Deepening Understanding of Certification Adoption and Non-Adoption of International-Supplier Ethical Standards

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Abstract

This study presents a theory of multiple, equifinality, causally complex, configurations of antecedents influencing the adoption versus non-adoption of international supplier ethical certification-standards. Here are three propositions in the theory. No single (simple) antecedent condition is sufficient for accurately predicting a high membership score in outcome conditions—a firm's adoption or rejection of a product certification. No single (simple) antecedent condition is necessary for accurately predicting high scores in the outcome condition. Statements of combinatory (complex) antecedent conditions (configurations) are sufficient but not necessary for accurately predicting high scores in the outcome condition. The study examines the theory for the populations of exporting firms in the cut-flower industry in two South American countries. The findings support all but one proposition in the theory.

Keywords: adoption; asymmetry; causal recipe; complex antecedent conditions; equifinality; ethical standards; product certification

1. Introduction

In several industries involving international supplier-distributor-retailer-customer chains, local trade industry associations encourage adoption of certification standards by individual producers to sustain downstream customer acceptance and avoid bad publicity. For example, in an article provocatively entitled, “There's blood on those [Colombian and Ecuadorian] Valentine's Day roses,” Wojcik (2011) informs that an industry watchdog group, Fairness in Flowers, reports that at flower farms in Colombia and Ecuador—where most of the flowers now sold in the U.S. originate—two-thirds of the workers are women. “These women are routinely subjected to harassment and even rape from their male supervisors. They suffer eye infections and miscarriages from consistent contact with dangerous pesticides,” according to a release put out by Change.org (Wojcik, 2011, p. 1). Riisgaard (2008, p. 328) stresses, “Consumers in EU markets are demanding greater variety and are increasingly interested in the environmental and social dimensions of production of cut flowers. This is leading to a proliferation of social and environmental standards in the cut flower industry.” Hira and Ferrie (2006, p. 107) describe a rapid expansion in U.S. consumer interest in fair trade industry behavior that has “raised alarm bells and questions for the business community about ethically produced goods….”

The growing focus on the development and adoption of industry ethical fair trade standards prompts asking several questions of both theoretical and practical importance including the following ones. Which firms within an industry adopt which fair trade production standards? What are the characteristic patterns of firms who do not adopt these standards? Does adoption of specific international fair trade standards vary for producing firms in different countries? Does the non-adoption of these firm-level standards vary between nations? In examining these issues the study here is unique in proposing and empirically testing a theory that is causally asymmetric (causal conditions leading to adoption of ethical standards differ from causal conditions leading to non-adoption behavior). The study's findings support an equifinality view of adoption behavior (more than one unique complex antecedent configuration lead to the same adoption or non-adoption outcome). The study employs a mix of quantitative and qualitative empirical methods to test formal propositions of the theory for the entire population of firms in the industry in each of the countries in the study. The findings support several insights for nurturing the acceptance of industry ethical standards by individual firms by industry trade and consumer fair trade organizations. The findings demonstrate that Roberts (2003, p. 159) perspective appears accurate at first blush, "understanding the patchy success of ethical sourcing initiatives" is not straightforward; however, the applications of configurational theory and analyses in the present study do make substantial progress in achieving such understanding.

1.1 Structure of the Paper

Following this introduction, section two provides an objective-antecedent based theory of adoption of product certification standards. The theory focuses on the relationships of simple and complex antecedent conditions of verified fundamentals of firm-level characteristics, such as size (total revenues from exports), number of other certifications adopted, and membership in the local industry association, on product certification adoption (PCA). Section three describes the method for testing the theory. Section four presents the findings. Section five concludes by discussing the implications for managing product certification programs, adoption of such certification standards, limitations and suggestions for future research.

1.2 Producer Ethical Certification Programs

A producer ethical certification program is an accreditation initiative that attests to an organization's compliance with a set of predefined ethical quality, environmental, and/or labor standards in its production process. These standards encompass the list of practices and requirements that organizations must implement to achieve certification. Participating firms undergo an auditing process which can be conducted by a third-party organization or by the certifying agency, but self-reporting by the firm is unacceptable for gaining certification. Participation in these programs is voluntary.

