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# Determinants of Risk Management and Risky Decision-Making strategies from Colombian Coffee Growers

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**Abstract**

*The main object of this paper is to identify the determinants of risk management and risky decision-making strategies from Colombian coffee growers through relationship between risk management by the institutions underlying the Colombian coffee sector and risk perceptions by Colombian coffee growers from a neo-institutional approach. In order to explain the risk perceptions and individual behaviours of coffee growers, and establishing the effect of institutions on risk perception and management of Colombian coffee growers; we use a survey from a selected sample from 459 Colombian coffee growers. The study was performed by using Structural Equation Model (SEM), through which the existing relationship between risk management offered by Colombian coffee sector institutions, and risk perceptions of Colombian coffee growers were empirically evaluated. This was possible by studying risk perceptions from past experiences and the way coffee growers deal with the risk associated to situations they must face, risk attitudes and management strategies. We demonstrate that the set of risk management instruments offered by the institutions underlying the coffee sector lower risk exposure of Colombian coffee growers, and determine their risk management strategies.*

**Keywords:** *risk management; risk perception; risk propensity; small-scale coffee grower; Structural Equation Model; institutions*

## Introduction

The agriculture and specifically the coffee sector are vulnerable to climate change and its commodity nature leaves it highly exposed to volatility in international prices. Uncertainty on prices and production levels of commodities increases vulnerability among small farmers in the world, leading to the decisions these producers take on how and what to grow when be subject to a higher risk (Antwi-Agyei, Peasey, Biran, Bruce, & Ensink, 2016). Small-scale farmers with limited income face higher costs and risks, and observe how their purchasing power and production capacity decreases and inequalities widen (Estrada, Gay, & Conde, 2012). For example, Amador et al. (2012) explained how financial factors have also contributed to the increase in food prices, and how expansionary monetary policies, adopted by developed countries as a countercyclical tool, generate the incentives for speculation in financial derivatives and future investments, which act as a refuge for investors in times of high uncertainty.

The global coffee sector, unlike others in agriculture, is mainly made up of small farmers, who are in turn completely dependent on coffee growth for sustenance (Castellanos et al., 2013). In Colombia, the small size of coffee farms exposes approximately 527 thousand coffee growers to different types of risk (market, interest rate, contractual, financial, etc.), including vulnerability to climate change and natural disasters. According to Ashan (2001), risk perceptions of farmers and their risk management strategies still receive little attention in agricultural research, while such vulnerability and risk faced by coffee growers has required the intervention of institutions offering instruments intended to mitigate and lower the risks to which they are exposed (Lozano, 2011). Carlton et al. (2016) suggested that policy design and the creation of institutions from this increase on risk perceptions must motivate actions on climate change and thus reduce vulnerability to risk.

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Studies have focused primarily on productive behaviour, industry development, as well as the problem represented by the crises. In this sense, Colombia has created institutions dedicated to strengthening the production and defending the sector, one of these being the (Federación Nacional de Cafeteros [Colombian Coffee Growers Federation] (FNC), which is one of the oldest private institutions on Earth.

Possessing an efficient institutional structure that looks after the welfare of federated coffee growers. Which was founded on the coffee growers' initiative supported by the government in 1927, through the Act 76 of 1927, with the objective of defending the Colombian coffee industry and its guild interests (Kalmanovitz & López 2002a, 2002b; Junguito & Pizano, 1993, 1997). Its main economic role consists of managing the Fondo Nacional del Café [National Coffee Fund] (FoNC), established in 1940 with contributions originated from two taxes specifically created for this purpose in order to gather the resources needed to smooth fluctuations in international prices.

According to North (1990) neo-institutional approach, institutions understood as rules of the game, have evolved from being an informal set of rules to become formal standards established through the consensus of social groups. Institutions are present in every single economic sector, but it is the primary sector where these really take a higher relevance as an instrument of support and protection for small producers (Kalmanovitz & López, 2002a).

The importance of the structural transformation experienced by Colombian agricultural institutions during the 20th century lies on labour condition improvements parting from a change in the State and its performance on the economic realm which increased productivity (Kalmanovitz & López, 2002a; 2002b). This evolution influenced the development of internal markets and served as the support for the export of some products to the international market, accompanied by the structuring of financial supports and organizations articulating the production and the commerce which gave greater dynamism to the agriculture.

Hence, the main goal in this paper is identify the determinants of risk management and risky decision-making strategies from Colombian coffee growers through relationship between risk management by the institutions underlying the Colombian coffee sector and risk perceptions by Colombian coffee growers from a neo-institutional approach.

For this, a Structural Equation Model (SEM) was employed, following the latent construct design methodology of the model proposed by Sitkin and Weingart (1995). In the next paragraphs, we present the conceptual model, explicate the main concepts, their relations and posit the hypotheses for this study. Next, the used data and methodology are illustrated and after we describe the main results. Finally, we discuss our results and conclude.

**Conceptual model**

The conceptual model presented in this paper exposes how perceptions of risk and risk attitude from Colombian coffee growers can influence the intended decision to implement risk management strategies at the farm level.

Other determinants of the intended risk behaviour, like perceived past exposure to business risk and farming attitude, are determining risk behaviour only indirectly, i.e. mediated by risk perception and risk attitude (indirect determinants). Finally we evaluate the role of institutions underlying to coffee sector and its influence in the coffee growers risky decision-making strategies. Our conceptual model is presented in Figure 1.

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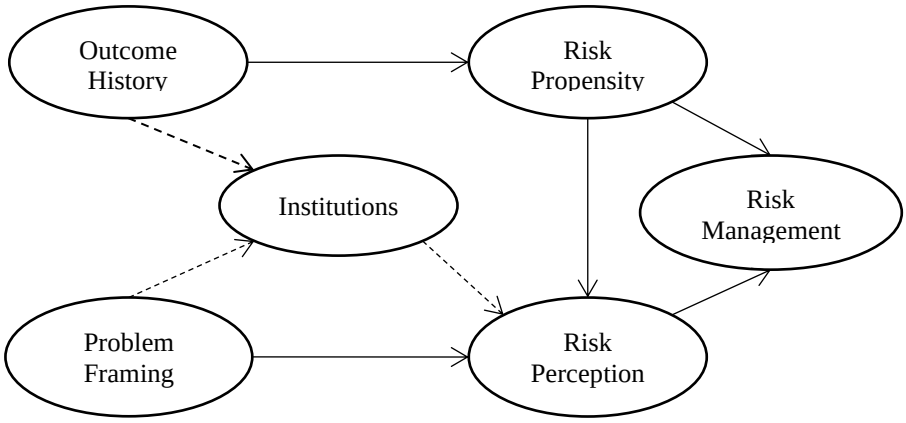


*Figure 1* Structural model with the incorporation of the mediating variable *Institutions*

This risk management analysis on Colombian coffee growers is based on the theoretical tradition of the model for behavior on risk laid out by Sitkin and Pablo (1992). The current research evaluated, through SEM analysis, the ability of the model to capture the covariance structure found in data. If results are satisfactory, it leads to the proposition of a mediation of institutions in the structural relationship between the latent variables *Problem Framing* and *Risk Perception*. Specifically, it comprised evaluating the hypothesis that actions performed by sector institutions, represented through the latent construct *Institutions*, affect risk perceptions on the agent, thus indirectly determining their risk management behaviors. The latter is represented by the latent construct *Risk Management*.

