

**Building trust in agri-food chains:  
the mediating role of effective communication**

**Christian Fischer**

Agribusiness, Supply Chain Management & Logistics; IFNHH; Massey University,

Auckland, New Zealand; C.Fischer@massey.ac.nz

*Contributed Paper prepared for presentation at the International Association of  
Agricultural Economists Conference, Beijing, China, August 16-22, 2009*

This publication derives from the research project on ‘Key factors influencing economic relationships and communication in European food chains’ (FOODCOMM, SSPE-CT-2005-006458) which was funded by the European Commission as part of the Sixth Framework Programme. The collaborating laboratories were: Department of Agricultural and Food Market Research, University of Bonn, Germany (Co-ordinator); Land Economy Research Group, Research & Development Division, Scottish Agricultural College (SAC), Aberdeen, UK; Institute for Agricultural Development in Central and Eastern Europe (IAMO), Germany; The Ashtown Food Research Centre (AFRC), Teagasc, Dublin, Ireland; Ruralia Institute, University of Helsinki, Finland; Institute of Agricultural and Food Economics (IAFE), Poland; and Department of Agricultural Economics, Agri-Food Research and Technology Center (CITA), Spain.

*Copyright 2009 by Christian Fischer. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.*

**Abstract.** Using recent survey data ( $n = 1,430$ ) on trust levels in agri-food supplier-buyer relationships in six different European countries, two commodity chains (meat and cereals) and two chain stages (farmer-processor and processor-retailer), main determinants of trust are identified and discussed. The structural equation modelling estimation results indicate that trust can be significantly improved by effective communication and by a positive collaboration experience. The existence of personal bonds does not seem to play a direct role in the retailer-processor relationship but is important when dealing with farmers. In both chain stages a positive collaboration experience as well the existence of personal bonds also indirectly enhance trust by promoting effective communication which in turn positively impacts on trust levels, thus making it a powerful mediator.

**Keywords:** Trust, Agri-food Chains, Europe

**JEL Codes:** Q13, L14, L66

## **Introduction**

The concept of (global) value chains has been heavily promoted and applied during the last decades as a means of fostering agricultural development and in particular of linking farmers to markets (Webber, 2008; Humphrey & Memedovic, 2006). While the competitiveness advantages for enterprise integration into global and/or local collaborative value chains are well understood (Jenkins et al., 2007), less research attention has been given to the question of how to actually enable enterprises to do so. Being part of a business alliance (i.e., a group of knowledge-sharing but independent enterprises organised in a non-hierarchical way) poses management challenges. In particular, vertical chain integration requires from farmers, food processors and grocery retailers to develop and maintain close and sustainable business relationships with each other.

The existence of trust has been identified by previous work to be of considerable importance when trying to get independent enterprises to collaborate in a business partnership (Kumar, 2000). Given the usual lack of an existing collaboration experience, a non-existence of trust maybe the one decisive factor which determines whether a loose business network develops into a formal and successful enterprise alliance, or not. Later on in an alliance's life cycle, the existence of trust in a relationship is thought to contribute strongly to relationship sustainability and therefore to the building and maintaining of competitive advantage (Dyer & Chu, 2003).

This paper discusses first the role of trust in agri-food chains. Second, it presents empirical evidence from substantial recent European survey work on key trust determinants, and finally it describes what can be done by agribusiness managers to overcome trust problems in their buyer/supplier relationships.

## **Theoretical framework and hypotheses**

Trust in business relationships has been characterised as a “safeguard mechanism” (Dyer & Singh, 1998), serving as an efficient facilitator for the involved parties to receive from the relationship what they expect. In a commercial relationship, the existence of trust between exchange parties may not strictly be necessary since contracts can be used (Cox, 2004).

### *Defining trust*

Generally speaking, trust is “the inter-personal reliance gained from past experience which requires a previous engagement on a person’s account, recognising and accepting that risk exists” (Luhmann, 1988, p. 95).

