Information sharing as a safeguard against the opportunistic behavior of South African Karoo Lamb farmers

by

Melissa van der Merwe,[a,*] Johann, F. Kirsten[b] and Jacques, H. Trienekens[c]

[a] Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, Pretoria, South Africa.
[b] Bureau of Economic Research, Stellenbosch University, Stellenbosch, South Africa.
[c] Department of Management Studies/Social Sciences, Wageningen University and Research Centre, Wageningen, the Netherlands.
* Corresponding author. Tel.: +27 (0) 12 420 4084. *Email address:* melissa.vandermerwe@up.ac.za (Melissa van der Merwe)

Abstract

Misconduct in global meat supply chains are omnipresent and even more so in differentiated chains where credence attributes such as origin and taste are used to differentiate the product. By definition, these attributes signal asymmetric information which implies that in the presence of bounded rational individuals with conflicting interests, misconduct in the form of opportunistic behavior is bound to prevail. Increased information exchange through farmer networks is, however, expected to reduce opportunistic behavior. In the case of a differentiated meat product, such as Karoo Lamb, the paper studies the farmer-abattoir transaction with the purpose of recommending strategies that can be implemented to reduce the farmer's tendency to behave opportunistically. The paper employs the PLS approach to SEM and reveals a significant negative relationship between information shared and opportunistic behavior. The results indicate significant positive relationships between trust in the abattoir and information shared as well as between farmer networks and information shared. These results are indicative of the support provided to the information shared construct by higher levels of trust between farmers and abattoirs and established farmer networks. It is, therefore, recommended that differentiated meat supply chains, through their various associations, concentrate their efforts to promote information sharing by building stronger, trust centered relationships and by supporting farmer networks.

JEL classification: D22; D23; D70; D82; D85; Q10

Keywords: Opportunistic behavior; farmer networks; trust; information sharing; Karoo Lamb

1. Introduction

Collaboration throughout the supply chain is improved when information exchange is fast and easy. With higher collaboration between supply chain stakeholders, information sharing is likely to increase which might reduce opportunistic behavior (Van der Vorst et al., 2002).

According to Williamson (1975), under conditions of asymmetric information and conflicting interests, transactions are likely to suffer from opportunistic behavior; "self-interest seeking with guile." Williamson (1985) elaborated on this view by describing opportunism as the "incomplete or distorted disclosure of information, especially calculated efforts [by the agent] to mislead, distort, disguise, obfuscate or otherwise confuse" the principal thereby exploiting the information vulnerability of the principal.

The danger for opportunistic behavior seems to be particularly true for differentiated supply chains that moved from commodity supply chains, driven by autonomous stakeholders, to differentiated product supply chains with a wide array of interconnected complex relationships between stakeholders (Wever, 2012). These differentiated supply chains often focus on differentiated claims based on credence attributes such as "free range", "antibiotic free", "hormone free" or from a particular "region of origin". These claims, however, bring about several possibilities for opportunistic behavior because of increased information asymmetries surrounding these claims (Wever, 2012).

Although opportunistic behavior is suspected, and can admittedly cause havoc in differentiated supply chains, it is not always easy to detect, which makes it quite difficult to prevent. A better understanding of the drivers of opportunistic behavior may, therefore, lead to the development of customized monitoring and enforcement mechanisms to safeguard, not only the product's reputation and the supply chain stakeholders, but also the uninformed consumer against possible exploitation.

2. The case of Karoo Lamb

One illustrative case study of a differentiated meat supply chain is Karoo Lamb in South Africa. The Karoo Lamb supply chain is differentiated in that it identifies and guarantees the Karoo region[1] as the origin of the lamb product but also include claims such as free range, no routine antibiotics, hormone free, good animal practices, and full farm-to-fork traceability[2] (KMOO, 2016).

Lamb reared on natural indigenous Karoo veldt[3] is believed to produce meat with a unique flavor (Erasmus et al., 2016). The unique identity of, and the geographical value attached to, Karoo Lamb makes it possible to sell Karoo Lamb at a premium price above ordinary lamb products. This unique identity makes the product exceptionally vulnerable to opportunistic behavior by stakeholders who do not comply with the strict Karoo Lamb production protocols. The misuse of the name means that the geographic advantage of farmers raising lamb, according to the protocols, in the Karoo region is lost, not only to the farmers but also to the Karoo community. Moreover, this misuse of the name further confuses the consumers, who have no way of authenticating the Karoo Lamb's origin and free-range credence attributes.

In an attempt to combat the exploitation of the Karoo name, a group of farmers established the Karoo Development Foundation (KDF) in 2009, to act as the custodian of the intellectual property rights embedded in the name "Karoo". With the purpose of mobilizing this responsibility, the KDF registered the Karoo Meat of Origin certification mark in 2011. This

[1] The Karoo in the Northern Cape Province of South Africa is a vast semi-arid area that covers almost 46 million hectares, 50% of the total area of South Africa (Le Roux et al. in Kirsten et al. 2008). The region is far from urban centers and home to flocks of free roaming sheep. The vegetation of this region comprises a variety of different species of wild herbs with limited grass growth.

[2] See http://www.karoomeatoforigin.com/karoo-standards/ for the complete list of protocols.

[3] In general, veldt refers to uncultivated grass and shrub land in southern Africa. Karoo veldt specifically refers to a combination of different species of indigenous wild herbs.

meant that it was now illegal to label a product as "Karoo Lamb" if it is not certified under the Karoo Meat of Origin certification scheme (Kirsten, 2011).

Following the establishment of the certification mark, Karoo farmers, abattoirs, processors, retailers and other outlets can apply to use the certification mark. The certification scheme, as a system of auditing and certification, has the responsibility to prevent supply chain stakeholders from exploiting the marketing potential that rests in the name "Karoo", by selling lamb products, that do not comply with the scheme's protocols, as "Karoo Lamb". The certification of Karoo Lamb furthermore assumes that the consumer is willing to pay a price premium for these products, of between 0.07 and 0.15USD per kg carcass weight[4] (in previous years) (van Zyl et al., 2013). This potential price premium makes the concept of Karoo Lamb even more attractive for farmers, abattoirs, processors and retail outlets.

Although all the entities in the Karoo Lamb supply chain can act opportunistically (by not complying with the stipulated protocols), and probably do from time to time, the paper focuses mainly on the Karoo farmers' since the essence of the Karoo Lamb product is rooted in the unique production practices. In the Karoo Lamb case, the farmers are found to behave opportunistically specifically by breaching the certification scheme's free range on indigenous Karoo vegetation protocol.

During some initial conversations with the certified Karoo abattoirs, they revealed instances where they had to reprimand opportunistic farmers for violating the Karoo Lamb protocols. These farmers would feed their lambs, either in feedlots or on Lucerne (alfalfa) fields, to realize a higher price for a better carcass, and then market the lambs as Karoo Lamb to capture the potential price premium paid for Karoo Lamb.

[4] Income from premium: Average farm with 500 lambs x 22 kg carcass x 0.07 USD premium/kg = 770 USD
Average farm with 500 lambs x 22 kg carcass x 0.15USD premium/kg = 1650 USD

The opportunistic behavior of farmers does not only increase the risk of reputational damage to the Karoo Lamb name if non-compliance with protocols are revealed but also puts the reputation of the other stakeholders at risk. Continued opportunistic behavior can potentially lead to the collapse of the Karoo Lamb name, especially if consumers decide to boycott Karoo Lamb because they feel cheated in that they pay premium prices for commodity lamb products.

Clearly, the opportunistic behavior of farmers may damage the reputation of Karoo Lamb and could potentially lead to welfare losses to every stakeholder participating in the Karoo Lamb supply chain. Adequate measures to safeguard the Karoo Lamb supply chain will reduce opportunism, which will result in absolute gains due to the supply chain stakeholders' complete commitment to the transaction (Lippert et al., 2014; Williamson, 1999). These safeguards usually include a monitoring system, to monitor supply chain stakeholders for opportunistic behavior, and enforcement mechanisms, to enforce penalties for opportunistic behavior and incentives to reward principled behavior.