The mediation analysis strategy follows the four steps suggested in Baron and Kenny (1986); James and Brett (1984); and Judd and Kenny (1981). The first step, related to the assessment of the correlation between the causal variable and the outcome variable, refers to the analysis of the effect *Problem Framing* has on the construct *Risk Perception* in the model proposed by Sitkin and Pablo (1992). The relationship was verified on a restricted model where the mediating variable *Institutions* was absent (Base model: without a moderating variable). Figure 1 shows the dependency relationships or paths of the model with continuous arrows, and the paths related to the mediation are represented as discontinuous arrows. In the base model, the construct *Institutions* and the discontinuous arrows are either absent or with their parameters set to zero. In the extended model, both the construct *Institutions* and its relationships with the other constructs *Outcome History, Problem Framing* and *Risk Perception* are unconstrained model components that must be estimated through the selected optimization method.

The SEM used in Sitkin and Weingart (1995), based on the model laid out by Sitkin and Pablo (1992), was used. They created a model with five latent factors, namely: *Outcome History, Problem Framing, Risk Propensity, Risk Perception* and *Risky Decision Making*, in which it was established that risk propensity and risk perception mediated the effects of problem features and result history in decision making behaviour under risk; two innovations were introduced on the aforementioned model, the first one referring to the grouping of risk perception into four dimensions: climate, biological, financial and operational, defined from the discussion in the panel of experts. This definition overcomes the criticism that may arise from the construction of theoretical categories resulting from multidimensional reduction offered by statistical techniques.

The second innovation is the introduction of the latent construct *Institutions*, also introduced by Van Winsen et al. (2014), who empirically evaluated the farmers' intention to implement different common risk management strategies on their farms through a structural equation model using a conceptual

model, based on the findings of the model proposed by Sitkin and Weingart (1995). This matched the findings of Tucker et al. (2010), Eakin et al. (2013) and Castellanos et al. (2013) who, in an analysis of risk perception and the adaptation ways of some coffee growing populations in Central America and Mexico, Tucker et al. (2010) concluded that the farmers' response is mainly idiosyncratic and restricted by external conditions.

## Sample and Data

Colombian coffee growers as a whole are defined by being mostly small-scale producers, whose unit of analysis is the majority of coffee growers in condition of vulnerability against the multiple risks faced by the sector that are associated or affiliated to existing institutions within the sector. According to Tucker et al. (2010), this group of coffee growers included small-scale owners who rely exclusively on coffee bean production for survival, with entire families involved in agriculture. In this sense, the population targeted for the current research was formed by active coffee growers affiliated to the FNC in the 22 coffee-producing Colombian departments. The sample size was determined through simple random sampling, which led to the survey being deployed on 459 coffee growers located in 16 of the 22 coffee growing departments in Colombia. The universe of coffee growers employed to calculate the sample was 383.978. Seeking to obtain greater coverage, the random sample was distributed among Colombian coffee growing regions in a proportional fashion, according to coffee grower concentrations. For the current research, simple random sampling was considered since population features are similar for different groups, thus allowing greater efficiency on the elaboration of data over the stratified random sampling used to discriminate the features of different population groups (Levy & Lemeshow, 2013). The sample size selection formula is described next:

$$n = \frac{Npq}{(N-1)\frac{\alpha^2}{4} + pq}$$

With $N = 383.978$, an error margin $\alpha$ = 5% and probability of success *p* and error *q* of 50% each. Finally, a sample of 459 coffee growers was selected, which were proportionally distributed among 16 of the 22 coffee growing departments.

Table 1

*Sample Distribution*

| Number of federated coffee growers | | |
|---|---|---|
| Department | Total | Sample |
| Antioquia | 56971 | 64 |
| Bolívar | 302 | 0 |
| Boyacá | 7380 | 7 |
| Caldas | 26062 | 26 |
| Caquetá | 1531 | 3 |
| Casanare | 1430 | 0 |
| Cauca | 48182 | 84 |
| Cesar | 7444 | 5 |
| Chocó | 126 | 0 |
| Cundinamarca | 21803 | 20 |
| Huila | 57921 | 65 |
| La Guajira | 1502 | 1 |
| Magdalena | 4335 | 4 |
| Meta | 1396 | 0 |
| Nariño | 25456 | 29 |
| Norte De Santander | 12640 | 7 |
| Putumayo | 111 | 0 |

| | | |
|---|---|---|
| Quindío | 4313 | 0 |
| Risaralda | 15179 | 19 |
| Santander | 20943 | 24 |
| Tolima | 51131 | 90 |
| Valle Del Cauca | 17820 | 11 |
| TOTAL | 383978 | 459 |

*Note*. Taken from Sistema de Información Cafetero SICA (2015, May 5). Bogotá. Recovered from https://www.federaciondecafeteros.org/clientes/es/servicios_para_el_cafetero/sistema_de_informacion_sica-1/

Since sample size is an essential aspect in SEM, Iacobucci (2010) consider that although "…there was some thinking that strong, clean measures (…) would be somewhat compensatory for sample size, but while the number of variables per factor has an effect on improving fit statistics, its effect is modest compared to that of sample size" (Iacobucci, 2010, p. 91). In this sense, Iacobucci (2010) argue that there is likely to be bias in parameter estimates, but for three or more indicators per factor, this bias almost disappears In terms of reduced bias and even of the model being executed. With three or more indicators per factor, a sample size of 100 is usually sufficient for convergence and a sample size of 150 will usually be sufficient for a convergent and adequate solution (Iacobucci, 2010).