In the business context, trust can be an important prerequisite for commercial exchange. When goods are not traded on spot markets trust in business partners is necessary as to whether they keep their promises. During the last decades trust has become increasingly important given that commercial transactions nowadays take place in a global context. That is, business parties on average may not know each other personally to the extent they used to as completely new trading infrastructures (e.g., e-commerce platforms) have emerged. Furthermore, products have become increasingly complex (e.g., the rising significance of ‘credence’ attributes for food products) implying increased information asymmetries between producers and distributors.

In collaborative inter-enterprise relationships, trust is therefore considered as a powerful commercial asset (Morgan & Hunt, 1994; Svensson, 2005), mostly because a lack of trust can have severe cost implications. If business partners can trust each other, contractual arrangements may be reduced or avoided, thereby implying lower costs (Chiles & McMackin, 1996) and thus securing competitive advantage. Chen (2000)

shows that trust is widely relied on in transactions involving relatively low monetary value and considerable resources are sometimes used in structuring contracts when the transactions involved have a relatively high monetary value.

Hence, trust in business relationships relates to “the belief into the ability of a business partner to fulfil his/her business commitments” (Wong & Sohal, 2002, p. 35), and thus to show patience until collecting one’s rewards.

### *Factors affecting trust in business relationships*

Previous research has identified several factors which potentially can affect trust. In the following, only studies are reviewed which deal with trust in inter-enterprise relationships, thus ignoring the issue of building trust with final consumers. Overall, trust can be affected by communication and ‘actions’ (Roy & Tomlinson, 2003).

Effective communication provides relevant information to trustors helping them to assess what trustees do, thus increasing transparency and affecting trust levels. Communication or ‘information sharing’ has been shown to be positively related to trust levels in business relationships in earlier studies (Kumar, 2000; Morgan & Hunt, 1994). Characterising effective communication, Low & Mohr (2001) use the indicators of relevance, accuracy, reliability and timeliness for ‘information quality’. In addition, the consistency of transmitted information may also be important, meaning that when several communication channels are used simultaneously, the transmitted information should be identical. Also, information should be delivered in appropriate frequency. Previous research shows that managers tend to believe that more information is better (O’Reilly, 1980), but clearly, information overload needs to be avoided.

**Hypothesis 1.** *Effective communication, which is influenced by the quality of the exchanged information and by an adequate exchange frequency, is positively related to trust levels in buyer/supplier relationships.*

As for ‘actions’, experiences with a trustee can be a more powerful indicator of a partner’s ‘trustworthiness’ than communication since former collaboration episodes in fact demonstrate a partner’s reliability. Previous research has used different ‘action’ indicators. For instance, Kwon & Suh (2004) and Batt (2003) included idiosyncratic investments in their empirical models and found that spending on relationship-specific assets strongly promotes trust among business partners. Both studies also used perceived (or relational) satisfaction with a business partner as a trust-enhancing variable and found strong positive and significant effects. ‘Relationship duration’, as an indirect measure of experience with a business partner was also tested by Batt (2003) but was found to be insignificant. In the following, a more general construct is used to summarise previous experiences with a buyer or supplier, and which is called ‘existence of a positive past collaboration’.

**Hypothesis 2.** *The existence of a positive past collaboration with a supplier/buyer positively affects relationship trust.*

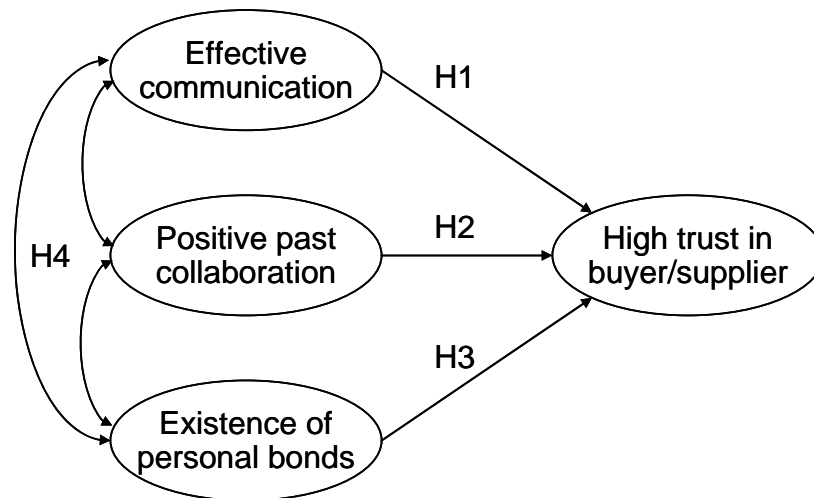
Another factor which may play a role in affecting trust is business partners’ personal characteristics. The more favourably these attributes are perceived in business partners, the more likely it is that trust develops. For instance, Kwon & Suh (2004) used inter-personal qualities such a business partner’s ‘honesty’, ‘integrity’ and ‘reputation’ and found trust-enhancing effects. Morgan & Hunt (1994) used ‘shared values’, while Batt (2003) tested the concept of ‘goal compatibility’. Since earlier studies have used different indicators and the interest here is in a more aggregate