Upon its establishment, the certification scheme appointed the South African Meat Industry Company (independent third party) to conduct the audits for certification as well as the follow-up inspections for compliance on behalf of the certification scheme. Currently, it seems like the certification scheme has a handle on ensuring protocol compliance among the abattoirs, processors, and retailers; these entities are audited annually with the danger of losing their certification if non-compliance is suspected. However, to monitor and reprimand the opportunistic farmers that are scattered throughout the very remote Karoo region[5] has proven to be more challenging. The measures stipulated to monitor farmers include scheduled audits every four years and the (often empty) promise of an annual unscheduled audit with the danger of losing their certification if opportunism is suspected. Moreover, all the stakeholders are

[5] Up to date, a total of 209 Karoo farmers have been certified, which relates to a total of 417 farms covering close to two million hectares across the almost 46 million hectare Karoo region.

allowed to reapply for permission to use the certification mark if their certification was revoked for whatsoever reason (KMOO, 2016). Even though the certification scheme stipulated their measures to deal with opportunistic stakeholders on their official website, very few of the stakeholders (specifically the farmers), are aware of these monitoring and enforcement mechanisms.

It is in this context, that the paper aims to identify measures that can safeguard the farmer-abattoir transaction against the opportunistic behavior of farmers to assure the credibility of Karoo Lamb, in an attempt to increase the overall success of the Karoo Lamb supply chain.

3. The theoretical framework and research hypotheses

Trust, in particular between stakeholders in differentiated supply chains, becomes significantly more important due to the higher degree of interdependencies (La Londe in Kwon & Suh, 2005). For stakeholders participating in differentiated agricultural supply chains, with increased interdependencies because of pooled reputational capital, trust and the importance of information sharing become even more important. The more the supply chain stakeholders trust each other, the more likely they are to share information with each other (Eckerd & Hill, 2012) and the less likely they are to act opportunistically (Wang et al., 2014; Wang et al., 2013; Chymis et al., 2007). Exploring the relationship between information sharing and opportunistic behavior is therefore postulated.

Hypothesis 1: *Information sharing between the farmer and the abattoir has a negative effect on the opportunistic behavior of the farmer*

"It is trust – not power, wealth, or even love – that is the most important operational resource in our society. Why? Without trust, we would simply be unable to act." (Eisenegger, 2009). Trust is having confidence in each other's reliability and integrity, and on the expectation that

the one has the other's best interest at heart (Jones & George, 1998; Williamson, 1993). Although Fawcett et al. (2007) regard information sharing as the most important factor for successful supply chain relationships and performance, the exchange of information requires trust between supply chain stakeholders (Kwon & Suh, 2005). However, the level of trust between two supply chain stakeholders often dictates the type and detail of the information shared between them. A relationship is, therefore, expected between the trust that the farmer has in the abattoir, and the information that the farmer shares with the abattoir.

Hypothesis 2: *The farmer's trust in the abattoir has a positive effect on the information that the farmer shares with the abattoir*

According to Hines (1995), organizations form networks based on the need to exchange resources. This is especially true in the vast Karoo region, where the townsfolk and neighboring farmers rely heavily on one another. To that end, although relatively isolated, close-knit communities are formed in which resources and information are shared[6]. By being part of a network, farmers gain access to valuable information. Information obtained and shared within a network function as a mechanism for reducing information asymmetries and subsequent opportunistic behavior (Lu 2007). Recent studies that investigated the relationship between networks and information sharing implied that farmer networks might stimulate information sharing for improved technology adoption (Manson, 2016; Burbi, 2016; Ward & Pede, 2015), enhanced conservation (Rosman, 2015) and better-performing collectives (Ostrom, 2014) or cooperatives (Bijman et al., 2012). Most of the research did not explicitly focus on the impact of networks on information sharing. However, Jraisat et al., (2013) did find that networks triggered information exchange in supply chains. It is, therefore, expected that farmers who participate in a network are not only more likely to share information within the network but

[6] Most of the farmers (92%) belong to a farmer's union that hold monthly meetings during which information on many different aspects are shared by either the community or an expert in the field. Some of the farmers (20%) belong to a smaller study group where confidential information, such as finances, are shared among the farmers. These farmer's unions and study groups include both certified Karoo Lamb, and non-certified farmers.

are also more likely to exchange information with the rest of the supply chain to achieve their common goal.

Hypothesis 3: *Positive psychographic variables of farmers participating in farmer networks have a positive effect on the information shared between farmers and abattoirs*

Although the farmers' loyalty to the Karoo region and their common goals, led to the formation of the certification scheme, it is unclear whether or not the farmers are satisfied with the certification scheme's efforts to protect the Karoo name from exploitation. Farmer satisfaction is an important consideration, since a person's satisfaction with a service, is often used to predict future usages of that service (Newman & Werbel, 1973). Satisfied customers are more likely to continue using the service, share their positive experiences and are less receptive to a competitor's offerings. This demonstrates the fact that a relationship between satisfaction and loyalty exist, namely that satisfaction may lead to increased loyalty (Gallarza et al., 2016; Awan & Rehman, 2014). Although studies that focus on the effect of customer satisfaction on loyalty are abundant in market research (see *inter alia* Gallarza et al., 2016; Pappu, 2016; and Mutonyi, 2016 for an agricultural study) the relationship between satisfaction with, and loyalty towards an agricultural collective organization, such as Karoo Lamb, are not researched explicitly. The farmer's satisfaction with the certification scheme's efforts to protect the geographical value of the Karoo Lamb product is, therefore, expected to positively influence the farmer's loyalty to the certification scheme. Moreover, although specific research on the relationship between satisfaction and information sharing is scarce, it is postulated that farmers who are satisfied with the performance of the certification scheme would be (more) willing to share (more) information in an attempt to reach their common goal.

Hypothesis 4: *Farmer satisfaction with the certification scheme has a positive effect on farmer loyalty to the establishment of the differentiated product*

Hypothesis 5: *Farmer satisfaction with the certification scheme has a positive effect on the information shared between the farmer and the abattoir*

The farmers and abattoirs participating in the Karoo Lamb supply chain can be viewed as nodes embedded in a network of organizations that simultaneously facilitate and constrain their interests and actions (Nohria & Eccles, 1992; Powell, 1990). Various definitions for networks are present in the literature (see *inter alia* Claro, 2004; Ménard, 2002; Omta et al., 2001), all of which describe a network as a coalition of organizations that recognize that they can benefit from pooling their resources to achieve a common goal. The effect of loyalty on specifically social network participation has recently received much attention (Zamanian & Khanlari, 2015; Gamboa & Gonçalves, 2014). Since a farmer network is also a type of social network, farmer loyalty is expected to influence farmer participation in the network. Moreover, the close-knit farming community in the Karoo region is rooted in social relationships and is a good example of a network based on mutual trust, loyalty to the cause and their shared goals. It is therefore postulated that the farmers' loyalty to the Karoo region led to the development of farmer networks (study groups, farmer's associations, community networks, and the certification scheme) to achieve their shared goals (protect the Karoo name from exploitation).

Hypothesis 6: *Farmer loyalty to the establishment of the differentiated product and its origin has a positive effect on the general psychographic variables of farmer networks*

The paper aims to make the following theoretical contribution to the knowledge base; to identify and evaluate the different factors that impact (directly or indirectly) on the farmers' tendency to behave opportunistically (see Assefa Wendimu et al., 2017 for a recent addition to the knowledge base). The theoretical objective is achieved through a novel application of the PLS-SEM approach to identify the factors most likely to impact on the farmers' tendencies to behave opportunistically. The paper is expected to act as a point of departure on which future research can build to enhance the understanding of the somewhat unexplored (especially in the

context of agricultural transactions) concept that is opportunistic behavior (Fig. 1). In doing so, the paper is able to make a practical contribution; to develop strategies that can be implemented by the custodians of differentiated products and by the broader industries of these products, to prevent opportunistic behavior, at least for now, among farmers.

4. Methodology and research context

4.1 Research design

From the total population of 209 certified Karoo Lamb farmers, 73 farmers[7] were interviewed on their farms in the Karoo region. These farmers were identified by using convenience sampling, specifically the referral sampling method.