A firm within an industry may seek product certification for one or a combination of several reasons. For example, self-regulation may help firms preempt tougher regulation, respond to stakeholders' demands, or protect themselves from other firms' "spillover" harms (Barnett & King, 2008; Khanna, 2001; Lyon & Maxwell, 2002; Rees, 1997; Rice, 2001). Certified firms may achieve higher financial benefits or a sales winning advantage compared to non-certified organizations (Rivera, 2002; Corbett, Montes-Sancho, & Kirsch, 2005; Terlaak, & King, 2006). Formal certifications can also provide legitimacy to new startups, especially in the case of emerging sectors (Sine, David, & Mitsuhashi, 2007).

Nevertheless, one of the primary motives considered in the industry self-regulation literature is the use of certifications as signals to reduce asymmetric information between exchange partners (King, Lenox, & Terlaak, 2005; King & Toffel, 2007; King, Prado, & Rivera, 2011). Certification programs can help firms communicate unobservable product characteristics to their customers (King, Lenox, & Barnett, 2002). The environmental and labor practices are usually hidden attributes of a good or service, as stakeholders cannot determine, even after purchased, whether the good was produced in a socially responsible way (Reinhardt, 2000; Rice, 2001). Therefore, firms often adopt product certification programs to credibly communicate the unobserved attributes of these "credence goods" (Darnall & Carmin, 2005).

1.3. Expansion of Producer Ethical Certification Standards

Starting in the mid-1990s a proliferation of producer ethical certification programs in many industries has occurred. In 2009, the World Resource Institute identified 340 different eco-label organizations operating in 42 countries (WRI, 2010). Multiple certification programs often operate within a single industry where they compete for producers' adoption and buyers' support. For instance, there are more than 100 certifications for food products, more than 70 in the tourism sector, and more than 30 in the forestry industry (Blackman & Rivera, 2011). While they may be confined to a national setting, many of these certification programs have spread across international borders (Smith & Fischlein, 2010). Overall, these initiatives compete for rule-setting authority to influence other economic actors (Cashore, Auld, & Newsom, 2004; Smith & Fischlein, 2010; Reinecke, Manning, & von Hagen, 2012).

1.4 Unique and Valuable Features in the Present Study

The present study examines causal configurations of firm level data (e.g., size of firm in total export revenues, membership in a local industry association, share of product category, share of exports to Europe versus USA, firm's national location, number of current certifications held) on the adoption of eight product certification programs. Unlike all prior studies explaining adoption of product certifications and management systems (e.g., Christmann &Taylor, 2001, 2006; Delmas & Montiel, 2008; Rivera, 2004; Rivera & DeLeon, 2004) by examining the net effects of independent variables via statistical methods (i.e., multiple regression analysis, MRA); our study here performs fuzzy-set qualitative comparative analysis ("fsQCA," Ragin, 2008) to examine for the possibilities of multiple configurations (a.k.a. " algorithms", "combinations", "conjunctions", and "paths") that result in a firm's adoption of certification programs. We develop a theory of antecedent based causal configurations for acceptance versus rejection of product certification programs and use a unique dataset on cut-flower exporters from Colombia and Ecuador to test the theoretical propositions.

The findings support asymmetric and multiple combinatory statements of associations for product certification adoption (PCA) rather than a symmetric multiple regression analysis (MRA) stance. From an asymmetric approach, any one independent variable (i.e., "simple antecedent condition" in the terminology of fsQCA) can have a negative impact as well as a positive impact on the dependent variable ("outcome condition"). The impact of a simple antecedent depends on the presence or absence of other conditions within different causal configurations. In MRA, high values of individual independent variables associate with PCA and low values of these variables associate with non-PCA. Algorithm-building studies, as the ones employing fsQCA, identify complex statements of high values of combinations of typically two-to-seven simple antecedent conditions. These complex statements are associated with a given outcome condition (e.g., PCA) without concern about the relationship between low values of the configurations and the values of the outcomes condition.

Therefore, the identification of such statements indicates sufficiency but not necessity in predicting high values for the outcome condition. Such an algorithm-building focus offers important advantages over MRA (McClelland, 1998; Ragin, 2008; Woodside, 2013). Some advantages of this analytical approach include the following. First, substantial differences in an outcome condition ("dependent variable" in MRA) often occur only for the first and fifth quintiles of cases in the antecedent condition—thus, a low correlation between the simple antecedent and outcome may mislead. Second, an algorithm-building focus overcomes problems in examining complex three-way to six-way interaction effects in MRA. Third, the algorithm focus retains explanation details at the case level that variable level findings do not report, while still providing sample or population-level generalizations. Referring to fsQCA but applicable to all algorithm-building foci, Ragin (2006) expands on these and additional advantages.