approach, the personal characteristics variables are summarised into a proxy factor called ‘existence of personal bonds’. It is assumed that favourable partner attributes will eventually translate into the development of personal bonds which foster trust.

**Hypothesis 3.** *The existence of personal bonds in a buyer-supplier relationship positively affects trust between business partners.*

In summary, it is hypothesised that the level of trust which buyers develop towards their suppliers (or vice versa) is determined by three factors (see Figure 1), all of which are assumed to display a positive impact, and which are interrelated.

**Hypothesis 4.** *Effective communication, positive past collaboration and personal bonds are positively correlated, suggesting that these factors reinforce each other.*



**Figure 1. Hypothesised relationships between trust-affecting factors**

## Methodology

To test these hypotheses, the trust situation in buyer-supplier relationships is studied in six different EU countries (Germany, UK, Spain, Poland, Ireland and Finland) for two different commodities (meat and cereals) and two different chain stages (upstream: farmers-processors and downstream: processors-retailers).

### *Questionnaire development and data collection*

Based on the findings of a pilot study, a survey instrument was developed in order to validate the previous results but mostly to expand the acquired understanding of the trust situation in EU agri-food chains. The cross-country, multi-commodity survey of farmers, food processors and retailers, conducted between November 2006 and April 2007, resulted in 1,430 usable responses on which the subsequent analysis is based.

### *Model estimation*

Structural equation modelling (SEM; or covariance structure analysis) was used for the statistical data analysis. In its most general form, SEM consists of a set of linear equations that simultaneously test two or more relationships among directly observable and/or unmeasured latent variables (see Bollen, 1989).

In order to judge a SEM's goodness of fit, several criteria are commonly used (Shook et al., 2004): (i) the Chi-square Test, (ii) the Normed Fit Index (NFI) and (iii) the Root Mean Square Error of Approximation (RMSEA). The chi-square fit index tests the hypothesis that an unconstrained model fits the covariance/correlation matrix as well as a specified model. For a good model fit the test outcome should be *not* significant. More commonly used is the minimum sample discrepancy divided by degrees of freedom (CMIN/DF). Values as large as 5 are accepted as adequate fit, but more conservative thresholds are 2 or 3. The NFI varies from 0 to 1, with 1 equals the perfect fit. By convention, NFI values below .90 indicate a need to re-specify the model. The RMSEA incorporates a discrepancy function criterion (comparing observed and predicted covariance matrices) and a parsimony criterion, and it should be less than .05.



## Results

First trust levels are reported before the SEM estimations results are discussed.

### *Trust levels*

Tables 1 and 2 present the measured trust levels for the two agri-food chains, the different EU countries, and separately for different chain stages.<sup>1</sup>

**Table 1. Trust levels\* in B2B relationships in EU meat (beef, pig) chains**

Country	Chain stage					
	Farmer-processor			Processor-retailer		
	Mean	Std dev	(n)	Mean	Std dev	(n)
UK	5.8	1.2	(151)	5.3	1.4	(6)
Poland	5.7	0.8	(225)	6.1	0.7	(105)
Spain	5.7	1.0	(116)	5.9	0.7	(47)
Germany	5.7	0.9	(23)	5.0	1.6	(10)
Ireland	5.1	1.3	(121)	5.9	0.8	(28)
Finland	5.1	1.3	(81)	5.2	0.4	(9)
<b>Total</b>	<b>5.5</b>	<b>1.1</b>	<b>(717)</b>	<b>5.9</b>	<b>0.8</b>	<b>(205)</b>

Notes: \*Mean values calculated from single survey item ('Our trust in this supplier/buyer'), measured on a seven-point rating scale. In parentheses, no. of obtained observations.