Although the certification scheme has an elaborate database of their certified members, most of the farmers were unable to provide their GPS coordinates to be captured. This shortcoming made it exceptionally difficult to track down these farmers for interviews. Keeping the vastness of the Karoo region (totaling 46 million hectares) in mind, endeavoring to locate 73 farmers (farming on a total of approximately two million hectares) would have been a laborious and expensive task if a random sampling method was used instead.

As a result, appointments were scheduled with the managers of three of the five certified abattoirs located in the central Karoo region during May of 2015. These abattoirs assisted with the identification and locality of the certified farmers in each of the districts surrounding the abattoirs. During June and July of 2015, interviews were scheduled with each of the 73 certified farmers to complete structured questionnaires that contained predominantly five-point Likert

[7] The sample of 73 farmers comply with both the 10 times rule of thumb fostered by Barcley et al. (1995) as well as the more differentiated rules of thumb for structural equation modelling, presented by Cohen (1992). The sample size is also in line with the minimum of 50 observations recommended by Sideridis et al. (2014) and Iacobucci (2010) for structural equation modelling.

scale questions going from strongly disagree (1) to strongly agree (5). These questions (summarized in Table 4 of the online appendix) were developed specifically to be used as indicators to explain the latent variables identified as; farmer satisfaction, trust in the abattoir, farmer loyalty, farmer network, information sharing and opportunistic behavior.

The questions related to farmer satisfaction mainly focused on the farmer's level of satisfaction with the management of the certification scheme, the way in which the Karoo Lamb product is marketed, and whether or not the farmer felt that he or she gained (financially or otherwise) from being a certified member. The trust in the abattoir construct included questions about the relationship the farmer had with the abattoir, and whether or not the farmer saw the abattoir as a trustworthy business partner with a good reputation in the Karoo community. The farmer loyalty construct referred to the farmer's loyalty towards the Karoo region and the development thereof, his or her loyalty to the certification scheme and to what extent the farmer supported the protection of the Karoo name against exploitation.

The farmer network construct was examined by focusing on the farmer's opinion of his or her neighboring farmers since these farmers are likely to participate in the same network (farmer association or study group). The questions inquired about their opinion of their neighbors' trustworthiness, reputations, and integrities, to what degree they are loyal to the certification scheme, and to what extent do they support the development of the Karoo region. The questionnaire included a section where the farmers were asked to express an opinion of themselves by using the same criteria, but the results were biased towards strongly agree and were, therefore, excluded from the analysis.

The information sharing construct focused on how well the farmer shares information with the abattoir, as well as the types of information that the farmer is likely to share with the abattoir. These include information on feed, diseases, droughts and the quantity of lamb to be marketed to the abattoir.

In an attempt to prevent measurement error, some of the questions were repeated somewhat differently elsewhere in the questionnaire, especially the questions related to the farmers' tendencies to behave opportunistically. The farmers were asked directly if they have feedlots and Lucerne fields on their farms and whether or not they used these facilities. Later on in the questionnaire, the farmers were asked if they ever marketed lamb from a feedlot or Lucerne field to the abattoir as Karoo Lamb. As a control, they were also requested to comment on their neighbors' tendencies to behave opportunistically by marketing fed lamb to the abattoir as Karoo Lamb. In a further attempt to ensure the honesty of farmers about their behavior, the reasoning behind the study was explained as an endeavor to understand the farmers' role in the Karoo Lamb supply chain, without explicitly mentioning opportunistic behavior.

One after the other, all the questions related to opportunistic behavior were tested in the PLS-SEM path model, and the results analyzed. In the end, the questions related to whether or not farmers have feedlots and Lucerne fields that are in use demonstrated acceptable significance levels and were therefore used as proxy indicators for the latent opportunistic behavior construct.

In general, the indicator correlation matrix (included in the online Appendix - Table 5) demonstrate high positive correlations between the indicators of the same construct. Some of the indicators that showed weaker relationships with the other indicators of the same construct include the relationships between; (i) farmer satisfaction with the marketing of Karoo Lamb, and the extent to which the farmer gained from being part of the certification scheme, and (ii) how well the farmer share information with the abattoir and the information that is shared relating to droughts experienced on the farm.

The correlation matrix showed a weak negative relationship between the utilization of feedlots and the use of Lucerne fields. This is to be expected since some of the farmers had both facilities on their farms and elected to, at certain times, only use one of the two.

The descriptive statistics indicated that on average, almost half of the surveyed farmers utilized their feedlots and Lucerne fields to get lambs market ready. Equally troublesome for the certification scheme is the fact that, on average, only some farmers shared information related to supplementary feed fed to lambs, and animal diseases with the abattoir (online appendix Table 3).

4.2 Empirical method

A structural equation modeling (SEM) approach, specifically the partial least squares (PLS) method was applied to explain the structure among the unobserved latent variables by using observed variables (Hair et al., 2014). The PLS approach to SEM, initially developed by Wold (1982), has been widely adopted for analyzing complex situations where theories are not well developed (Garson, 2016; Wong, 2013; Hwang et al., 2010).

PLS-SEM does not require normally distributed data, which makes relatively small sample sizes acceptable, especially if the variables are reliable, the effects strong, and the model not overly complex (Sideridis et al., 2014 & Iacobucci, 2010). The PLS-SEM approach can, furthermore, handle multicollinearity among the independent variables and is robust in the face of data noise and, depending on the software used, missing data. PLS-SEM also allows for the simultaneous analysis of all structural relationships among many constructs (based on several indicator variables) which ultimately leads to more accurate results and stronger predictions (Hair et al., 2014). Unlike other SEM techniques, PLS-SEM permits the inclusion of single item measures to explain latent variables.

On the other hand, the primary and most often referred to shortcoming of PLS-SEM is the inconsistency of the latent variables and the biasedness of the latent variable relationships that are reflected in the path coefficients. The result of this biasedness is that the path coefficients

are often underestimated, while the measurement model loadings are typically overestimated. Although this applies in particular to models with small samples, simulation studies found PLS-SEM bias to be present at very low levels and is therefore of limited relevance (Hair et al., 2014). Other disadvantages include difficulties in interpreting the loadings of the latent variables because they are abstract, complex and not directly observable and the fact that PLS-SEM cannot measure undirected correlation (Fornell & Cha, 1994).

The advancement of PLS-SEM as an analytical tool has recently been applied to a number of studies in the agricultural domain; see *inter* alia, Franken et al. (2017), Ragasa and Golan (2014), Ji (2012), Franken et al. (2010), Han (2009), Dentoni et al. (2009), Van Ittersum et al. (2007), Lu (2007), Pennings and Garcia (2001), and Pennings and Leuthold (2000). However, the application of the PLS-SEM approach to opportunistic behavior in agricultural transactions has received limited attention. The application of PLS-SEM to the Karoo Lamb case, primarily to determine the factors impacting on the opportunistic behavior of farmers, is therefore of particular interest.

The SEM, adopted from Bollen (1998), is represented by the following equations:

$$x = \lambda^x \xi + \delta \quad (1)$$

$$y = \lambda^y \eta + \varepsilon \quad (2)$$

$$\eta = \boldsymbol{B}\eta + \Gamma\xi + \zeta \quad (3)$$

Equations one and two are factor-analytic measurement models that link observable indicators to the unobservable latent constructs. The vectors x and y represent the measures of the independent and dependent constructs in the vectors ξ and η respectively. The coefficient matrices are represented by λ^x and λ^y with measurement errors contained in the vectors δ and ε. Equation three signifies the path model with path matrices $\boldsymbol{B}$ and Γ denoting the path

coefficients between dependent constructs and the coefficients between independent and dependent constructs respectively. The disturbance term ζ represents the errors in the path model equation.

The analysis was conducted with the SmartPLS3 software (Ringle et al., 2015), which is widely used for PLS-SEM path modeling. The SmartPLS3 algorithm provides empirical measures that are used to determine how well the theory fits the data (Dijkstra, 2010). The SmartPLS3 bootstrapping and blindfolding techniques can furthermore be applied to determine the significance (by estimating the standard errors for each hypothesized relationship) of the relationships and the predictability of the PLS-SEM model respectively (Hair et al., 2014).

5. Results

The evaluation of the empirical results follows a two-step process in which the relationships between the indicators and constructs (measurement model), and the relationships between the constructs (structural model) in the PLS-SEM path model are assessed separately but consecutively (Hair et al., 2014).