Differently than most prior explorations of product certification adoption, we use a unique dataset that relies on archival information of the whole population of exporting firms in two developing countries. We also analyze the adoption decision for all product certification programs available for firms operating in this industry. Most studies on certification adoption use survey or qualitative data to analyze firms' adoption decision and study a single certification program—often ISO 9000 an ISO 14000 (Boiral, 2007; Christmann & Taylor, 2001; Rivera, 2002;). Research also focuses on certification programs in developed countries or manufacturing industries (King, et al., 2012). Therefore, the empirical context, the data, and the methodology used in this study contribute to our understanding of firms' participation in voluntary programs in developing countries.

More specifically, the study contributes to the self-regulation literature by providing insights for certification organizations' planning and marketing strategies. These organizations face selection pressures that trigger their need to grow and expand into international markets (Durand & McGuire, 2005). They also implement differentiation strategies to compete for producers' adoption seeking positioning among certain niches or targeting specific types of firms (Reinecke, et al., 2012). Therefore, identifying the antecedents for adoption—by program—constitutes valuable information for the certifying organization's strategic decisions and contributes to prior research on the dynamics of the standards market and the coexistence of multiple certifications in an industry (Durand & McGuire, 2005; Reinecke et al., 2012; Riisgaard, 2008; Sasser, Prakash, Cashore, & Auld, 2006; Smith & Fischlein, 2010).

The study here also contributes to the research on certification adoption by analyzing a set of firm characteristics and their influence both on adoption as well as rejection of multiple certification programs. Some of these firm characteristics—such as size, membership to industry association and exports share to a specific market—have been analyzed by prior research even if through MRA (Christmann & Taylor, 2005; Delmas, 2002; Montiel & Husted, 2009; Rivera, 2002). By identifying specific combinations of firm charactertistics revelent for certification adoption and rejection, the algorithm-building approach in the present study extends and serves to change the perspective on findings towards a configurational assessment.

Heretofore, the number of other certifications adopted by the firm and how prior adoption behavior influences additional adoptions at the firm level has not been explored in the self-regulation literature. Firms' prior experience with other certifications and how such experience influences certification adoption has only been studied at the country level; such research finds that this experience positively impacts the firm's likehood of adopting a certification program (Delmas & Montiel, 2008). Some of these programs seek to become the first-step firms take to adopting more stringent certifications later (Reinecke, et al., 2012). However, no research has been available relating to adoption of multiple programs. The study here contributes to this line of inquiry by analysing if the number of other certifications at the firm level plays a role in adoption. We identify specific programs and combinations of antecendents for which such influence occurs.

Finally, an additional implication of our findings is in recognizing that models of both certification adoption as well as non-adoption are useful and such modeling is most useful when performed separately for different national markets (e.g., Colombia versus Ecuador). For example, the study provides answers as to how effective the marketing of competing certification programs is likey to be considering their respective designs, adopter/rejector charactertistics, and country markets. What may be effective for program X for producers who have adopted other programs in Ecuador is frequently ineffective for program Y for producers who have adopted other programs in Colombia. The study provides specific algorithms for adoption as well as rejection for specific programs, customers, and markets.

2. Theory of Adoption of Producer Ethical Certification Standards

The theoretical propositions and testing of the propositions in the present study are unique in comparison to prior literature (e.g., Christmann & Taylor, 2001, 2006; Delmas & Montiel, 2008; Naveh & Marcus, 2004). For instance, Christmann and Taylor (2001, 2006) and Naveh and Marcus (2004) rely on respondents' subjective self-reports via five-point Likert scales, and while

Delmas and Montiel (2008) use objective verifiable metrics, both sets of studies use versions of MRA to report on the net effects of independent variables on adoption of voluntary certification standards. In contrast to these prior approaches, the present study proposes theory and examines the combinatory influences of verified objective antecedents of firm self-regulation via adoption of product certifications.

Crafting theory for the present study is an application of Gigerenzer's (1991) proposition, "Scientists' tools are not neutral." Both methods and instruments suggest new theoretical metaphors and theoretical concepts once they become entrenched in scientific practice. The use of algorithms (usually involving combinations of two to seven simple antecedent conditions) for crafting theory and configurations which accurately predict high scores in an outcome condition (analogous to dependent variable) offers a distinct perspective from MRA (McClelland, 1998; Ragin, 2006; Woodside, 2013). The present study focuses on theory-building and testing from an algorithm perspective—a perspective permitting generalizing beyond individual cases while being able to identify specific cases which comply with rules in specific algorithms.