Vargas Halabí and Mora-Esquivel (2017) worried about it, and although the literature has not provided a conclusive answer to determine the number of cases required for an analysis of SEM, Kline (2011) identified a great diversity of criteria that constitute a disjointed mass of literature that hinders the work of the researcher. To give some order for the purposes of this paper, these criteria have been grouped into four categories: (a) absolute number of cases (Hair, Black, Babin, & Anderson, 2014); (b) cases per parameter (Hair et al., 2014; Iacobucci, 2009; Kline, 2011); (c) cases per observed variable (Hair et al., 2014), and (d) statistical power (Cumming, 2012). All these criteria agree that, for sample size definition in SEM, a minimum of 200 observations must be averaged for a SEM of six latent constructs. This is consistent with the sample of 459 observations obtained through simple random sampling, which offers an overidentified model.

Data on coffee growers was collected through a survey that was designed using the results obtained from the review of literature, which were validated by a panel of experts. Then, the next step consisted of training a group of agricultural engineers who applied the pilot survey on 20 coffee growers, thus leading to instrument validation, feedback and calibration. Finally, the survey was applied on a sample distributed to the 459 coffee producers in the mong 16 of the 22 Colombian coffee growing departments by agricultural engineers with experience in rural extension, throughout the period comprising November 2015 and February 2016.

**Latent Constructs and Hypotheses**

Data analysis at the current research was proposed in two stages, a qualitative stage and a quantitative one. The qualitative stage corresponded to the elaboration of the taxonomies on risk, institutions and risk management instruments. For this stage, a panel of experts was used to validate the taxonomy of risks and instruments created from literature. The taxonomy of 58 risks Colombian coffee growers were used to led to the creation of four risk groups: (a) climate risk; (b) biological risk; (c) financial risk; and (d) operational risk. Meanwhile, during the construction of the taxonomy on instruments, 161 risk management instruments were identified, being grouped into 26 instruments that were classified into four risk management instruments according to the risks these managed.

The quantitative phase of the current research was developed in two stages. During the first stage, a Confirmatory Factor Analysis (CFA) was estimated for each of the six latent constructs[2]: *Outcome History, Problem Framing, Risk Propensity, Risk Perception, Risk Management,* and *Institutions*. The manifest variables associated with each latent construct are described in Table 2 to 7. In the second stage, the six latent constructs were integrated into a SEM that adapted the structural relations framework proposed by Sitkin and Pablo (1992) to the Colombian coffee context. Structural relations of the model are described in Figure 4, in which the observed variables describing the measure relations were omitted to facilitate reading and analysis. Like CFAs, the model is estimated through Maximum Likelihood and the hypothesis tests on the coefficients are evaluated through bootstrapping after 5000 simulations. As shown by Cheung and Lau (2008), bootstrapping provides results independent of the normality condition generally required by parametric procedures.

To determine de degree of effectiveness and the significant relationship between risk management offered by the institutions underlying the Colombian coffee sectors and risk perceptions of coffee growers, the current research estimated a SEM model formed by six latent constructs as described in the research design, following Sitkin and Pablo (1992), and Sitkin and Weingart (1995). The first construct, *Outcome History,* represents the history of successes and failures resulting from past decisions, and it is crucial to risk propensity (Sitkin & Weingart, 1995; March & Shapira, 1987; Osborn & Jackson, 1988; Thaler & Johnson, 1990). This construct answers Hypothesis 1, being built upon the variables introduced in Table 1.

*Hypothesis 1: The more successful the results of past decisions taken by the coffee grower are, the greater its risk propensity will be.*

Table 2

*Observed Variables of the Latent Construct Outcome History*

| Index | Variable | Description |
|---|---|---|
| b32 | *Agricultural practice* | This variable indicates that favourable results from agricultural practices lead to positive experiences that reinforce future positive or proactive behaviour |
| b39 | *Plague control* | This variable indicates that positive results increase optimism on the future of the productive unit |
| e1 | *Price information* | This variable indicates frequent access to information by coffee growers |
| e19 | *Climate damage* | This variable indicates the efficiency of decisions on climate change. Low efficiency might be related to higher climate risk and lower incomes in the future, as well as increased exposure to uncertainty due to natural events |

*Note.* Adapted from "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity" by Sitkin and Weingart, 1995, Academy of management Journal, 38(6), 1573-1592.

[2] The detail of CFAs can see in Monrroy-Guerrero, G. (forthcoming). Determinant Factors of the Decisions Associated to Risk of The Colombian Coffee Growers.

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The second construct is labelled as *Problem Framing*, representing the influence of idiosyncratic features of the problem on the risk perceptions of coffee growers. That is, if situations are positively conceived, these lead to risk averse decisions, and viceversa (Kahneman & Tversky, 1979). This construct corresponds to hypotheses 2 and 3, its latent variables being shown in Table 3.

*Hypothesis 2: The assessment of a risky situation as an opportunity or a threat by a coffee grower determines its risk perception.*

*Hypothesis 3: The results of risky past decisions taken by the coffee grower determine its assessment of the institutions underlying the sector.*

Table 3

*Observed Variables of the Latent Construct Problem Framing*

| Index | Variable | Description |
|---|---|---|
| b26 | *Price-quality ratio* | This variable serves as a proxy for quality management issues, which have an impact on productive unit income |
| b28index | *Commercialization complexity* | This index averages commercialization difficulty causes, and measures commercialization system inefficiencies. A higher index value is associated to higher commercialization risks, which leads the most risk-averse coffee growers to negative shocks |
| b14 | *Harvest losses* | This variable indicates whether the coffee grower had losses during the latest harvest |
| b47 | *Quality issues* | This variable indicates whether the coffee grower had quality issues originating from the productive process |

*Note.* Adapted from "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity" by Sitkin and Weingart, 1995, Academy of management Journal, 38(6), 1573-1592.

The third latent construct known as *Risk Propensity,* represents the tendency of coffee growers to take or avoid risks. It is an emerging feature of the coffee grower that might change over time. The construct corresponds to Hypothesis 4, and it is built on the variables introduced in Table 4.

*Hypothesis 4: The greater the risk perceptions of coffee growers are, the higher the number of risk management strategies is.*

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Table 4

*Observed Variables of the Latent Construct Risk Propensity*

| Index | Variable | Description |
|---|---|---|
| c3 | *Staff* | This variable measures the number of workers in the small-scale productive |
| b3 | *Area scaling* | This variable measures the adjustments performed on the cultivated area. It is taken as the response to positive or negative shocks, depending on the coffee grower's risk propensity |
| e21 | *Income changes* | This dummy variable displays whether income increased or decreased during the last 10 years. If an individual shows a higher risk propensity score, this means the individual has been exposed to loss situations, becoming more risk averse due to a negative assessment of the future if optimistic, or |
| c1 | *Management time* | This variable determines coffee grower behavior regarding the number of hours dedicated to coffee farming |

*Note.* Adapted from "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity" by Sitkin and Weingart, 1995, Academy of management Journal, 38(6), 1573-1592.