5.1 Measurement model evaluation

The constructs indicate robust internal consistency with most of the composite reliability[8] values well above the 0.7 cut-off point. The constructs furthermore demonstrate mostly high levels of convergent validity[9] with average variance extracted values well above the 0.5 rule of

[8] Composite reliability is a measure for internal consistency reliability, and measures the reliability based on the intercorrelations of the indicator variables. Values between 0.7 and 0.9 are regarded as satisfactory, and values between 0.6 and 0.7 are acceptable for exploratory research (Hair et al., 2014).

[9] Average variance extracted (sum of the squared outer loadings divided by the number of indicators) is used to determine convergent validity. Convergent validity measures the extent to which one indicator correlates positively with other indicators of the same construct (Hair et al., 2014).

thumb. In addition, the correlation matrix (indicated in bold in Table 5 in the online appendix) demonstrates mostly positive and strong correlations with indicators of the same construct. An assessment of the cross-loadings and the Fornell-Larcker criterion provide evidence for the discriminant validity[10] of the modeled constructs (Table 1).

The empirical results of the reflective measurement model are indicative of a robust model based on reliable and valid measures. The relationships between constructs in the structural model and the model's predictive capabilities can now be evaluated.

5.2 Structural model evaluation

The structural model serves to test the relationships between the latent constructs. Because PLS-SEM applies ordinary least squares regression (OLS) to estimate path coefficients a collinearity test is required to prevent biasedness among path coefficients before assessing the structural model (Hair et al., 2014). In order to evaluate the collinearity of the structural model, an assessment of the predictor constructs' variance inflation factors are required. The observed variance inflation factors of below 5 indicate that collinearity among the predictor constructs is not a problem, and the systematic evaluation of the structural model is permitted (Table 2).

An assessment of the R^2 values demonstrates the structural model's predictive accuracy. The R^2 value for opportunistic behavior (R^2=0.070) are considered to be relatively weak, even for studies on agent behavior, but the exploratory nature of this study renders its inclusion noteworthy. The R^2 values for farmer network (R^2=0.144) and farmer loyalty (R^2=0.113) are considered to be moderate. The R^2 value for information sharing (R^2=0.387) can be seen as high for behavioral studies (Hair et al., 2011). Although the R^2 values are relatively low,

[10] Discriminant validity is a measure of individuality and measures the extent to which one construct is truly different from another construct to ensure that two or more constructs do not capture the same phenomena. The Fornell-Larcker criterion, an approach that compares the square root of the average variance extracted values with the latent variable correlations, is used to determine discriminant validity (Hair et al., 2014).

including more constructs to the structural model for the sake of increasing the coefficient of determination might destroy the ultimate goal of model parsimony (Hair et al., 2014).

The R^2 value is furthermore used to determine the effect size (f^2). The structural model indicates strong effects between trust in the abattoir and information sharing (f^2=0.200). The medium effects include that of farmer loyalty on farmer network (f^2=0.168), and farmer satisfaction on farmer loyalty (f^2=0.128). The other constructs, on the other hand, demonstrate small effect sizes with f^2 values ranging between 0.092 (farmer network on information sharing) and 0.075 (information sharing on opportunistic behavior).

The structural model demonstrates predictive relevance since the Q^2 values although small (ranging from 0.135 for information sharing to values as low as 0.003 for opportunistic behavior), as is expected for theory development, are greater than zero (Fornell & Bookstein, 1982).

5.3 Evaluating the hypothesized relationships

The path coefficients indicated in the structural model demonstrates relatively robust and significant relationships between all the constructs contained in the model, except for the direct relationship between farmer loyalty and information sharing that are not significant. The indirect relationships between farmer loyalty and information sharing via farmer network and farmer satisfaction are however significant (Fig. 2).

The PLS-SEM analysis of the structural model revealed a positive relationship between farmer loyalty and farmer networks (β=0.379; p-value=0.000), confirming the hypothesized relationship. The farmer's loyalty to the Karoo region, the unique Karoo Lamb product that they produce, and their determination to protect the geographical value attached to the Karoo name provides them with a shared goal to find like-minded farmers with whom to build

networks. Farmer satisfaction furthermore demonstrated a positive relationship with farmer loyalty (β=0.337; p-value=0.042). This hypothesis supports the notion that the farmer's satisfaction with the performance of the certification scheme, to protect the geographical indication, impacts positively on their loyalty to protect the Karoo name against exploitation.

One of the reasons why farmers establish networks in farming communities is to share information. The network's common goal, to protect the Karoo name against exploitation, is therefore expected to inspire honest information sharing with the abattoir. The results confirmed the positive effect that farmer networks have on information sharing (β=0.259; p-value=0.022). Farmers who participate in farmer networks are expected to, frequently, share information regarding droughts, feeding practices, and disease treatments, with the abattoir as a dedicated effort to reach the common purpose of the network. Comparably, farmer satisfaction has a positive effect on information sharing (β=0.216; p-value=0.037). Farmers who are satisfied with the efforts of the certification scheme and the abattoir, to protect Karoo Lamb against exploitation, are more likely to build long-term relationships with these stakeholders. Farmer satisfaction, in turn, encourages the farmer to share information, specifically about droughts, supplementary feed, lamb numbers, and diseases. It is especially important that farmers share this information with the abattoir since it relates directly to the free range, and free from antibiotics protocols. If farmers violate these protocols and the abattoir are not informed, the reputation of Karoo Lamb can be harmed. Moreover, trust in the abattoir has a positive effect on information sharing (β=0.371; p-value=0.003). The more the farmer trust the abattoir as a business partner the more likely the farmer will be to share information regarding the production practices with the abattoir.

As the most important factor for successful supply chain relationships, it was expected that information sharing would play a significant role to reduce the opportunistic behavior of farmers. The PLS-SEM results supported this hypothesis (β=-0.264; p-value=0.008). The more

information the farmer shares with the abattoir regarding droughts, feeding practices, and disease treatments, the less likely he will be to act opportunistically by, for example, delivering lamb as Karoo Lamb that has in fact been reared in a feedlot or on Lucerne fields. Moreover, the frequent exchange of relevant information is likely to deepen the level of trust between the farmer and the abattoir, which will further reduce the farmer's tendency to behave opportunistically.

6. Applicability of the findings

The many efforts to upgrade commodity supply chains to more differentiated chains increased the interdependencies between supply chain stakeholders (in this case the farmer and the abattoir) and increased their exposure to behavioral uncertainties (Wever, 2012). The Karoo Meat of Origin certification scheme was the first attempt in South Africa to differentiate and protect a region of origin meat product. Although the certification scheme has come a long way in protecting the value embedded in the name "Karoo", many loopholes for opportunistic behavior still exist. Misconduct on the farmers' side regarding the vulnerable free range on indigenous Karoo veldt claim may have disastrous consequences since the essence of the Karoo Lamb product is embedded in this claim.

The purpose of this study was to suggest, to not only the KDF and the certification scheme but also to the broader red meat industry, strategies aimed at safeguarding farmer-abattoir transactions against opportunistic behavior in differentiated meat supply chains by identifying factors most likely to influence opportunistic behavior.

Although the results should be interpreted with caution due to the theory development nature of PLS-SEM path modeling, the initial results revealed some interesting findings. The four most important relationships to consider for practical application in differentiated meat supply

chains (such as Karoo Lamb) are the relationships between farmer loyalty and farmer network, farmer network and information sharing, trust in the abattoir and information sharing, and information sharing and opportunistic behavior.

The successive relationships between farmer network, information sharing, and opportunistic behavior are indicative of the catalytic effect of farmer networks to improve information sharing among farmers, and with abattoirs. The farmers' loyalty to the abattoirs (60.3% of the farmers only deliver to one abattoir, and 27.4% of the farmers have been delivering to the same abattoir for more than 30 years) ensures that the farmers and the abattoirs share information easily. It might, therefore, be in the interest of the certification scheme and the KDF to support farmer networks, to stimulate information sharing between the farmers and the abattoirs to inhibit the opportunistic behavior of farmers eventually. Opportunistic behavior is even more likely to be inhibited when information regarding opportunistic farmers is available, and members of the network are willing to act jointly against the opportunistic farmer[11].