In the meat chain (Table 1), trust levels are overall high. In the downstream relationship, trust levels are generally higher, although Germany and the UK are the exception. The differences between these chain stages are overall statistically significant at the 99% confidence level (using univariate ANOVA). Within the chain stages, the differences between the countries are also statistically significant the 99% confidence level. However, these differences may be too small to have practical implications. Hence, trust seems to be higher – as well as agreement on this – in the processor-retailer relationship relative to the farmer-processor one.

<sup>1</sup> The given scores are averaged across farmers and processors in the 'farmer-processor' relationship and across processors and retailers in the 'processor-retailer' relationship. While it is the case that upstream and downstream stakeholders rate the respective relationships differently, in this paper the interest is in comparing the two chain-level relationships rather than the different stakeholders.

**Table 2. Trust levels\* in B2B relations in EU cereals (wheat, barley, rye) chains**

Country	Chain stage					
	Farmer-processor			Processor-retailer		
	Mean	Std dev	(n)	Mean	Std dev	(n)
UK	6.0	0.9	(61)	7.0	–	(1)
Ireland	6.0	–	(1)	–	–	–
Germany	5.9	0.9	(59)	5.7	1.2	(29)
Spain	5.5	0.9	(117)	5.8	0.7	(52)
Finland	5.4	1.1	(89)	6.2	0.8	(40)
<b>Total</b>	<b>5.7</b>	<b>1.0</b>	<b>(327)</b>	<b>5.9</b>	<b>0.9</b>	<b>(122)</b>

Notes: \*Mean values calculated from single survey item ('Our trust in this supplier/buyer'), measured on a seven-point rating scale. In parentheses, no. of obtained observations.

In the cereal chain (Table 2), trust levels are overall even somewhat higher than in the meat chain. Again, trust levels are higher in the downstream relationship (with the exception of Germany). As before, these differences in means are statistically significant (95% confidence level) across chain stages. However, as in the meat chain, these differences are too small in practical terms to carry implications.

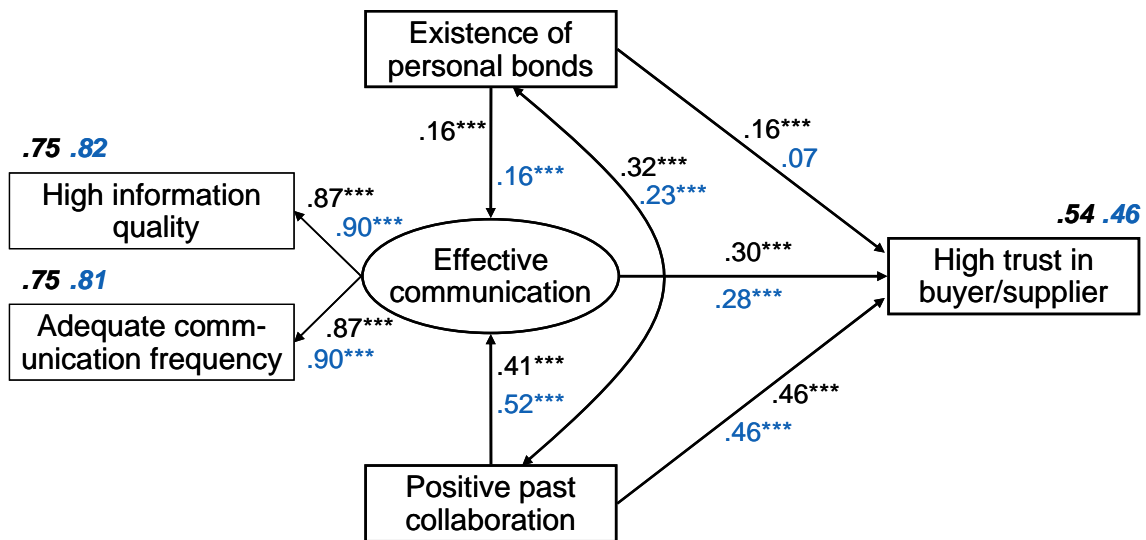
Hence, overall it appears that trust levels are comparatively high across the investigated EU countries, commodities and chain stages. Moreover, no meaningful differences can be detected. The only larger difference seems to be across the downstream and upstream relationships, with trust levels generally being higher in the latter one.