The fourth latent construct known as *Risk Perception* represents individual risk assessment given a situation, and the confidence on that assessment. That is, risk prevention is greater when risk perceptions are higher, compared to a scenario with low risk perceptions, as the latter lead to believe there is nothing to lose (Sitkin & Weingart, 1995). This construct corresponds to Hypothesis 9, formed by Likert scale measures, where larger values are associated with greater risk perceptions. These variables are displayed in Table 5

*Hypothesis 9: Risk perceptions of coffee growers determine their risk management approaches.*

Table 5

*Observed Variables of the Latent Construct Risk Perception*

| Index | Variable | Description |
|---|---|---|
| e23risk_cl | *Climate risk impact* | These indexes were built using a combination of risk perception variables using Likert scales, measuring the degree of perception for each risk type. A higher index value indicates a greater perception for each risk type |
| e23risk_bio | *Biological risk impact* | |
| e23risk_fin | *Financial risk impact* | |
| e23risk_op | *Operational risk impact* | |
| e12index | *Context complexity* | This index averages coffee grower expectations and measures the problematic complexity degree the farmer has on the future, with higher index values indicating more negative expectations |

*Note.* Adapted from "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity" by Sitkin and Weingart, 1995, Academy of management Journal, 38(6), 1573-1592.

The construct labelled as *Risk Management* featured the alternatives faced by a decision maker. Following Sitkin and Pablo (1992), it is, to some extent, the risk component of the strategies available to coffee growers, making it a latent factor to strategies. This construct corresponds to Hypothesis 5, formed by the variables introduced in Table 6, representing strategies developed by the coffee grower.

*Hypothesis 5: The risk propensity level of coffee growers determines their risk management approaches.*

Table 6

*Observed Variables of the Latent Construct Risk Management*

| Index | Variable | Description |
|---|---|---|
| b44 | *Fertilization* | This variable represents the response to production risks due to less soil nutrients |
| b45 | *Soil analysis* | This variable represents the strategic long-term decision associated to coffee quality through soil care |
| c4 | *Technical assistance* | This variable represents the short-term strategy that guarantees optimization, good practices in the productive process and quality of the final product |
| c6 | *Assistance requirements* | This variable measures the assessment on technical assistance needs by coffee growers |
| d1 | *Financial support* | Strategic short-term decision that allows coffee growers to operate under adverse conditions |
| Id7 | *Coffee ID* | This variable represents the association level of coffee growers and their guild strategy |

*Note.* Adapted from "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity" by Sitkin and Weingart, 1995, Academy of management Journal, 38(6), 1573-1592.In addition to the described constructs, the creation of the construct *Institutions* was proposed, which described the effects of risk management instruments available to coffee growers. According to this construct, greater institutional trust is related to greater efficiency of institutions as risk management instruments.

Table 7

*Observed Variables of the Latent Construct Institutions*

| Index | Variable | Description |
|---|---|---|
| e24index_bio | *Trust on biological risk instruments* | This variable represents trust on risk management instruments, offered by public and private institutions, employed to manage biological risks |
| e24index_oper | *Trust on operational risk instruments* | This variable represents trust on risk management instruments, offered by public and private institutions, employed to manage operational risks |
| e24index_cli | *Trust on climate risk instruments* | This variable represents trust on risk management instruments, offered by public and private institutions, employed to manage climate risks |
| e24index_fin | *Trust on financial risk instruments* | This variable represents trust on risk management instruments, offered by public and private institutions, employed to manage financial risks |

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*Note.* The combination of variables was performed following the taxonomies obtained during the qualitative stage (panel of experts), where risk instruments refer to the different institutions related to the Colombian coffee sector

Figure 4 displays the methodological structure of the model, including the six aforementioned latent variables and their respective observed variables.

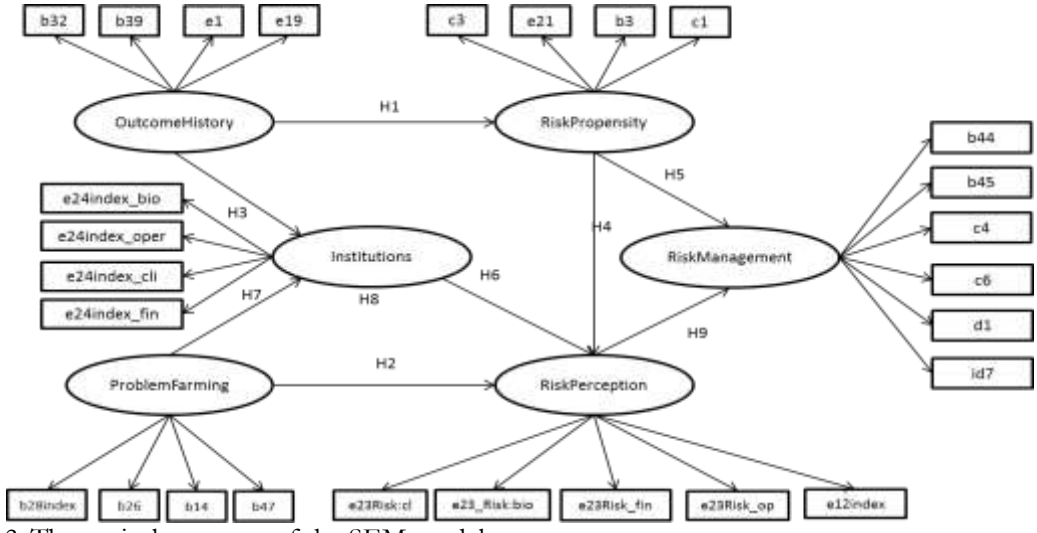


*Figure 2*. Theoretical structure of the SEM model

**Validity and Reliability**

After reviewing the methodological literature (Arbuckle, 2013; Hair et al., 2014; Véliz Capuñay, 2016), it was found that the most used indicators to evaluate model fit for SEM are: CMIN/DF ratio (*Minimum discrepancy*), GFI (*Goodness-of-Fit Index*) and AGFI (*Adjusted Goodness-of-Fit Index*) indexes, and RMR (*Root Mean Square Residual*) and RMSEA (*Root Mean Square Error of Approximation*) indexes. The CMIN/DF ratio corresponds to the quotient between the value $\chi^2$ divided by its degrees of freedom. Véliz Capuñay (2016) considered that a value less than two for this quotient indicated that the covariance matrix derived from the model and the covariance matrix based on the data are close enough, thus the model adequately captures the relations between data (Véliz Capuñay, 2016, p.170). On the other hand, Van Winsen et al. (2016) considered that a value no higher than three for the CMIN/DF ratio is an acceptable result. In this research, the threshold of three proposed by Van Winsen et al. (2016, p.66) was adopted, as presented in Table 8: an indicator of 1.835 revealed that the model captured the relationships between data.