Additionally, abattoirs should focus on building stronger, trust-centered relationships with the farmers. Stronger relationships are likely to stimulate information sharing with the abattoir, specifically information concerning the deviations from protocols by the farmer, to safeguard the farmer-abattoir transaction against opportunistic behavior.

Satellite technology might also play a role in combatting farmers' tendencies to behave opportunistically. If the certification scheme invests in the collection of certified farmers' GPS coordinates, satellite technology, such as Google Earth, can enable the certification scheme to at least monitor the use of Lucerne fields and feedlots for rearing Karoo Lamb. Unfortunately,

[11] The surveyed farmers agreed that opportunistic farmers should be expelled from the certification scheme forever (35.6%), for five years (26%), or for three years (38.2%). As further support, the majority of the farmers (85.7%) believed that they should be monitored by members of the collective by means of self-monitoring (13.9%), and by the other Karoo Lamb farmers (4.7%). The rest of the farmers felt that monitoring through the certification scheme (9.4%), by the general farmer's union (4.7%), and by the independent third party, currently responsible for the monitoring (1.2%), would be sufficient.

this technology will not be able to spot farmers who provide excessive (more than 300g per lamb per day) supplementary feed on the veldt, which remains a problem, especially during times of drought.

Correspondingly, the findings suggest that red meat industries with differentiated product supply chains, through their various associations, should concentrate their managerial efforts to promote information sharing between farmers and abattoirs. Information sharing between the farmer and the abattoir is crucial especially when it comes to assuring credence attributes such as free range, hormone and antibiotic free or from a specific region. In supply chains with a strong collective presence, attempts to strengthen communion in farmer networks might be sufficient to encourage information sharing among farmers, and with abattoirs. However, in supply chains where a collective organization is lacking, investments in comprehensive farm-to-fork traceability systems might be required to enforce information sharing. Overall, it is expected that improvements in information sharing would reduce the uncertain behavioral dimension, thereby limiting the opportunistic behavior of farmers and ultimately safeguarding the unacquainted consumers of differentiated products against deception.

7. Recommendations for future research

In a consumer driven world, where consumers are longing a connection with their product's origin and are becoming more concerned with the protocols under which their products are produced, there are definite values to be captured from differentiated product supply chains. However, to successfully capture this value, consumers should be certain of the origin and the production protocols that they are often willing to pay a premium for, and they should ultimately be protected from exploitation by opportunistic supply chain stakeholders.

Although the paper originated from a practical problem of opportunistic behavior faced by the Karoo Lamb supply chain in South Africa, the paper also functions as a point of departure for future studies relating to opportunistic behavior in other differentiated supply chains. Further research in other differentiated meat supply chains is expected to make exciting discoveries regarding additional factors that influence opportunistic behavior. These factors are likely to increase the number of indicators per latent variable for more robust structural equation models with higher path coefficients and stronger relationships between latent constructs.

Furthermore, determining the factors that have an impact on opportunistic behavior is especially challenging since the data focused almost exclusively on the farmer's perceptions, or on the farmer's honesty about his/her own production and marketing practices. As a result, the set of indicators used for opportunistic behavior might be incomplete. It would, therefore, be valuable if future research focuses on additional measures that will produce complementary indicator variables, in particular for the opportunistic behavior construct, and for the constructs related to opportunistic behavior such as, farmer networks, farmer satisfaction, and information sharing constructs. Variables with higher reliability scores are expected to yield higher path coefficients from which additional inferences can be made.

Additionally, future studies can explore completely different ways in which to determine whether farmers tend to be opportunistic in their production and marketing decisions. One of the avenues that can be explored includes field experiments, specifically randomized controlled trials (see Saenger et al., 2014 for a field experiment in Vietnam). These randomized controlled trials allow supply chain stakeholders to make decisions in their natural environments. A field experiment approach, although time-consuming and expensive, is sure to bring alternative strategies for preventing opportunistic behavior among Karoo Lamb farmers.

Opportunistic behavior can occur throughout the supply chain. This study, however, only focused on the factors that impact on the farmer's tendency to behave opportunistically. A study that includes all the stakeholders participating in the supply chain might, therefore, be particularly interesting. Specifically, to explore the factors that lead other stakeholders to behave opportunistically, which can be utilized to suggest organization specific strategies, to safeguard transactions against opportunistic behavior.

Finally, future studies could eventually lead to comparative studies to determine the impact of culture, norms, and beliefs on the opportunistic behavior of farmers residing in different countries, governed by different institutions, and participating in various differentiated product supply chains.

Acknowledgments

The authors would like to extend their sincere appreciation to the Karoo farmers for their participation in the data collection process. In addition, the authors would like to thank the three anonymous reviewers for their thorough reviews of the paper. This research was sponsored by Red Meat Research and Development SA and the Bill and Melinda Gates Foundation.

References

Assefa Wendimu M., Henningsen A., Czekaj T. G., 2017.Incentives and Moral Hazard: Plot Level Productivity of Factory-Operated and Outgrower-Operated Sugarcane Production in Ethiopia. Agricultural Economics, 00(2017): 1-12

Awan, A. G., Rehman, A. U., 2014. Impact of customer satisfaction on brand loyalty-an empirical analysis of home appliances in Pakistan. British Journal of Marketing Studies, 2(8): 18-32.

Barcley, D. W., Thompson, R., Higgins, C., 1995. The partial least squares approach to causal modelling: personal computer adoption and use as an illustration. Technology Studies: Special Issue on Research Methodology, 2(2): 285-309.

Bijman, J., Iliopoulos, C., Poppe, K. J., Gijselinckx, C., Hagedorn, K., Hanisch, M., Hendrikse, G. W. J., Kühl, R., Ollila, P., Pyykkönen, P., Van der Sangen, G., 2012. Support for farmers' cooperatives: final report. Wageningen University. The Netherlands.

Bollen, K. A., 1998. Structural Equation Models. John Wiley, New York.

Burbi, S., Baines, R.N., Conway, J.S., 2016. Achieving successful farmer engagement on greenhouse gas emission mitigation. International Journal of Agricultural Sustainability, 14(4): 466-483.

Chymis, A. G., James, H. S., Konduru, S., Pierce, V. L., Larson, R. L., 2007. Asymmetric information in cattle auctions: the problem of revaccinations. Agricultural Economics, 36: 79–88

Claro, D. P., 2004. Managing business networks and buyer-supplier relationships: How information obtained from the business network affects trust, transaction specific investments, collaboration and performance in the Dutch potted plant and flower industry. PhD Thesis. Wageningen University and Research Centre. The Netherlands.

Cohen, J., 1992. A power primer. Psychological bulletin, 112(1): 155.

Dentoni, D., Tonsor, G. T., Calantone, R. J., Peterson, H. C., 2009. The Direct and Indirect Effects of 'Locally Grown' on Consumers' Attitudes towards Agri-Food Products. Agricultural & Resource Economics Review, 38(3): 384

Dijkstra, T. K., 2010. Latent variables and indices: Herman Wold's basic design and partial least squares. In: Vinzi, V. E., Chin, W. W., Henseler, J., Wang, H. eds. Handbook of partial least squares: Concepts, methods and applications. Springer. Heidelberg, Dordrecht, London, New York.

Eckerd, S., Hill, J. A., 2012. The buyer-supplier social contract: information sharing as a deterrent to unethical behaviors. International Journal of Operations & Production Management, 32(2): 238-255.

Eisenegger, M., 2009. Trust and reputation in the age of globalisation. In: Klewes, J., Wreschniok, R. eds. Reputational capital: Building and maintaining trust in the 21st century. Springer. Heidelberg, Dordrecht, London, New York.

Erasmus, S. W., Muller, M., van der Rijst, M., Hoffman, L. C., 2016. Stable isotope ratio analysis: A potential analytical tool for the authentication of South African lamb meat. Food chemistry (192): 997-1005.

Fawcett, S. E., Osterhaus, P., Magnan, G. M., Brau, J. C., McCarter, M. W., 2007. Information sharing and supply chain performance: the role of connectivity and willingness. Supply Chain Management: An International Journal, 12(5), pp.358-368.

