average completion time was about 14 minutes. The target group of the survey was the respective quality assurance manager or quality assurance staff.

The companies that participated in the survey represent more than fifteen different sub-sectors of the food-processing industry. The majority belongs to the following industries: meat products (incl. sausages) (23 %), beverages (12 %), deep-frozen food (12 %), sweets and snacks (12 %), fruits and vegetables (12 %), tinned food (12 %) and dairy products (11 %). It is noteworthy that the sample is predominantly characterized by medium-sized companies; two thirds of the companies realize turnovers between 5 and 250 million €. About 20 % have a turnover higher than 250 million €, only 15 % generate a turnover lower than 5 million €. Therefore, our sample reflects the general situation in the German food industry, which is characterized by many SMEs and few very large companies.

The focus of the conceptual framework is a behavioural research model. More precisely, the theoretical framework of the empirical study is a tracking and tracing investment model. The model presented is based, firstly, on the theory of planned behaviour (AJZEN: 1991) and, secondly, on the technology acceptance model II (VENKATESH/DAVIS: 2000) developed on the basis of the first-mentioned. The basic assumption of the model is that investment behaviour is influenced by the attitudes of decision makers, who may depend on cost-benefit evaluations and subjective perceptions of third persons.

To take this into account, our paper includes a partial least square model to analyse causal relations in the afore-mentioned context. The statistical analysis is accomplished by conducting uni-, bivariate and multivariate statistics. Furthermore, cluster analysis is applied to group the companies in terms of their acceptance and investing behaviour concerning traceability systems.

d Results

Descriptive results for the internal variables provided initial impressions of companies' attitudes towards the traceability scheme; about three-fourth of the companies regard traceability as important and reasonable. This is a very positive evaluation compared to studies analysing the acceptance of e.g. certification schemes (FITZGERALD ET AL. 1999; BÖCKER ET AL. 2003).

As a second step, factor analysis was used to identify groups of inter-related variables and understand how they are related to one another (ABDI 2003). After minor modifications for double loading and nonloading items, the measures demonstrated acceptable levels of fit and reliability (KMO = 0.758). All in all, ten different statements entered the factor analysis and three factors were extracted: "Improvement of processes", "stakeholder requirements" and "legal requirements". The first factor—improvement of processes—summarizes statements that emphasize traceability as part of a firm's risk management strategy, the optimization of its internal and external business processes and the differentiation of food products within its competitive strategy. Obviously, these aspects correlate closely with one another. The second factor—stakeholder requirements—reflects the perceived external pressure from stakeholders, such as nongovernmental organizations, and society in general, represented, for instance, by the mass media. The third factor—legal requirements—summarizes the firms' perceptions of the legal framework with regard to food product traceability.

Besides these factors, a single statement ("Traceability is a precondition for successful certification.") was used as a cluster variable. In the questionnaires this aspect was represented through that one single statement only, so that its inclusion in the factor analysis did not seem reasonable. Since correlations between this statement and the three factors identified are low, using it as a cluster variable does not create any technical problems.

In the third step of our study, cluster analysis was applied to group the firms in our sample according to their dominant motives for investing (or not investing) in tracking and tracing systems. First, the single linkage method was applied to eliminate seven outliers from the sample. Then Ward's method was used to determine the optimal number of clusters. Since the elbow criterion did not show clear results, additional plausibility reasoning was undertaken to determine the optimal number of clusters. We came up with a five-cluster solution and, finally, ran a k-means analysis. In doing so, the mean values of the cluster variables were used as starting partitions.

Cluster 1: "Certified companies": Cluster 1 comprises 36 companies that have implemented tracking and tracing systems mainly in order to successfully pass a third-party audit and get a required certificate (for instance, ISO 9001, BRC Global Standard or International Food Standard). Statements summarized by factor 1—risk management, process improvements and competitive strategies—are of minor relevance for these firms. Most of the companies in this cluster are small and specialize in producing retailer-owned brands. Producers of frozen foods, fish and beverages are frequent in this cluster. Only 15 percent of the respondents have ever suffered a public product recall. The implementation of tracking and tracing systems has not advanced very far; the technological capacity of the systems implemented is considered rather low.

Cluster 2: "Disregardful companies": The 28 companies in cluster 2 rank the relevance of traceability lowest in our sample and do not attribute high relevance to any of the statements in the questionnaire. Especially stakeholder requirements and legislation are perceived as not very important. The companies in this cluster are very different in size. It is noteworthy that as many as 40 percent of these respondents have already undergone one or more product recalls. Nevertheless, their tracking and tracing systems are not very advanced. Furthermore, a comparatively high percentage of these respondents do not want to implement a dedicated tracking and tracing system at all.