Table 8

*CMIN/DF Ratio*

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 61 | 532.031 | 290 | .000 | 1.835 |
| Saturated model | 351 | .000 | 0 | | |
| Independence model | 26 | 3969.032 | 325 | .000 | 12.212 |

*Note.* Adapted from "Determinants of risk behaviour: effects of perceived risks and risk attitude on farmer's adoption of risk management strategies" by van Winsen F. et al. 2016, *Journal of Risk Research*, 19(1), 56-78.
*The ratio between the $\chi^2$ value and its degrees of freedom is adjusted according to the propositions from "Análisis multivariante: métodos estadísticos multivariantes para la investigación" by Veliz Campuñay, 2016, Cengage. Buenos Aires.

The GFI (*Goodness-of-Fit Index*) and AGFI (*Adjusted Goodness-of-Fit Index*) indexes are goodness-of-fit measures designed by Jöreskog and Sörbom (1984) to evaluate a SEM estimated through maximum likelihood. The GFI index is one of the most employed measures and has a range between zero and one, where zero indicates that the model does not fit the observed covariance in the data, and one indicates that the model fits perfectly to the covariance in the data. AGFI is an adjustment to the GFI index based on the degrees of freedom. It has an upper limit of one, where it indicates perfect fit, but it does not have a zero value as the lower limit. Véliz Capuñay (2016) considered that GFI and AGFI values above 0.90 are acceptable, whereas Van Winsen et al. (2016) used a threshold of $> 0.95$ as an acceptable fit value. Because the analysis of a model is not based on a single measure, but on a set of fit measures, 0.90 was defined as an acceptable value for GFI and AGFI. Table 9 shows the goodness-of-fit of the model, with GFI = 0.914.

Table 9

*Goodness-of-fit Measures*

| Model | RMR | GFI | AGFI | PGFI |
|---|---|---|---|---|
| Default model | .023 | .914 | .896 | .755 |
| Saturated model | .000 | 1.000 | | |
| Independence model | .091 | .585 | .552 | .542 |

*Note.* Adapted from "Determinants of risk behaviour: effects of perceived risks and risk attitude on farmer's adoption of risk management strategies" by van Winsen, F. et al. 2016, Journal of Risk Research, 19(1), 56-78.
The goodness-of-fit measures were adjusted according to the propositions "Análisis multivariante: métodos estadísticos multivariantes para la investigación" by Veliz Campuñay, C., 2016, Cengage. Buenos Aires.

RMR and RMSEA are measures based on residuals. RMR (*Root Mean Square Residual*) is the square root of the mean quadratic difference between the observed variances and the estimated variances under the assumption that the model is correct (Arbuckle, 2013, p.636). RMSEA (*Root Mean Square Error of Approximation*) is an adjustment measure that uses the population discrepancy function adjusted by the model's complexity level. Both measures are better the closer these are to zero. Arbuckle (2013, p.624) and Véliz Capuñay (2016) considered that an RMSEA value of 0.05 or less would indicate a proper model fit in relation to degrees of freedom.

However, Arbuckle (2013) also considered that values lower than 0.08 would indicate a reasonable approximation error, but models with RMSEA greater than 0.10 should not be used for analysis. Van Winsen et al. (2016) used a limit of 0.05 for RMR and 0.08 for RMSEA. In this study, the recommendations of Arbuckle (2013) were adopted, as presented in Table 10 with RMSEA = 0.043.

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Table 10

*Model RMSEA*

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .043 | .037 | .048 | .984 |
| Independence model | .156 | .152 | .161 | .000 |

*Note.* The residual-based measures are adjusted according to the proposition from "IBM SPSS AMOS 22 Users' Guide" by Arbukle, J. L. 2013, IBM Corp.

It is important to note that a single goodness-of-fit measure is not enough to accept or reject a model. For model assessment in the current research, there is a simultaneous evaluation of statistical goodness-of-fit measures, but mainly theoretical considerations for model acceptance are considered. From the theoretical point of view, the models must have the signs and values appropriate to the theoretical precepts on which it was built. Summing up, theoretical considerations are also relevant, and sometimes they will prevail over statistical considerations.

**Results and Discussion**

Base model results, summarized in the first row of Table 11, indicate a proper fit to data, while the structural relationship coefficient measuring the impact of *Problem Framing* over the construct *Risk Perception* (third row of Table 11) indicates that the relationship is both statistically significant and theoretically consistent. That is, higher risk values in *Problem Framing* are related with a higher risk perception level, *Risk Perception*, by the coffee grower. This agent sensitivity to different intensity levels of the phenomenon and its risk features might lead them towards strategies with a greater immunizing effect, or towards decisions related with the postponement of investment projects (Pindyck, 1988).

In the three steps afterwards, the mediating variable was introduced, also declaring its relationship with both the causal variable and the outcome variable. For the case of the current research, the latent variable *Institutions* was entered as a mediating variable on the relationship between *Problem Framing* and *Risk Perception* levels. For the second step, the mediating and causal variables were related, by measuring the relationship between *Institutions* and the construct *Problem Framing* to identify the importance of the mediating construct on the explanatory variable. The relationship between the response variable, *Risk Perception*, and the mediating variable, *Institutions*, was analysed during the third step. In the fourth and final step, the mediation was theoretically and statistically analysed based on the results of the previous steps. The steps two to four were performed on the extended SEM model including the variable *Institutions*, as shown in Figure 4.