Fornell, C., Bookstein, F. L., 1982. Two structural equation models: LISREL and PLS applied to consumer exit-voice-theory. Journal of Marketing Research, 19(4): 440-452.

Fornell, C., Cha, J., 1994. Partial least squares. In Bagozzi, R. P. (editors). Advanced Methods of Marketing Research. Oxford: Blackwell.

Franken, J. R., Pennings, J. M., Garcia, P., 2017. Risk attitudes and the structure of decision-making: Evidence from the Illinois hog industry. Agricultural Economics, 48(1), pp.41-50.

Franken, J., Parcell, J., Patterson, D., Smith, M., Poock, S., 2010. Cow-calf producer interest in retained ownership. Journal of Agribusiness, 28(1): 49-59.

Gallarza, M. G., Arteaga-Moreno, F., Del Chiappa, G., Gil-Saura, I., 2016. Intrinsic value dimensions and the value-satisfaction-loyalty chain: a causal model for services. Journal of Services Marketing, 30(2): 165-185.

Gamboa, A. M., Gonçalves, H. M., 2014. Customer loyalty through social networks: Lessons from Zara on Facebook. Business Horizons, 57(6): 709-717.

Garson, G. D., 2016. Partial Least Squares: Regression and structural equation models. Statistical Associates Blue Book Series, Statistical Associates Publishing, Asheboro, USA.

Hair, J. F. (Jr.), Hult, G. T. M., Ringle, C. M., Sarstedt, M., 2014. A primer on partial least squares structural equation modelling (PLS-SEM). SAGE Publications, Inc. USA.

Han, J., 2009. Supply chain integration, quality management and firm performance in the pork processing industry in China. PhD Thesis. Wageningen School of Social Sciences. Wageningen University. The Netherlands.

Hines, P., 1995. Network sourcing: A hybrid approach. International Journal of Purchasing Materials Management, 31(2): 18-24.

Hwang, H., Malhotra, N. K., Kim, Y., Tomiuk, M. A., Hong, S., 2010. A comparative study on parameter recovery of three approaches to structural equation modelling. Journal of Marketing Research 47 (4): 699-712.

Iacobucci, D., 2010. Structural equations modeling: Fit Indices, sample size, and advanced topics. Journal of Consumer Psychology, 20(1): 90-98.

Ji, C., 2012. Governance structure choices in supply chain management: Evidence from Spanish and Chinese pork. PhD Thesis. University of Madrid. Madrid, Spain.

Jones, G. R., George, J. M., 1998. The experience and evolution of trust: Implications for cooperation and teamwork. Academy of Management Review, 23(3): 531-546.

Jraisat, L., Gotsi, M., Bourlakis, M., 2013. Drivers of information sharing and export performance in the Jordanian agri-food export supply chain: A qualitative study. International Marketing Review, 30(4): 323-356.

Karoo Meat of Origin (KMOO), 2016. Minimum standards: Minimum requirements to qualify for certification (farmers). Available at http://www.karoomeatoforigin.com/karoo-standards/

Kirsten, J. F., 2011. Protecting a product's unique qualities. Farmer's Weekly, Volume 11037:40. 7 October 2011.

Kirsten, J. F., Troskie, D., Vermeulen, H., Schönfeldt, H. C., Bramley, C., 2008. The potential for Karoo Lamb as origin based meat and a Geographical Indication. Research Report, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, South Africa.

Kwon, I. W. G., Suh, T., 2005. Trust, commitment and relationships in supply chain management: A path analysis. Supply Chain Management: An International Journal, 10(1): 26 – 33.

Lippert, C., Zorn, A., Dabbert, S., 2014. Econometric analysis of noncompliance with organic farming standards in Switzerland. Agricultural Economics, 45: 313–325

Lu, H., 2007. The role of guanxi in buyer-seller relationships in China: A survey of vegetable supply chains in Jiangsu province. PhD Thesis. Wageningen School of Social Sciences. Wageningen University. The Netherlands.

Manson, S. M., Jordan, N. R., Nelson, K. C., Brummel, R. F., 2016. Modeling the effect of social networks on adoption of multifunctional agriculture. Environmental Modelling & Software, 75(2016): 388-401.

Ménard, C., 2002. The economics of hybrid organizations, Presidential Address. International Society for New Institutional Economics. MIT, USA. September.

Mutonyi, S., Beukel, K., Gyau, A., Hjortsø, C. N., 2016. Price satisfaction and producer loyalty: the role of mediators in business to business relationships in Kenyan mango supply chain. British Food Journal, 118(5): 1067-1084.

Newman, J. W., Werbel, R. A., 1973. Multivariate analysis of brand loyalty for major household appliances. Journal of Marketing Research, (November): 404-409.

Nohria, N., Eccles, R. G., 1992. Face to face: Making network organizations work. In: Nohria, N., Eccles, R. G. (eds). Networks and organizations: Structure, form and action. Boston, Harvard Business School Press.

Omta, S. W. F. O., Trienekens, J. H., Beers, G., 2001. Chain and network science: A research framework. Journal on Chain and Network Science, 1(1):1-6.

Ostrom, E., 2014. Collective action and the evolution of social norms. Journal of Natural Resources Policy Research, 6(4): 235-252.

Pappu, R., Quester, P., 2016. Brand Innovativeness Effects on Perceived Quality, Satisfaction and Loyalty. In Looking Forward, Looking Back: Drawing on the Past to Shape the Future of Marketing, 763-763. Springer International Publishing.

Pennings , J. M. E., Garcia, P., 2001. Measuring producers' risk preferences: A global risk-attitude construct. American Journal of Agricultural Economics, (83): 993-1009.

Pennings, J. M., Leuthold, R. M., 2000. The role of farmers' behavioral attitudes and heterogeneity in futures contracts usage. American Journal of Agricultural Economics, 82(4): 908-919.

Powell, W. W., 1990. Neither market nor hierarchy: Network forms of organization. Research in Organizational Behavior, 12(1190): 295-336.

Ragasa, C., Golan, J., 2014. The role of rural producer organizations for agricultural service provision in fragile states. Agricultural Economics, 45(5): 537-553.

Ringle, C. M., Wende, S., Becker, J.-M., 2015. SmartPLS 3. Boenningstedt: SmartPLS GmbH. Available at http://www.smartpls.com.

Rosman, H. T., 2015. The farmer and farm networks: an examination of conservation adoption in the US corn belt. Dissertation. Iowa State University. USA.

Saenger, C., Torero, M., Qaim, M., 2014. The impact of third-party contract enforcement in agricultural markets—A field experiment in Vietnam. American Journal of Agricultural Economics, 96(4): 1220-1238.

Sideridis, G., Simos, P., Papanicolaou, A., Fletcher, J., 2014. Using structural equation modeling to assess functional connectivity in the brain power and sample size considerations. Educational and Psychology Measurement, (74):733-758

Van der Vorst, J. G. A. J., Van Dongen, S., Nougier, S., Hilhorst, R., 2002. E-business initiatives in food supply chains; Definition and typology of electronic business models. International Journal of Logistics (5:2).

Van Ittersum, K., Meulenberg, M. T., Van Trijp, H., Candel, M. J., 2007. Consumers' appreciation of regional certification labels: a Pan-European study. Journal of Agricultural Economics, 58(1): 1-23.

Van Zyl, K., Vermeulen, H., Kirsten, J. F., 2013. Determining South African consumers' willingness to pay for certified Karoo lamb: An application of an experimental auction. Agrekon, 52(4): 1-20.

Wang, Q., Li, J. J., Ross Jr, W. T., Craighead, C. W., 2013. The interplay of drivers and deterrents of opportunism in buyer–supplier relationships. Journal of the Academy of Marketing Science, 41(1): 111-131.

Wang, G., Zheng, Y., Li, R., 2014. The impact of relation-specific investments on channel performance: Focusing on mediators. Journal of Marketing Channels, 21(2): 87-99.

Ward, P. S., Pede, V. O., 2015. Capturing social network effects in technology adoption: the spatial diffusion of hybrid rice in Bangladesh. Australian Journal of Agricultural and Resource Economics, 59(2): 225-241.