The present study avoids the inherent challenges of Likert-type questions and survey data. Some of these challenges include "telling more we can know" (e.g., people provide answers to issues without prior knowledge about the issue, Nisbett &Wilson, 1997) and less that we are aware unconsciously (e.g., unconscious beliefs affect behavior in many contexts, Bargh & Chartrand, 1999). The study here avoids concerns regarding the metric meaning of Likert responses, and issues relating to "self-generated validity" when answering a string of survey questions (Feldman & Lynch, 1988). Self-generated validity refers to the influence that expressing beliefs and emotions in answering questions early in a survey can have on answering the questions that follow. Therefore, by using a unique database of the whole population of exporting firms in two developing countries, we are able to develop an objective theory of adoption of product certification standards.

2.1. Theory of Objective-Antecedents Based Causal Configurations for Acceptance versus Rejection of Product Certification Standards

Figure 1 is a Venn diagram that includes five of the seven simple antecedent conditions in a theory of objective causal configurations associated with acceptance versus rejection of product certification standards. Only five of the seven antecedents appear in Figure 1 to avoid additional visual complexity. The theory focuses on possible causal configurations resulting in acceptance versus rejection of a product certification standard.

Figure 1 here.

The seven simple antecedent conditions include size of the firm (in total export revenues), product concentration (for the context of this paper, share of exported roses vis-à-vis other types of cut flowers), share of exports to Europe, share of exports to USA, membership in the local industry trade association, number of prior certifications held by the firm, and its country of operation. For most of these antecedent conditions, the relevant main effects hypothesis is that increases in the conditions associate positively with adoption of a product certification—exports to the USA is an exception. Studies in the extant literature (Christmann & Taylor, 2001; Corbett, 2006; Corbett, Montes-Sancho, & Kirsch, 2005; Guler, Guillen, & MacPherson, 2002; King et al., 2005; Montiel & Husted, 2009; Potoski & Pratash, 2004; Rivera, 2002; Rivera & De Leon, 2005) provide rationales and empirically support these positive net effects hypotheses.

Here are example rationales for positive firm-size influence on product certification adoption: big firms have greater capability than small firms to complete the certification process and are most likely to be within supply chains of big retailers who frequently require suppliers to have achieved product certification. That European versus American retailers and individual consumers have greater concerns with foreign suppliers achieving product certifications, provides a rationale for the hypothesis of a positive export-to-Europe main effect—Asian and European nations are prone to be more collectivistic versus individualistic societies that the United States (Hsu, et al. 2013). Collectivistic versus individualistic societies often nurture/require programs of environmental sustainability and high labor standards.

For historical reasons, firms in one nation versus firms in other nations are more or less likely to adopt product certifications. For example, during the early stage in the emergence of product certifications in the cut-flower industry—circa mid1990s—, several Colombian exporting firms in this industry were approached by a German certification organization (FLP) offering them to certify their environmental and labor practices. These early interactions and attempts by FLP were viewed widely in Colombia as negative encounters. Consequently, cut-flower producing firms in Colombia held negative views about adopting product certifications—especially certification programs originating overseas—motivating the local industry association to develop its own program (FV) (Prado, 2012). Ecuadorian firms had the opposite reaction towards the German certification organization (Prado, 2012).

The number of product certifications a firm holds is likely to influence the firm's adoption of an additional product certification. Prior experience with certifications can influence adoption, but the data analysis on this issue has been conducted with a certification count at the country level (Delmas & Montiel, 2008). Reinecke et al. (2012) argues that some certifications are meant to prepare firms to be able to adopt other certifications later, implying that firms with such a certification might be more likely to adopt an additional label. For a firm large (L) in revenues with several prior certifications (F), having high product concentration (C), and marketing mostly to Europe (E), the firm is likely to adopt (A) a new product certification—using Boolean algebra the expression for this contingency statement is $L \bullet F \bullet C \bullet E \leq A$. (The mid-level dot ("•") represents the logical "and" condition.) However, the influence of already having product certification on PCA may be negative or positive depending on the presence of other antecedent conditions.