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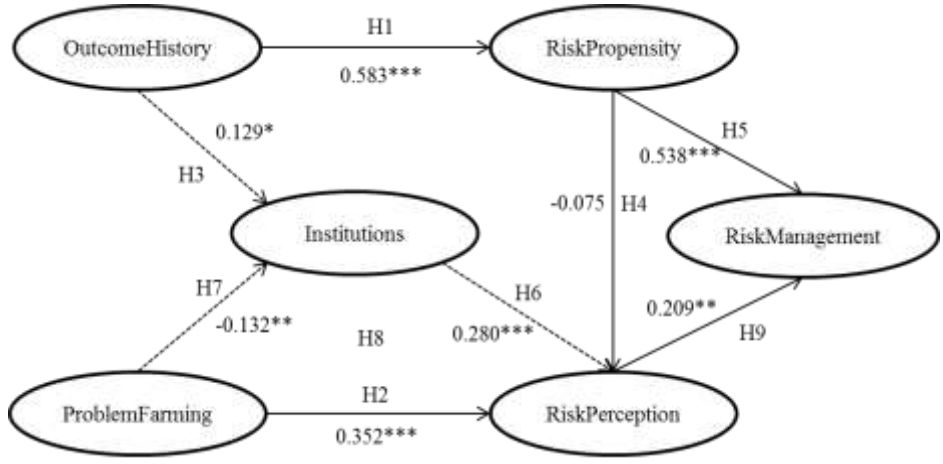


*Figure 3* Results of the extended model with the mediating variable *Institutions* and the related hypotheses

Model comparison through model global fit indicators delivered results that favoured the addition of the latent construct *Institutions*. As shown in Table 30, fit for the extended model introduced in Figure 15 created changes on fit indicators while remaining satisfactory. Two of these, CMIN/DF and CFI, showed the extended model as the best one: CMIN/DF went down from 1.89 to 1.84 and the CFI index increased from 0.836 to 0.934. Except for AGFI, the other indicators did not show substantial changes on fit levels. Even though GFI and AGFI decreased, fit levels remained satisfactory after introducing the construct *Institutions*.

Table 11

*SEM Models Related with Institutional Moderation*

| Model | CMIN | DF | P-val | CMIN/DF | RMR | GFI | AGFI | CFI | RMSEA |
|---|---|---|---|---|---|---|---|---|---|
| Base model: without a moderating variable | 384.82 | 204 | 0.000 | 1.89 | 0.022 | 0.927 | 0.910 | 0.836 | 0.044 |
| Extended model: with a moderating variable | 532.03 | 290 | 0.000 | 1.84 | 0.023 | 0.914 | 0.896 | 0.934 | 0.043 |

*Note.* CMIN is the $\chi^2$ statistic once the SEM model has been optimized, DF is the number of degrees of freedom, P-val is the significance level of the CMIN statistic with DF degrees of freedom. RMR, GFI, AGFI, CFI, RMSEA are goodness-of-fit statistics of the model on the data explained at the beginning of the section.

## Hypotheses Testing

Estimates of the structural coefficients for both the base and the extended models are shown in Table 12. Correlations found in the base model validated the capacity of the model proposed by Sitkin and Pablo (1992) to capture the relationships found in the context of the Colombian coffee grower. Except for the coefficient of the path from *Risk Propensity* to *Risk Perception*, the other coefficients of the base and extended models were statistically significant and theoretically consistent.

The Hypothesis 1 was tested: *The more successful the results of past decisions taken by the coffee grower are, the greater its risk propensity will be.* As a result, the model shows that the relation between the latent construct

*OutcomeHistory* and *RiskPropensity* is positive. The estimated coefficient of (0.583) for structural regression relationship, with a significance level (*p<0.095)*, indicates that risk propension of the agents was reinforced by successful decisions on their own domain. During a review of the prospect theory of Kahneman and Tversky (1979), Sitkin and Pablo (1992) had already identified this type of result as plausible. Besides, the empirical studies of Taylor, Hall, Cosier, and Goodwin (1996); Cho and Lee (2006) and van Winsen et al. (2016) on the impact of experience on agent risk propensity validate the result obtained for this coefficient, thus confirming Hypothesis 1 is supported on the variable nature of risk propension and its dependence on past experiences of the agent.

For the Hypothesis 2: *The assessment of a risky situation as an opportunity or a threat by a coffee grower determines its risk perception.* The significant coefficient obtained from (0.352) suggests a positive with a significance level (*p<0.085)* and statistically discernible relationship between both constructs. In other terms, data support Hypothesis 2 and lead to conclude that agents have conceptual frameworks for problem analysis that allow them to identify different risk levels associated to a given decision situation. Summing up, the agent or producer is sensitive to environmental features, such sensitivity determining its behaviour.

For the Hypothesis 3: *The results of risky past decisions taken by the coffee grower determine its assessment of the institutions underlying the sector.* The statistically significant and positive coefficient obtained for the path from *Outcome History* to *Institutions*, amounting (0.129) with a significance level (*p<0.066)*, supported this relationship proposed in Hypothesis 3. This indicates that perceptions on institutional arrangement effectiveness is assessed as the capacity of institutions and the current rules to mitigate or cover the multiple risk dimensions a farmer is subject to. Successful experiences in the past must be correlated with positive evaluations of the institutional apparatus.

Table 12

*Estimated Coefficients for Structural Relationships*

| Path (Independent → Dependent) | Hypothesis | Base model | Extended model |
|---|---|---|---|
| Outcome history → Risk propensity | H1 | 0.611*** | 0.583*** |
| | | (0.093) | (0.095) |
| Outcome history → Institutions | H3 | | 0.129* |
| | | | (0.066) |
| Problem framing → Risk perception | H2 | 0.318*** | 0.352*** |
| | | (0.088) | (0.085) |
| Problem framing → Institutions | H7 | | -0.132** |
| | | | (0.057) |
| Institutions → Risk perception | H6, H8 | | 0.280*** |
| | | | (0.065) |
| Risk propensity → Risk perception | H4 | -0.063 | -0.075 |
| | | (0.080) | (0.076) |
| Risk propensity → Risk Management | H5 | 0.540*** | 0.538*** |
| | | (0.069) | (0.069) |
| Risk perception → Risk Management | H9 | 0.229** | 0.209** |
| | | (0.097) | (0.093) |

*Note.* The values in the upper section of each cell correspond to maximum-likelihood estimates. The values in parentheses are the standard errors calculated through bootstrapping with 5000 subsamples. * indicates significance at 10% level, ** indicates significance at 5% level, and *** indicates significance at 1% level.

For Hypothesis 4: *The greater the risk perceptions of coffee growers are, the higher the number of risk management strategies is.* The not significance in the estimated coefficient of (-0.075) for the path from *Risk Propensity* to *Risk perception,* seemed to question the validity of the relationship proposed in Hypothesis 4, the negative sign is consistent with the arguments of Sitkin and Pablo (1992), Sitkin and Weingart (1995) and the empirical results obtained by Cho and Lee (2006) and Van Winsen et al. (2016). That is, the greater the risk perception of the coffee grower, the higher the number of risk management strategies.

For the Hypothesis 5: *The risk propensity level of coffee growers determines their risk management approaches.* That is supported by significant coefficient of (0.538) with *(p<0.069)*, corresponding to the path from *Risk Propensity* to *Risk Management*, points towards a dependence of agent behaviour on its risk aversion level. That is, behaviours and decisions of risk-averse coffee growers differ from those displayed by risk-loving coffee growers. The former agents take more conservative decisions in the sense of a lower risk level or being preciously tested by other market agents. Enrolment in associations and adoption of techniques previously tested in other productive units are a manifestation of said risk aversion.