Wever, M., 2012. Chain wide consequences of transaction risks and their contractual solutions. Managing interdependencies in differentiated Agri-food supply chains. PhD Thesis. Wageningen School of Social Sciences. Wageningen University and Research Centre. The Netherlands.

Williamson, O. E., 1999. Strategy research: governance and competence perspectives. Strategic Management Journal (20): 1087–1108.

Williamson, O. E., 1993. Calculativeness, trust, and economic organization. The Journal of Law and Economics, 36 (1) (1993): 453–486

Williamson, O. E., 1985. The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting. Macmillan: London.

Williamson, O. E., 1975. Markets and Hierarchies: Analysis and Anti-trust Implications: A Study in the Economics of Internal Organization. Free Press: New York.

Wold, H., 1982. Systems under indirect observation using PLS. In: Fornell, C. ed. A second generation of multivariate analysis. Praeger, New York.

Wong, K. K. K., 2013. Partial least squares structural equation modelling (PLS-SEM) techniques using SmartPLS. Marketing Bulletin, 24(1): 1-32.

Zamanian, S., Khanlari, A., 2015. Electronic word of mouth marketing: Relationship between brand loyalty and electronic word of mouth in social marketing networks. In: Khanlari, A. Strategic Customer Relationship Management in the Age of Social Media. Business Science Reference. IGI Global, USA.

Tables and figures

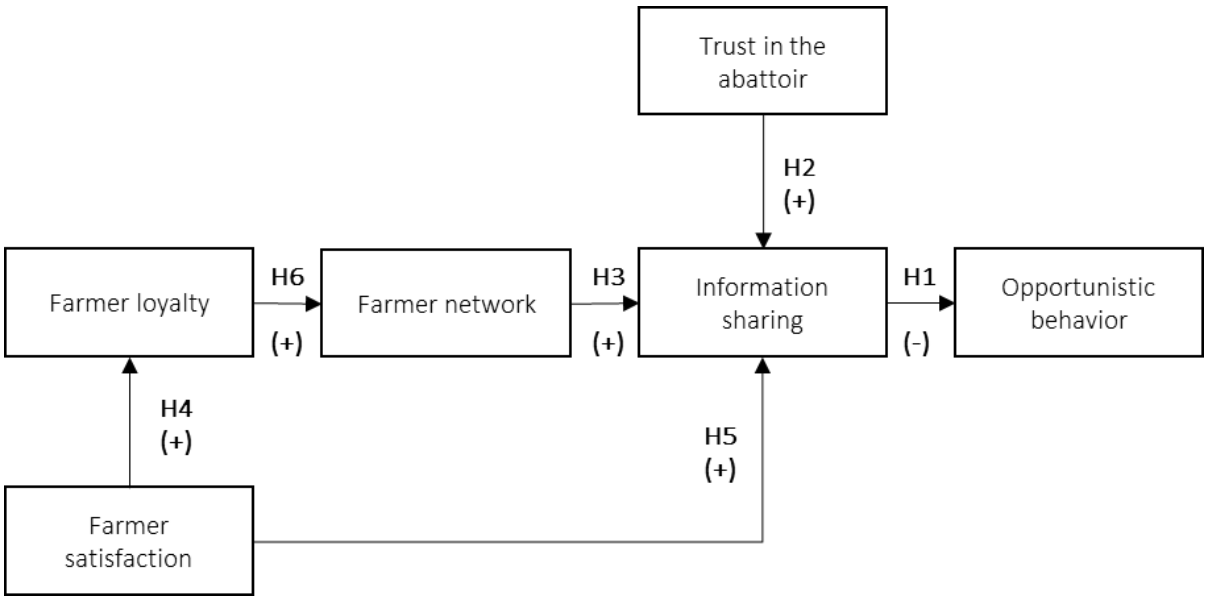


Fig. 1. Conceptual path model of the factors impacting on opportunistic behavior

Table 1

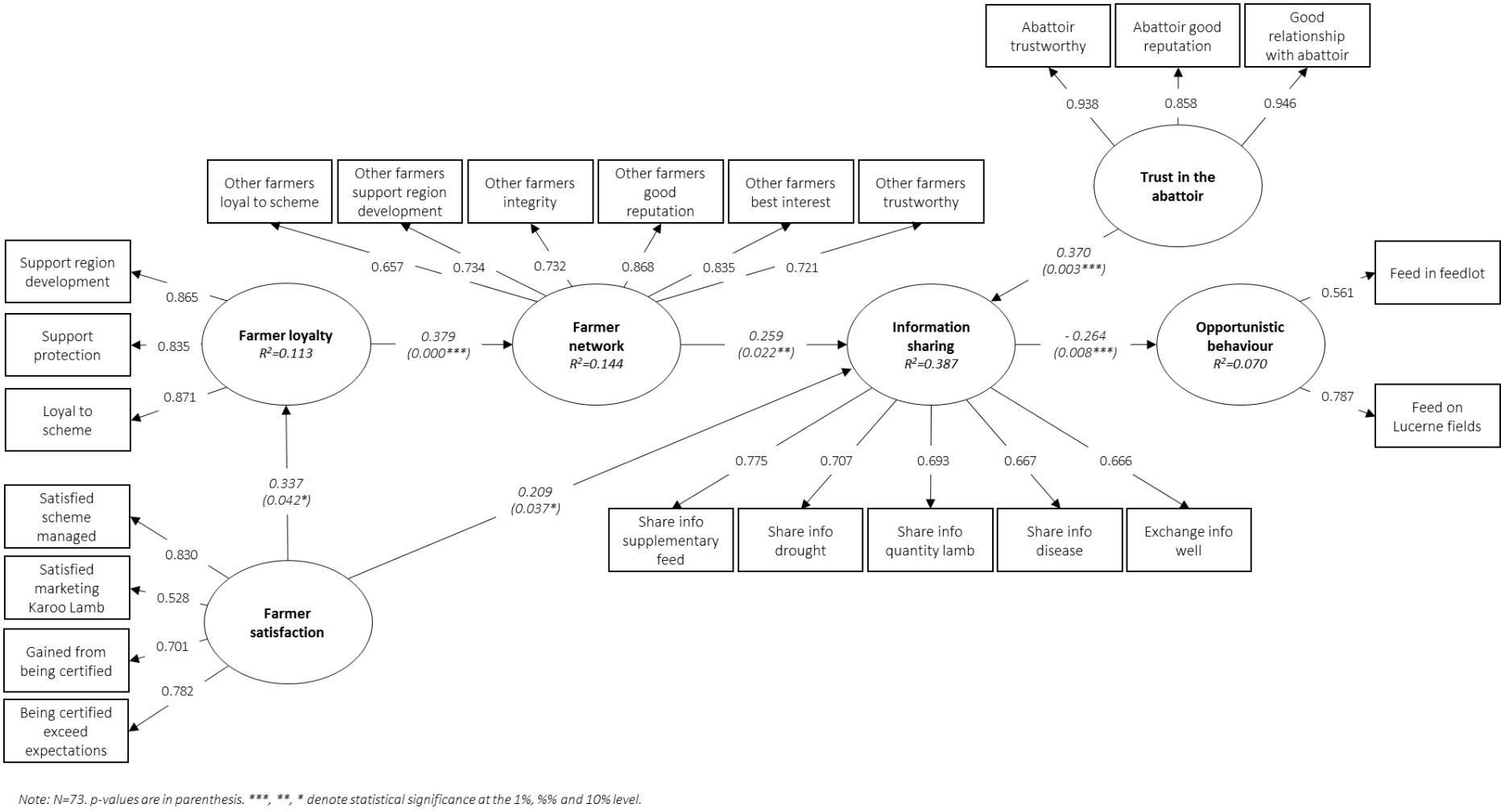
Summary of the reflective measurement model results

Construct	Composite reliability	Average variance extracted	Discriminant validity
Farmer loyalty	0.893	0.735	Yes
Farmer network	0.891	0.579	Yes
Farmer satisfaction	0.807	0.518	Yes
Trust in the abattoir	0.939	0.837	Yes
Information sharing	0.829	0.494	Yes
Opportunistic behavior	0.630	0.467	Yes