If a firm is small (~L) with no prior certifications (~F) and low product concentration (~C) and exports mostly not to Europe (~E), the firm is unlikely to adopt any given product certification—using Boolean algebra the expression for this contingency statement is ~L•~F•~C•~E ≤ ~A. (The sideways tilde ("~") represents "not" or negation and (1- the specific condition); thus, ~C = 1.00 – Concentration.) Therefore, having or not having a prior certification can influence adoption of a program depending on the presence of other antecedents. This result can constitute an insight for the marketing strategy of certifying organizations when promoting their program among producers. Such theoretical expressions are representative of a paradigm shift from a net effects perspective to a combinatory (recipe) perspective.

The less than or equal to symbol ("≤") refers to the sufficiency condition that the value for the complex antecedent condition (L•F•C•E) is less than or equal to the outcome condition (A). Using Boolean algebra for expressing conjunctive statements, the given membership score for a complex antecedent condition (e.g., ~L•~F•~C•~E) is equal to the lowest score appearing among the simple antecedent conditions in the statement. Thus, if S = 1.00, F = 0.80, C = 0.85, E = 0.90, then L•F•C•E = 0.80 for the firm for this complex antecedent condition. An algorithm is a rule stating that a given statement leads to a given outcome. For example, the following statement is an algorithm, "If a given complex statement for a firm has a score equal or greater than 0.80, then the firm has adopted a given product certification." Analogous to z-transformations of values of different variables in statistical analysis, the metrics in estimating the influence of combinatory statements on an outcome condition requires consciously or unconsciously converting the original values of simple conditions to the same metric scoring system. The software program for fuzzy-set qualitative comparative analysis (fsQCA) performs such conversions of conditions to "membership scores" ranging between 0.00 and 1.00 (fsQCA refers to such conversions as "calibrations," see Ragin, 2008). The program is able to do such analysis after the researcher identifies three qualitative breakpoints that structure a fuzzy set: full non-membership in a condition (=0.05); the cross-over point indicating maximum ambiguity in membership (=0.50); and full membership (=0.95).

> It is important to note that the set membership scores that result from these transformations (ranging from 0.0 to 1.0) are not probabilities, but instead should be seen simply as transformations of interval scales into degree of membership in the target set. In essence, a fuzzy membership score attaches a truth value, not a probability, to a statement (e.g., the statement that a country is in the set of developed countries). (Ragin, 2008, p. 88)

2.2. Principal Propositions of the Theory

The principal propositions in the theory of objective-antecedents based causal configurations associated with acceptance versus rejection of product certification standards include the following statements

(P1) No single (simple) antecedent condition is sufficient for accurately predicting a high membership score in the outcome condition, for example, a firm's acceptance or rejection of a product certification. P1 is suggestive that a baker cannot bake a cake with one ingredient, but instead, configurations of high scores of conjoined simple-antecedent conditions are sufficient for doing so. Thus, exceptions to findings supporting a statistical main effect hypothesis are observable usually for large samples of cases ($n > 100$). For example, while some large firms do not adopt a given product certification, some small firms do, even though the main effect for firm size and adoption is large. In a study on adoption/rejection decisions of manufacturers' new consumer goods by supermarket managers, Montgomery (1975) reports no cases where a simple antecedent condition (e.g., favorable manufacturer's reputation) alone was sufficient for adoption. Executives making adoption decisions consider the conjunction of two or more favorable antecedent conditions consciously or unconsciously.

(P2) No single (simple) antecedent condition is necessary for accurately predicting high scores in the outcome condition. P2 is an application of equifinality—the idea that "a system [or process] can reach the same final state from different initial conditions and by a variety of different paths" (Katz & Kahn, 1978, p. 30). Prior research offers support and emphasizes the pervasiveness of P2 (Fiss, 2011; Montgomery, 1975; Weick, 1995).

(P3) Statements of combinatory (complex) antecedent conditions (configurations) are sufficient but not necessary for accurately predicting high scores in the outcome condition. "Not necessary" refers to the proposition that a few, not one, configurations are useful for accurately predicting high scores in the outcome condition. P3 indicates that what holds for simple antecedent conditions also holds for complex antecedent conditions—the relevant literature identifies multiple ways in reaching a given outcome (i.e., equifinality) when researchers look for alternative processes (e.g., Fiss, 2011; Howard & Morgenroth, 1968; Montgomery, 1975; Weick, 1995).