#### *SEM estimation results*

For the purpose of investigating the determinants of trust in chain relationships, all data were pooled into one single dataset given that trust levels are relatively similar across the included countries and analysed commodities. With the only meaningful differences existing across chain stages, it was only explicitly controlled for these in the following.

Based on the previous theoretical discussion, the model hypothesised in Figure 1 was tested. Only results for the best performing model found among different tested alternative specifications are reported. In particular, the outcomes from the estimation procedure led to a re-specification of the originally hypothesised model and to a refinement by replacing assumed correlations between trust determinants (H4) by causal relationships, resulting in mediation effects, in the sense that, for instance, personal bonds and positive past collaboration produce a positive effect on, and thus enhance, effective communication. This would turn effective communication into a mediator (i.e., an intervening, effect-modifying) variable. Using several formal mediation tests, it was found that such a model specification was strongly supported on statistical grounds (see Appendix). Note that overall SEM fit statistics are not affected when changing a covariance into a structural path between two variables (i.e., by estimating a regression parameter which is conditional on the overall model specification and thus all other included variables, instead of a bivariate correlation coefficient). Thus, the conducted mediation tests and the theoretical plausibility underlying the re-specification led to the adoption of the final model.

Figure 2 displays the estimation results, separately for the downstream and upstream relationships. Overall, this model fits the collected data well, with all goodness-of-fit measures being above/below the recommended acceptance levels.



**Figure 2. SEM estimation results**

Notes: .00 = standardised estimated parameters: farmer-processor (n=1,086); processor-retailer (n=344);  
 \*\*\* statistically significant at least at the 99% confidence level;  
 .00 = squared multiple correlations ( $R^2$ );  
 Model fit measures: CMIN/DF = 1.353 ( $p = .247$ ); NFI = .998; RMSEA = .016.

In the farmer-processor relationship, all three hypothesised variables have a positive and highly significant (99% confidence level) impact on the measured trust levels. This confirms hypotheses H1 to H3. The most important determinant is *positive past collaboration*, followed by *effective communication* and the *existence of personal bonds*. In the *effective communication* construct, both indicators are equally important, and about 75% of their information is extracted, thus making it a reliable measurement model. A *positive past collaboration* and the *existence of personal bonds* also display a positive and highly significant (99% confidence level) impact on *effective communication*. This implies that these two variables not only directly enhance trust levels. They also positively affect trust indirectly by improving communication effectiveness which in turn increases trust. Thus, *effective communication* serves as a (partial) mediator (see Appendix) in the formation of trust for the two other

determinants. In addition, the *existence of personal bonds* and a *positive past collaboration* are positively and highly significantly (99% confidence level) correlated with each other, suggesting that the *existence of personal bonds* contributes to *positive past collaboration*, and vice versa (thus partly confirming H4). Overall, using only these three determinants, 54% of the variance in the observed trust levels in the upstream chain stage can be explained.

In the processor-retailer relationship, the situation is similar to the upstream situation, with the exception that the *existence of personal bonds* does not have a statistically significant influence on the observed trust levels (i.e., H3 is not confirmed). In this case, with only two variables, a *positive past collaboration experience* and *effective communication*, 46% of buyer/supplier trust can be explained.<sup>2</sup> As before, a *positive past collaboration* and the *existence of personal bonds* also positively and significantly (99% confidence level) enhance *effective communication*. Thus, the latter variable serves as partial mediator in the case of *positive past collaboration* and as a complete mediator in the case of *personal bonds* (see Appendix). Finally, these two determinants reinforce each other positively and highly significantly (thus partly confirming H4).