Table 2

Summary of the variance inflation factors

	Variance inflation factors			
Construct	**Farmer loyalty**	**Farmer network**	**Information sharing**	**Opportunistic behavior**
Farmer loyalty		1.000		
Farmer network			1.198	
Farmer satisfaction	1.000		1.000	
Trust in the abattoir			1.120	
Information sharing				1.000



*Note: N=73. p-values are in parenthesis. ***, **, * denote statistical significance at the 1%, %% and 10% level.*

Fig. 2. Structural model with factor loadings, path coefficients and p-values

Online annexure

Table 3

Summary statistics of indicators

Indicators	Mean	Minimum	Maximum	Standard deviation
x1: Satisfied scheme managed	4.20	1.00	5.00	1.19
x2: Satisfied marketing Karoo Lamb	3.87	1.00	5.00	1.38
x3: Gained from being certified	3.48	1.00	5.00	1.79
x4: Being certified exceed expectations	2.96	1.00	5.00	1.68
x5: Abattoir trustworthy	4.85	3.00	5.00	0.40
x6: Abattoir good reputation	4.85	3.00	5.00	0.40
x7: Good relationship with abattoir	4.86	2.00	5.00	0.45
y1: Support region development	4.94	3.00	5.00	0.28
y2: Support protection	4.90	2.00	5.00	0.45
y3: Loyal to scheme	4.86	1.00	5.00	0.61
y4: Other farmers loyal to scheme	4.01	1.00	5.00	0.98
y5: Other farmers support region development	4.34	3.00	5.00	0.79
y6: Other farmers integrity	4.14	2.00	5.00	0.69
y7: Other farmers good reputation	4.12	3.00	5.00	0.73
y8: Other farmers best interest	4.01	2.00	5.00	0.84
y9: Other farmers trustworthy	3.92	1.00	5.00	0.86
y10: Share info supplementary feed	3.15	1.00	5.00	1.86
y11: Share info drought	3.24	1.00	5.00	1.74
y12: Share info quantity lamb	4.90	3.00	5.00	0.34
y13: Share info disease	3.10	1.00	5.00	1.79
y14: Exchange info well	4.36	1.00	5.00	1.10
y15: Feed in feedlot *(binary: 1=yes; 0=no)*	0.51	0.00	1.00	0.50
y16: Feed on Lucerne fields *(binary: 1=yes; 0=no)*	0.52	0.00	1.00	0.50

Note: N=73. Scale responses were used for most indicators except where otherwise indicated.

Table 4

Overview of the constructs and related indicators

Construct/Indicator	Explanation
Farmer loyalty	
Support region development	I support the development of the Karoo region.
Loyal to scheme	I am loyal towards the Karoo Meat of Origin certification mark.
Support protection	I support the protection of the Karoo name against exploitation.
Farmer network	
Other farmers are trustworthy	The other farmers in my community are trustworthy business partners.
Other farmers good reputation	The other farmers in my community have a good reputation.
Other farmers integrity	The other farmers in my community have integrity.
Other farmers best interest	The other farmers in my community have other's best interest at heart.
Other farmers support region development	The other farmers support the development of the Karoo region.
Other farmers loyal to scheme	The other farmers are loyal towards the Karoo Meat of Origin certification scheme.
Farmer satisfaction	
Satisfied scheme managed	I am satisfied with the way in which the scheme is managed.
Satisfied marketing Karoo Lamb	I am satisfied with the way in which Karoo Lamb is marketed.
Gained from being certified	I gained from being part of the certification scheme.
Being certified exceed expectations	Being part of the certification scheme exceeded my expectations.
Trust in the abattoir	
Good relationship with abattoir	I have a good relationship with the abattoir.
Abattoir good reputation	The abattoir has a good reputation in the community.
Abattoir trustworthy	The abattoir with whom I do business is trustworthy.
Information sharing	
Share info supplementary feed	I share information about supplementary feed with the abattoir.
Share info disease	I share information about animal diseases with the abattoir.
Share info drought	I share information about droughts on my farm with the abattoir.
Share info quantity lamb	I share information about the quantity of lambs delivered with the abattoir
Exchange info well	The abattoir and I share information well.
Opportunistic behavior	
Feed in feedlot	I make use of a feedlot when lambs are not market ready.
Feed on Lucerne fields	I have lucerne fields on my farm for lamb feeding purposes.

Table 5

Indicator correlations

	x1	x2	x3	x4	x5	x6	x7	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	y12	y13	y14	y15	y16
Farmer satisfaction																							
x1	**1.00**																						
x2	**0.51**	**1.00**																					
x3	**0.33**	**0.15**	**1.00**																				
x4	**0.37**	**0.34**	**0.55**	**1.00**																			
Trust in the abattoir																							
x5	0.41	0.25	0.09	0.03	**1.00**																		
x6	0.26	0.20	0.07	0.06	**0.70**	**1.00**																	
x7	0.35	0.20	0.06	0.11	**0.78**	**0.74**	**1.00**																
Farmer loyalty																							
y1	0.27	-0.09	0.13	0.08	0.16	0.17	0.16	**1.00**															
y2	0.26	0.06	0.27	0.08	0.05	-0.02	-0.01	**0.70**	**1.00**														
y3	0.41	0.11	0.21	0.17	0.02	0.03	0.03	**0.60**	**0.49**	**1.00**													
Farmer network																							
y4	0.21	0.01	0.10	0.17	0.18	0.22	0.16	0.20	0.16	0.24	**1.00**												
y5	0.36	-0.01	0.12	0.14	0.21	0.16	0.25	0.21	0.26	0.33	**0.59**	**1.00**											
y6	0.12	-0.05	-0.01	0.03	0.18	0.23	0.24	-0.03	-0.04	0.14	**0.43**	**0.33**	**1.00**										
y7	0.34	0.12	0.04	0.12	0.17	0.17	0.23	0.17	0.25	0.29	**0.42**	**0.54**	**0.65**	**1.00**									
y8	0.49	0.19	0.07	0.12	0.20	0.17	0.18	0.29	0.33	0.30	**0.37**	**0.50**	**0.50**	**0.75**	**1.00**								
y9	0.31	0.07	0.28	0.21	0.08	0.13	0.15	0.15	0.12	0.43	**0.34**	**0.33**	**0.64**	**0.54**	**0.48**	**1.00**							
Information sharing																							
y10	0.14	0.02	0.12	0.30	0.17	0.05	0.18	0.18	0.12	0.19	0.31	0.15	0.25	0.39	0.35	0.33	**1.00**						
y11	0.22	0.00	0.14	0.29	0.21	0.17	0.26	0.22	0.02	0.23	0.10	0.13	0.25	0.28	0.27	0.36	**0.60**	**1.00**					
y12	0.32	0.16	0.06	0.07	0.58	0.41	0.64	0.09	0.02	0.00	0.17	0.28	0.18	0.28	0.29	0.12	**0.27**	**0.25**	**1.00**				
y13	0.29	0.14	0.26	0.26	0.07	-0.04	0.17	0.17	0.11	0.19	0.21	0.12	0.14	0.22	0.23	0.24	**0.62**	**0.46**	**0.27**	**1.00**			
y14	0.33	0.10	0.21	0.18	0.38	0.28	0.52	0.20	0.19	0.05	0.10	0.26	0.12	0.23	0.33	0.18	**0.35**	**0.19**	**0.43**	**0.32**	**1.00**		
Opportunistic behavior																							
y15	-0.10	-0.12	-0.04	-0.16	-0.10	-0.00	-0.10	0.11	0.20	0.02	-0.02	0.09	0.02	0.06	0.13	-0.07	-0.18	-0.22	-0.10	-0.14	-0.01	**1.00**	
y16	0.10	-0.04	0.07	0.02	0.13	0.11	0.08	-0.08	-0.16	0.01	0.17	0.14	0.12	-0.09	-0.04	-0.08	-0.25	-0.08	0.20	0.06	-0.02	**-0.05**	**1.00**

Note: N=73. Indicator notation, assigned in Table 3, is used in Table 5. x1 to x7 refer to the indicators of independent constructs (farmer satisfaction and trust in the abattoir) and y1 to y16 refers to the indicators of the dependent constructs (farmer loyalty, farmer network, information sharing and opportunistic behavior.