(P4) Causal asymmetry occurs for adoption versus non-adoption of product certification. P4 means that the causal configurations leading to adoption are often quite different from than the negation of terms in the configurations leading to non-adoption. Fiss (2011) emphasizes that causal asymmetry stands in contrast to the common correlational understanding of causality, in which causal symmetry is assumed because correlations are by their very nature symmetric:

> For example, if one models the inverse of high performance [or adoption], then the results of a correlational analysis are unchanged except for the sign of the coefficients. However, a causal understanding of necessary and sufficient

> conditions is causally asymmetric. That is, the set of causal conditions leading to the presence of the outcome may frequently be different from the set of conditions leading to the absence of the outcome (Fiss, 2011, p. 394).

2.3. Calibration

All fuzzy set values for all simple conditions range from 0.00 to 1.00 and these values indicate the degree of membership of the case in each condition. As mentioned before, the set membership scores that result from calibrating original scores into fuzzy set scores are not probabilities Ragin (2008) emphasizes that fuzzy sets, unlike conventional variables, must be calibrated. "Because they must be calibrated, they are superior in many respects to conventional measures, as they are used in both quantitative and qualitative social science. In essence, fuzzy sets offer a middle path between quantitative and qualitative measurement. However, this middle path is not a compromise between the two; rather, it transcends many of the limitations of both" (Ragin, 2008, p. 174).

Much of variation captured by ratio-scale indicators such as age, income, and wealth is simply irrelevant to the distinction by low and high values. The original values must be adjusted on the basis of accumulated substantive knowledge in order to be able to interpret low versus high scores in a way that resonates appropriately with existing theory (cf. Ragin, 2008, p. 18). Ragin points out that there is a world of difference between living-in a country with a gross national product (GNP) per capita of $2000 and living in one with a GNP per capita of $1000. However, there is virtually no difference between living in one with a GNP per capita of $22,000 and living in one with a GNP per capita of $21,000. Calibration of fuzzy-set measures addresses such issues directly.

Fuzzy-set calibration makes use of external information on the degree to which cases satisfy membership criteria and not inductively derived determination (e.g., using sample means). Criteria need to be set for three breakpoints in fuzzy-set calibration with endpoints of 0.00 for full non-membership to 1.00 for full membership. The breakpoints include 0.05 for threshold for full non-membership, 0.50 for the crossover point of maximum membership ambiguity, and 0.95 for the threshold of full membership. Determination of the three breakpoints permits calibration of all original values into membership values using a direct method and an indirect method (see Ragin, 2008). Similar to the mathematics involved in calculating partial standardized regression coefficients for variables in MRA using the Statistical Packages for the Social Sciences (SPSS), performance of the mathematical calculations to calibrate all membership scores for a simple condition can be done by using a software routine in the program, fsQCA. See Ragin (2008, pp. 104-105) for an example of using this procedure.

2.4. Boolean Algebraic Metrics for Measuring Sufficiency and Coverage

The consistency index is analogous to a correlation (r) and the coverage index is analogous to the “coefficient of determination” (i.e., r^2). Details appear below on calculating consistency and coverage. The point for now is that whether or not a relationship between X and Y is symmetrical or asymmetrical has little impact on consistency scores—where X is a simple or a complex antecedent condition.

Panel a in Figure 2a illustrates the sufficiency and necessity conditions for a symmetric relationship for 15 cases of synthetic data. Panel b in Figure 2a illustrates a sufficiency but not necessary condition: cases high in X scores (cases d, e) nearly always associate with high Y scores but cases with low and medium scores in X with high Y scores also occur (cases a, b, c). Figure 2b illustrates a necessary but not sufficient relationship between X and Y: cases high in X are necessary for high Y to occur but some cases high in X also have low to medium scores for Y.

Figure 2a and 2b here.

The consistency index gauges the degree to which the cases share a simple or complex condition in displaying the outcome in question. Consistency is analogous to a correlation in statistical analysis. The coverage index in fsQCA assesses the degree to which a simple and complex causal condition (recipe) "accounts for" instances of an outcome condition—coverage is analogous to an r^2 in statistical analysis. In QCA a consistency index above 0.80 with a coverage index of 0.45 indicates high membership scores in the outcome condition for nearly all high scores in the antecedent statement and a substantial share of the cases fitting an asymmetric sufficiency distribution. Consistency $(Xi \leq Yi) = \sum \{\min(Xi, Yi)\} / \sum (Xi)$ where Xi is case i's membership score in set X; Yi is case i's membership score in the outcome condition, Y; $(Xi \leq Yi)$ is the subset relation in question; and "min" dictates selecting the lower of the two scores. Coverage $(Xi \leq Yi) = \sum \{\min(Xi, Yi)\} / \sum (Yi)$. The formula for coverage of Y by X substitutes $\sum (Yi)$ for $\sum (Xi)$ in the denominator of the formula for consistency. Table 1 includes example calculations for consistency and coverage; Ragin (2008) provides elaboration.