## **Discussion and conclusion**

The results show that in the investigated European agri-food chains, the perceived level of trust in suppliers/buyers is considerably high with only some minor derivations and differences across countries and commodities. This finding is in line with earlier results by Lobb et al. (2007) which show that consumer trust is comparatively high and similar across different EU countries. It was also found that effective communication, together

---

<sup>2</sup> Here, the *effective communication* construct is equally formed by both indicators (standardised factor loadings of .90) and more than 81% of the indicator variance is used for it.

with a positive collaboration experience, are the most important trust determinants. It appears that personal bonds do not in all observed situations have an impact on trust levels, but they are important when dealing with farmers. Previous research has shown that relationships between retailers and processors tend to be more formal (Fearne, 1998). This is due to the fact that in particular multiple retailers tend to have many different suppliers and they are larger corporations thus resulting in a higher need and greater ease to draft and use formal contracts. Farmer-processor relationships, in contrast, are often characterised by commercial transactions carried out on traditional local/regional spot markets where business partners tend to know each other. Hence, it is no surprise that the existence of personal bonds is an important direct trust-generating factor in the upstream relationship, while it works only indirectly at the processor-retailer stage.

A positive collaboration experience was found to be the most crucial trust-building factor. Yet, from a management point of view, this is the determinant which may be the most difficult to influence in practice, at least in the short run. Collaboration experience is subject to 'time compression diseconomies' because it cannot be developed quickly, nor can it be bought in the market place (Dyer & Singh, 1998). Thus, in practice, trust will develop slowly, growing each time an interaction/transaction episode with a business partner was carried out in a satisfactory way. Hence, it must be accepted that trust probably cannot be immediately 'created'. Rather, it must be built (or earned) step by step.

Effective communication seems to have an immediate impact on trust formation. Moreover, it has been found to be a powerful mediator, meaning that it enforces indirectly the effects of a positive collaboration history and the existence of personal

bonds. Widely known from other disciplines, our results confirm that communication effectiveness is crucial in management in general, and in buyer/supplier relationships in particular. Good communication is achieved by transmitting relevant information in an adequate frequency.

Further research may look at the trust situation in other countries and agri-food chains. In addition, given that the presented model in this paper – although showing favourable statistical properties – only tells half the story (i.e., it explains about 50% of trust variation), other trust-enhancing factors may need to be identified and considered in a more comprehensive analysis. Finally, future studies should look at practical implementation issues of trust-building mechanisms in agribusiness.

## References

- Baron, R. & Kenny, D. (1986), “The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations”, *Journal of Personality and Social Psychology*, 51, 1173-1182.
- Batt, P. (2003), “Building trust between growers and market agents”, *Supply Chain Management: An International Journal*, 8 (1), 65-78.
- Bollen, K. (1989), *Structural Equations with Latent Variables*, Wiley, New York.
- Chen, Y. (2000), “Promises, Trust, and Contracts”, *The Journal of Law, Economics & Organization*, 16 (1), 209-232.
- Chiles, T. & McMackin, J. (1996), “Integrating variable risk preferences, trust, and transaction cost economics”, *Academy of Management Review*, 21 (1), 73-99.

- Cox, A. (2004), "The Art of the Possible: Relationship Management in Power Regimes and Supply Chain", *Supply Chain Management: An International Journal*, 9 (5), 346-356.
- Dyer, J. & Chu, W. (2003), "The Role of Trustworthiness in Reducing Transaction Costs and Improving Performance: Empirical Evidence from the United States, Japan, and Korea", *Organizational Science*, 14 (1), 57-68.
- Dyer, J. & Singh, H. (1998), "The relational view: cooperative strategy and sources of interorganizational competitive advantage", *Academy of Management Review*, 23 (4), 660-679.
- Fearne, A. (1998), "The evolution of partnerships in the meat supply chain: insights from the British beef industry", *Supply Chain Management: An International Journal*, 3 (4), 214-231.
- Humphrey, J. & Memedovic, O. (2006), "Global Value Chains in the Agrifood Sector", United Nations Industrial Development Organisation, Vienna, Austria.  
[http://www.unido.org/fileadmin/import/60026\\_01\\_global\\_value\\_chains\\_agrifood\\_sector.pdf](http://www.unido.org/fileadmin/import/60026_01_global_value_chains_agrifood_sector.pdf)
- Jenkins, B., Akhalkatsi, A., Roberts, B. & Gardiner A. (2007), "Business Linkages: Lessons, Opportunities, and Challenges", IFC (International Finance Corporation), International Business Leaders Forum, and the Kennedy School of Government, Harvard University. [www.hks.harvard.edu/m-rcbg/CSRI/publications/report\\_16\\_BUSINESS%20LINKAGESFINAL.pdf](http://www.hks.harvard.edu/m-rcbg/CSRI/publications/report_16_BUSINESS%20LINKAGESFINAL.pdf)
- Kumar, N. (2000), "The Power of Trust in Manufacturer-Retailer Relationships", in *Harvard Business Review on Managing the Value Chain*, Harvard Business School Press, Boston, 91-126.