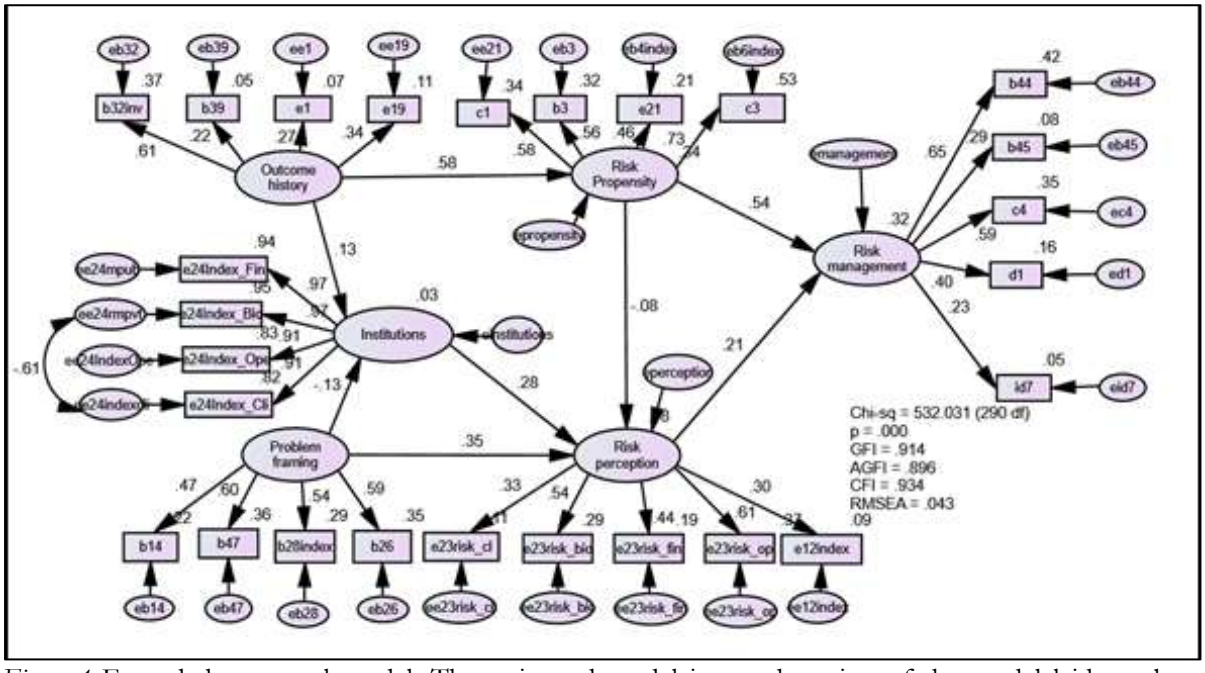


*Figure 4* Extended structural model. The estimated model is an adaptation of the model laid out by Sitkin and Weingart (1995) with the addition of the latent construct *Institutions*, which encompasses the set of rules, opportunities and restrictions conditioning the behaviour of the Colombian coffee grower.

For the Hypothesis 6: *The assessment of the institutions underlying the coffee sector is directly related to risk perceptions of coffee growers.* The coefficient estimated for the path from *Institutions* to *Risk Perception* (0.280) with *(p<0.065)* (see Table 31) indicated that better valued institutions are positively correlated with risk perception levels. This result validates Hypothesis 6. For the Hypothesis 7: *The assessment of risky*

*situations as an opportunity or a threat by a coffee grower determines its assessment of the institutions underlying the sector.* The coefficient estimated for the path from *Problem* Framing to *Institutions* (-0.132) with *(p<0.057) indicated* that cognitive schemes with higher risk levels are related to lower scores for the institutional arrangement. This result validates the Hypothesis 7.

For the Hypothesis 8: *The institutions underlying the coffee sectors affect risk perceptions of opportunity or threat situations faced by coffee growers.* The significant coefficients for the path from *Outcome History* to *Institutions* (0.129) with *(p<0.066)*, and the path from *Institutions* to *Risk Perception*, (0.280) with *(p<0.065)*, as well as an increase on risk perceptions after incorporating the mediating variable, from 0.318 to 0.352 against *Problem Framing*, and from (-0.063) to (-0.075) against *Risk Propensity*, demonstrated that institutions affect risk perceptions of coffee growers through the instruments they offer to the latter. The above validates Hypothesis 8.

Finally, for the Hypothesis 9: *Risk perceptions of coffee growers determine their risk management approaches.* The significant coefficient (0.209) with *(p<0.093)* for the path from *Risk Perception* to *Risk Management* also indicate a statistically significant impact, albeit of lower magnitude than the one estimated for Hypothesis 5, of *Risk Perception* over *Risk Management*. Both coefficients and their respective hypotheses lead to conclude that risk management of coffee growers is a function of both their risk propensity and their risk perceptions during decision situations. Both constructs are variables and functions of both coffee grower experience and their mental framework to analyse and take decisions under risk contexts. Under these terms, coffee grower behaviour can be described from the basic constructs outlined by Sitkin and Pablo (1992) and empirically evaluated by van Winsen et al. (2016) in European farms. This validates Hypothesis 9.

## Discussion

It was found there is a significant relationship between risk management offered by institutions underlying the coffee sector and the risk perception of Colombian coffee producers. The results laid out in the previous section indicate that the model of Sitkin and Pablo (1992) underlies the covariance structure of the data obtained from a sample of Colombian coffee growers. When the base model is extended with the construct *Institutions*, the model improves its CFI fit index and its CMIN/DF ratio. Such improvement in these global indexes, coupled with the individual significance of the variance of the construct *Institutions* and its relationships or paths with the other constructs in the base model, suggest that the model of Sitkin and Pablo (1992) must be extended to include the effect institutions might have on the behaviour and risk perceptions of an agent. Throughout the current research, the agent is defined as a small-scale producer that could be considered as a representative of the Colombian coffee sector. Said producer or agent has managed to set a State-backed institutional arrangement that gives the required action for certain operation rules to have the credibility and enforcement required to be seen as legitimate by all agents participating in this market.