Table 1 here.

"Causal configurations" (Ragin, 2008) are combinatory statements of two or more simple antecedent conditions. For example the combination statement of "old, wealthy, and divorced male" is a conjunctive statement of four antecedent conditions—a possible causal recipe with high values on this statement associated with a high score for playing golf twice-a-week or more frequently. A finding supporting this algorithm should not be viewed as being the one recipe indicating very frequent golf outings; additional routes are likely to be sufficient but not necessary for frequent golf outings. Unlike correlation analysis, consistency is a test for sufficiency and not a test for sufficiency and necessity. While multiple regression analysis is a matrix algebra application that predicts low, medium, and high scores for Y based on weighted scores in a model, consistency and coverage are Boolean algebra applications that predict high scores for Y based on high scores for a given combination of X antecedents. The latter application does not make a prediction for Y for low or medium scores for the given combination of high scores of X antecedent conditions.

3. Method

The empirical context of this study is the cut-flower industry. The two focal South American countries, Colombia and Ecuador, are two of the most important flower producers in the world. They export almost all their production to markets in developed countries. Indeed, more than 80 percent of the flowers imported into the U.S. are grown in these countries. This industry faces important environmental and labor challenges, so the adoption of certification programs could have a significant social impact by improving the working conditions of employees and contributing to the conservation of natural resources. The cut-flower industry is also an interesting setting for study, as most of its production centers are located in developing countries, where governments often lack the resources to enforce compliance with environmental and labor standards. Finally, there are multiple competing certification programs operating in this industry, allowing for the identification of causal configurations by program.

3.1. Floral Industry

Before the 1980s, the flower industry was dominated by producers in the developed world. Dutch producers dominated the European market, while Californian producers dominated the North American market. Starting in the early 1980s, however, production activity began migrating to developing countries which offered better weather and cheaper labor. Countries such as Colombia, Kenya, Ecuador and Tanzania became important producers of cut-flowers, competing strongly with developed countries through lower prices and equal or better quality. Thus, flowers from developing countries started to dominate the international market.

Flower producers compete mainly in two dimensions: price and quality. The quality of a flower is defined by its appearance (size of stem) and the time it lasts in the vase. The environmental and labor practices used to produce the flowers have become another way to differentiate among flower producers. Flower production has a set of environmental and labor challenges. First, the activity can pollute natural resources such as water, air, and soil through the use of pesticides, fertilizers, and chemicals, substances that can harm both humans and local wildlife. Second, it is a labor-intensive activity and employs a substantial number of female workers, often from rural areas, including a significant share of female heads-of-household. Thus, flower production has the potential for significant social impact.

The floral industry is extremely fragmented at all levels, with many small, family-operated companies. The three major agents in the floral industry are growers, wholesalers, and retailers. The trend in the industry is towards eliminating intermediaries between growers and retailers and the establishment of supermarkets as the preferred outlet for final consumers to buy their flowers. The typical distribution channel is from growers to distributors, to geographically dispersed wholesalers, who then sell to florists, supermarkets, and other retailers.

3.2. Floral Industry in Colombia and Ecuador

Colombia is the leading cut-flower producer in South America and, excluding the Netherlands, the most important cut-flower exporter in the world. In the surroundings of Bogotá, farmers harvest mainly roses and carnations. After Colombia, Ecuador is the most important flower exporter in South America (AIPH, 2009). Ecuador is well known throughout the world for its high-quality, large-headed roses harvested mainly in the surroundings of Quito. By 2008, Colombia had 7,870 hectares assigned to the harvest of flowers and exported EU 745 million worth of flowers, 80 percent of which went to the U.S. (Asocolflores, 2008; AIPH, 2009). In terms of employment, the activity generates approximately 100,000 direct jobs and 84,000 indirect jobs (Asocolflores, 2008). About 60 percent of the employees at Colombian flower farms are women (Asocolflores, 2008).