- Kwon, I. & Suh, T. (2004), "Factors affecting the level of trust and commitment in supply chain relationships", *The Journal of Supply Chain Management*, 40 (2), 4-14.
- Lewicki, R. & Tomlinson, E. (2003), "Trust and Trust Building", *Beyond Intractability*, in Burgess, G. & Burgess, H. (Eds.), Conflict Research Consortium, University of Colorado, Boulder. [http://www.beyondintractability.org/essay/trust\\_building/](http://www.beyondintractability.org/essay/trust_building/).
- Lobb, A., Mazzocchi, M. & Traill, B. (2007), "Modelling risk perception and trust in food safety information within the theory of planned behaviour", *Food Quality and Preference*, 18 (2): 384-395.
- Low, G. & Mohr, J. (2001), "Factors Affecting the Use of Information in the Evaluation of Marketing Communications Productivity", *Journal of the Academy of Marketing Science*, 29 (1), 70-88.
- Luhmann, N. (1988), "Familiarity, confidence, trust: Problems and alternative", in Gambetta, D. (Ed.), *Trust*, Basil Blackwell, New York, 94-107.
- Morgan, R. & Hunt, S. (1994), "The commitment-trust theory of relationship marketing", *Journal of Marketing*, 58 (3), 20-38.
- Muller, D., Judd, C. & Yzerbyt, V. (2005), "When moderation is mediated and mediation is moderated", *Journal of Personality and Social Psychology*, 89, 852-863.
- O'Reilly, C. (1980), "Individuals and Information Overload in Organizations: Is More Necessarily Better?", *Academy of Management Journal*, 23 (4), 684-696.
- Shook, C., Ketchen, D., Hult, G. & Kacmar, K. (2004), "An Assessment of the Use of Structural Equation Modeling in Strategic Management Research", *Strategic Management Journal*, 25, 397-404.

- Svensson, G. (2005), "Mutual and interactive trust in business dyads: condition and process", *European Business Review*, 17 (5), 411-427.
- Weber, M. (2008), "Using Value Chain Approaches in Agribusiness and Agriculture in Sub-Saharan Africa – A Methodological Guide", The World Bank, Washington DC. <http://www.technoserve.org/documents/VCGuideNov12-2007.pdf>
- Wong, A. & Sohal, A. (2002), "An Examination of the Relationship Between Trust, Commitment and Relationship Quality", *International Journal of Retail & Distribution Management*, 30, 34-50.

## Appendix: mediation tests

A mediator ( $M$ ) is an intervening variable which modifies the effect of an independent variable ( $X$ ) on a dependent variable ( $Y$ ) (Muller et al., 2005). Generally speaking, mediation can be said to occur when (1)  $X$  significantly affects  $Y$  in the absence of  $M$ ; (2)  $X$  significantly affects  $M$ ; (3)  $M$  has a significant effect on  $Y$ , controlling for  $X$ ; and (4) the effect of  $X$  on  $Y$  disappears (complete mediation) or shrinks (partial mediation) upon the addition of  $M$  to the model.