Colombian coffee sector institutions are designed to act over multiple variables of interest for the Colombian coffee grower. For example, the National Federation of Coffee Growers (FNC) and the cooperatives provide the purchase guarantee, as well as public instruments and goods that lower the effect of external price shocks that could threaten the stability and survival of the coffee grower. Said mitigation effect on prices is not included in the model of Sitkin and Pablo (1992), but it does lower risk perceptions held by coffee growers. Under market conditions, all agents are exposed to these market shocks. In the Colombian case, the institutional arrangement supported by coffee growers and the government modifies the way market rules are seen. This arrangement, centred on the coffee production unit, provides macroeconomic and sectorial instruments that have mitigated external and internal shocks that might have, under the conditions of small-scale coffee growers, affected them directly. Mechanisms such as complete supply absorption at published prices (purchase guarantee),

research and innovation, varieties improvement, plague control, future purchase contracts, commercialization networks operating in a coordinated manner with other mechanisms, constitute risk management instruments for agents in the sector.

The institutional arrangement underlying the coffee sector configures cognitive and knowledge schemes (Cornelissen & Werner, 2014) that are essentially dynamic and outcomes from social constructs (Kaplan, 2008). The rules governing the institutional arrangement give some stability to the agreement, but said institutional arrangement might change depending on the interactions of some agents with different levels of power and communication skills (Fligstein & McAdam, 2011; Gray, Purdy, & Ansari, 2006; Kaplan, 2008). The extended model proposed in the present research suggested the construct *Institutions* could perform as a proxy for the variable nature of the institutional arrangement that is instrumented through agent perceptions of the usefulness of institutions meant to cover their multiple risk dimensions.

The unidirectional relationship linking this construct as an output variable to the constructs *Outcome History* and *Problem Framing* does not satisfy the dynamic and bidirectional interaction argued by Kaplan (2008) in his analysis of political interactions to set up an operation scheme favorable to agents, or the dynamics of power supporting the strategic fields of action mentioned by Fligstein and McAdam (2011). The main reason for considering the relationship as unidirectional is the horizon of analysis for the information available to the current research. The analysed sample gathered current opinions and perceptions of the agents in comparison to their status ten years ago. A decade of analysis is not enough to deliver conclusions on the coffee sector in Colombia, and the author preferred to be conservative regarding research scope.

The construct *Institutions* responds in a statistically significant way to the constructs *Outcome History* and *Problem Framing*. Specifically, perceptions on institutional arrangement effectiveness is assessed as the capacity of institutions and the current rules to mitigate or cover the multiple risk dimensions a farmer is subject to. Successful experiences in the past must be correlated with positive evaluations of the institutional apparatus. The statistically significant and positive coefficient obtained for the path from *Outcome History* to *Institutions* that was presented in Table 31, amounting (0.129), supported this relationship proposed in Hypothesis 3.

Regarding the construct *Problem Framing*, the coefficient estimated for the path (-0.132) (see Table 31) indicated that cognitive schemes with higher risk levels are related to lower scores for the institutional arrangement. Meanwhile, the coefficient for the path from *Institutions* to *Risk Perception* indicated that better valued institutions are positively correlated with risk perception levels. This result validates Hypothesis 6. Both coefficients, which describe Hypotheses 6 and 7, indicated that mediation is statistically significant, and the negative sign of both coefficients showed that the mediation can be classified as suppression-type mediation (Conger, 1974).

A suppressor is a mediating variable that, once introduced into the model, increases the value of the coefficient between the independent and the dependent variables. As shown in Table 31, the coefficient for the path from *Problem Framing* to *Risk Perception* increased from (0.318) to (0.352) when the latent construct *Institutions* was added to the model (extended model). Cheung and Lau (2008) considered that this phenomenon indicates that the relationship between the latent constructs, in this case *Problem Framing* and *Risk Perception*, is hidden or suppressed by the effect of *Institutions*. When the model is not controlled by *Institutions*, the relationship coefficient might be lower or even negative (Cheung & Lau, 2008). The mediation effect can also be operationalized through the product of the estimated coefficients for the paths linking the mediating variable with the independent and dependent constructs.

The mediation value, calculated as the difference between the coefficients of the path from *Problem Framing* to *Risk Perception* in the base and extended models, indicates that the mediation had a mean value of (-0.037)[3]. This difference in the coefficient suggested that institutions underlying the coffee sector lower the risk magnitude farmers perceived by approximately 10%. The suppressive effect, although small, is statistically discernible when considered within the context of the extended model.

## Conclusions

Based on literature, we developed a theoretical model for understanding risk behaviour in terms of both risk attitude and perceived risks. Empirical evidence for this model is provided by using SEM on data gathered from a survey on a large and representative sample of Colombian coffee growers. The results of the current study showed that through the comparison of the models after the incorporation of global fit indicators that adding the latent construct *Institutions* offered favorable results to the expansion of the model proposed by Sitkin and Pablo (1992). Regarding risk propensity, the variable depending on the historical record of successes or failures in risk situations. That is: the more successful the results of past decisions taken by the coffee grower are, the greater its risk propensity will be. The risk propensity of the agent is reinforced by successful decisions in its own domain. In their review of *Prospect Theory*, introduced by Kahneman and Tverzky (1979), Sitkin and Pablo (1992) identified this type of outcome as important. Plus, the results of Taylor et al. (1996), Cho and Lee, (2006) and Van Winsen et al. (2016) on the impact of the experience over the agents' risk appetite validate the result obtained for this coefficient, confirming this hypothesis on the variable nature of risk propensity and its dependence on past agent experience.

In addition, opportunities and threats were represented by the construct *Problem Framing*, being evaluated against risk perception (*Risk Perception* construct), led to the conclusion that agents have conceptual problem analysis schemes that allow them to identify different risk levels associated to a given decision situation. On the other hand, the construct *Institutions* that represented the risk management instruments offered by the institutions, respond in a statistically significant way to the constructs that represented past decisions and the coffee grower's problematic framework (*Outcome History* and *Problem Framing* respectively). That is, successful past experiences must be correlated with positive evaluations of the institutional apparatus.

Finally, the behavior and decisions of risk-adverse farmers differ from the behavior of risk-loving farmers. The first agents make more conservative decisions that contain less risk or have been previously tested by other agents in the market. Membership in associations and the adoption of previously proven techniques in other productive units are a manifestation of risk aversion. In addition, the institutions that underlie the coffee sectors affect the risk perceptions of the situations of opportunity or threat faced by coffee growers, and determines the risk decisions of the coffee growers. In these terms, the behavior of the coffee grower can be described through the basic constructs delineated by Sitkin and Pablo (1992), evaluated empirically on European farms by Van Winsen et al. (2016).

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[3] The suppressing mediation value is -0.034 [ = 0.318 - 0.352] when calculated from the coefficients in Table 31. However, bootstrapping estimation in IBM SPSS AMOS v.24 showed an average value of -0.037 with a bias-adjusted standard error of 0.019, and a bilateral significance level of 0.013.

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