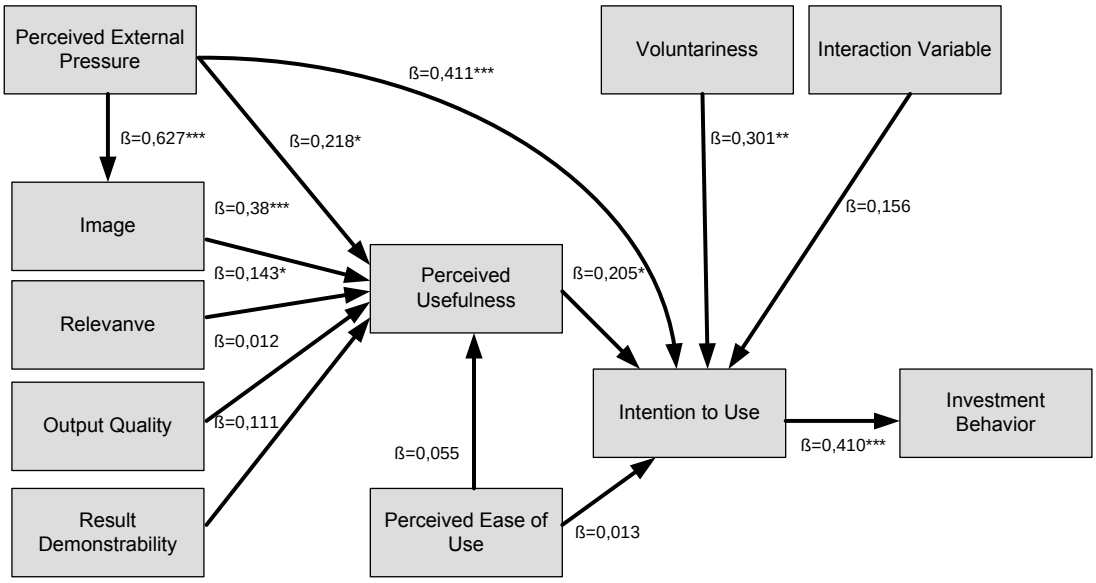
Cluster 3: "Lawful investors": Twenty-seven respondents state legal and stakeholder requirements as their main motives for implementing tracking and tracing systems. Most of the firms in this cluster are comparatively small. Only 13.4 percent produce retailer-owned brands, which is the lowest percentage in our sample. The tracking and tracing systems used by these firms are characterized by an advanced development status.

Cluster 4: "Image-oriented firms": In cluster 4 stakeholder requirements are the main reason tracking and tracing systems have been implemented. Improving traceability in order to meet the requirements of certification systems is also important. The firms in this group are of above-average size and often produce retailer-owned brands. The 60 companies in this cluster belong, for instance, to the fruits and vegetables and the dairy sectors. They attribute high benefits to improved traceability.

Cluster 5: "Versatile companies": The 73 firms in this cluster reveal several important reasons for investing in tracking and tracing systems and consider improved traceability very important. The companies are very different in size and have only rarely suffered public product recalls. The tracking and tracing systems are advanced and the capacity of these systems is considered high.

The fourth issue of the analysis was to take up causal dependencies between the variables of the tracking and tracing model introduced. Therefore, a partial-least-squares path modelling has been employed. Figure 1 illustrates the substantial explanatory contribution (ß) for the variables.

Figure 1: PLS model



Source: Authors' representation (*** = p<0.001, t-value>3.340; ** = p<0.01, t-value>2.601; *=p<0.05, t-value>1.972)

e Conclusions

Although food manufacturers perceive traceability as a useful instrument to ensure product safety, their motivation to invest in a traceability system stems from external pressure rather than an intrinsic sense of purpose.

The fact that we employ a PLS-path modelling analysis, a concept which has rarely been used in agricultural economics, makes our approach innovative. Moreover, the study might be of high interest for the whole sector, because by presenting empirical data on the investment behaviour concerning traceability systems in the food industry, we go far beyond a theoretical perspective. From the data obtained, managerial implications as well as implications for regulators can be derived. From a managerial perspective, long-term oriented shaping of traceability systems using advanced instruments as RFID can be brought to the minds of decision makers in the agribusiness. For policy makers, who want to improve the field of food safety, alternative ideas to strengthen the investment intentions of firms in capable traceability systems can be derived from our study. Whilst external pressure via legal requirements in that context works mainly on SMEs, better communication of the additional benefits of traceability system can enhance positive attitudes to invest in such systems in bigger companies. Our contribution highlights a variety of theoretical starting points for the further development of technology acceptance models for food supply chains. Moreover, the study gives initial indications of the positive and negative effects of traceability schemes on the internal processes of food companies. For the long term success of food safety systems, satisfaction and positive motivation are important because a scheme which is recognized as a bureaucratic burden will not necessarily lead to food safety improvements.

Thanks to the comprehensive sample, the presented study gives a good initial understanding of the factors influencing the investment behaviour of companies concerning traceability systems. However, this empirical study is limited to the analysis of investments in traceability systems in the food industry. Future research studies should seek to contrast the data with the investment behaviour in other countries.

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