Defining the direct (unstandardised) effect of  $X$  on  $M$  as  $a$  with standard error  $s_a$ , and the direct effect of  $M$  on  $Y$  as  $b$  (while controlling for the effect of  $X$  on  $Y$ ), the following mediation test equation have been proposed:

$$\text{Sobel: } z_S = \frac{a \cdot b}{\sqrt{b^2 \cdot s_a^2 + a^2 \cdot s_b^2}};$$

$$\text{Aroian: } z_A = \frac{a \cdot b}{\sqrt{b^2 \cdot s_a^2 + a^2 \cdot s_b^2 + s_a^2 \cdot s_b^2}};$$

$$\text{Goodman: } z_G = \frac{a \cdot b}{\sqrt{b^2 \cdot s_a^2 + a^2 \cdot s_b^2 - s_a^2 \cdot s_b^2}}.$$

If the empirical  $z$ -values exceed the theoretical ones from a standard  $z$  distribution at a pre-defined  $\alpha$  level, the null hypothesis of a zero mediation effect can be rejected with error probability  $p$ . The standard mediation test approach is the Sobel test statistic.

However, Baron & Kenny (1986) recommend using the Aroian formula since it does not make the unnecessary assumption of  $s_a^2 \cdot s_b^2$  being neglectably small and avoiding the unfortunate effect in the Goodman version of potentially ending up with a negative combined variance estimate under the square root.

**Mediation test (Sobel, Aroian, Goodman) results for *personal bonds* (X) affecting trust (Y), mediated by *effective communication* (M)**

	Chain stage	
	Farmer-processor	Processor-retailer
$X \rightarrow Y$	.104***	.039*
$X \rightarrow M$ (i.e., effect $a$ ) [std dev: $s_a$ ]	.094*** [.019]	.088*** [.028]
$M \rightarrow Y$ (i.e., effect $b$ ) [std dev: $s_b$ ], controlled for $X \rightarrow Y$	.332*** [.031]	.259*** [.050]
$X \rightarrow Y$ , in fully mediated SEM (i.e., Figure 2)	.100***	.033
Sobel $z_S$ ( $p$ )	4.49 (.000)	2.69 (.007)
Aroian $z_A$ ( $p$ )	4.48 (.000)	2.65 (.008)
Goodman $z_G$ ( $p$ )	4.51 (.000)	2.72 (.006)

Notes: all effects are unstandardised parameters estimated within the full SEM as given in Figure 2;  
 \*\*\* (\*): statistically significant at the 99% (90%) confidence level;  
 $p$ : error probability for the rejection of the null hypothesis of a zero mediation effect.

*Effective communication* partially mediates the effect of *personal bonds* on trust in the farmer-processor chain stage. In the downstream relationship, *effective communication* completely mediates the effect. The mediation effect itself is dependent on the chain stage, a case which is referred to as “moderated mediation” (Mueller et al., 2005).

**Mediation test (Sobel, Aroian, Goodman) results for *positive past collaboration* (X) affecting trust (Y), mediated by *effective communication* (M)**

	Chain stage	
	Farmer-processor	Processor-retailer
$X \rightarrow Y$	.461***	.425***
$X \rightarrow M$ (i.e., effect a) [std dev: $s_a$ ]	.364*** [.030]	.495*** [.052]
$M \rightarrow Y$ (i.e., effect b) [std dev: $s_b$ ], controlled for $X \rightarrow Y$	.316*** [.029]	.245*** [.045]
$X \rightarrow Y$ , in fully mediated SEM (i.e., Figure 2)	.441***	.406***
Sobel $z_S$ ( $p$ )	8.11 (.000)	4.73 (.000)
Aroian $z_A$ ( $p$ )	8.09 (.000)	4.71 (.000)
Goodman $z_G$ ( $p$ )	8.12 (.000)	4.75 (.000)

Notes: all effects are unstandardised parameters estimated within the full SEM as given in Figure 2;  
 \*\*\*: statistically significant at the 99% confidence level;  
 $p$ : error probability for the rejection of the null hypothesis of a zero mediation effect.

*Effective communication* partially mediates the effect of *positive past collaboration* on *trust* in the farmer-processor as well as in the downstream chain stage. The mediation effect itself is dependent on the chain stage, thus again moderated mediation occurs.