Ecuador had 3,441 hectares cultivated by 2006 and exported EU 293 million worth of flowers to markets such as the United States, Russia, Germany and Canada (AIPH, 2009). At the farm level, the flower industry in Ecuador generates approximately 50,000 direct and 50,000 indirect jobs (Expoflores, 2010). About 50 percent of the employees at Ecuadorian flower farms are women (Expoflores, 2010).

3.3. Certifications in the Floral Industry

Eight product certification programs operate in the flower industry in Colombia and Ecuador. Table 2 provides a summary of characteristics for these eight programs.

Table 2 here.

The study here analyzes the adoption of these eight certification programs relevant to Colombian and Ecuadorian flower firms. Given that the study includes data at the case and population levels for two countries and eight relevant product certification programs, the study is unique in its ability to include replications and extension of findings to different organizational structures and firm contexts. Among these eight certifications, some were developed by local industry associations, while others belong to non-governmental organizations or private specialized firms. Expoflores and Asocolflores, the local industry associations in Ecuador and Colombia, promote their own certification programs, FlorEcuador (FE) and Florverde (FV), respectively. The certifications in the sample developed by NGOs and private specialized firms include Rainforest Alliance (RA), Fair Trade (FT), Flower Label Program (FLP), Veriflora (VF), Milieu Project Sierteelt (MPS), and Fair Flower Fair Plants (FFP). Some of these programs even if they are administered by a non-governmental organization, they were developed by flower industry associations in Germany and Netherlands as it was the case with FLP and MPS. All these programs require firms to implement environmental and labor practices to be awarded their certification.

3.4. Data

This study uses a unique dataset of exporting cut-flower firms from developing countries. The dataset, collected from multiple sources, includes the entire population of exporting flower firms in Colombia and Ecuador. The Colombia data were obtained from Proexport and the Superintendent of Companies. For Ecuadorian firms, the data was provided by the Central Bank and the Superintendent of Companies. These institutions shared this information under strict confidentiality agreements that require specific cases not to be identified by firm names. Information on certification programs' characteristics was collected through the websites of each of the certifying organizations and, in some cases, through multiple e-mail exchanges with the organizations. The data on certified firms were taken from the sponsor organizations' websites or provided directly by these organizations.

The firms in the sample are exporting flower farms in Colombia and Ecuador. There are a total of 1,241 farms, 205 of which have adopted at least one certification. Only one firm in the database had adopted seven certifications, and most of them had adopted none. The average number of certifications among firms with at least one certification is 1.5. Qualitative data were collected through seventy semi-structured interviews with flower farmers, wholesalers, and representatives of industry associations and certifying organizations. Most of the face-to-face interviews occurred during a two-month visit to Colombia and Ecuador. Other interviews were conducted at the World Floral Expo in Miami, Florida, in March 2009 and by phone. This information was used to complement and verify the quantitative data.

The findings indicate statistical differences between firms that are certified and those that are not. Most certified firms are what can be considered big firms in this industry and their exports are mainly roses—instead of flowers such as carnations, gerberas, astromelias, or fillers. Firms that are members of the local industry association and operate in Ecuador are the most likely to adopt a certification program. Eighty percent of firms are uncertified in the year of collection of the data. Product certification programs in the cut-flower industry are entering a growth phase in the two countries of the study.

3.5. Data Analyses

Following calibration of the simple antecedent conditions and the outcome condition, the software program available at fsQCA.com was used to examine the propositions in the theory. For the analyses, minimum consistency thresholds were tested at both 0.75 and 0.80 for adoption of the specific product certifications. All causal configurations achieving the higher consistency level appear in the findings section for each of the product certification programs for both firm adoption and non-adoption sets of models. The analysis of those programs that had four or less firms certified was performed but it is not included here. For firm size and share of exports to the USA, the study includes three sets of calibrations: the first for the total population of firms (n = 1,241); the second for Colombian firms only (n = 758); the third for the Ecuador firms only (n = 483). These steps were taken to consider the perspective that what constitutes a "large" firm and "large" share of exports to USA differ in Colombia versus Ecuador.

A researcher or an executive managing a product certification program might wish to consider context-specific calibrations rather than using one set of calibrations across all countries. Considering context in calibration is analogous to adjusting country income levels by purchasing power parity (PPP). The findings include details for using one set of calibrations for both countries as well as for using country-specific calibrations. Details of the calibrations for the simple antecedent conditions appear in Table 3.

Table 3 here.

Output from fsQCA includes three sets of solutions of causal configurations: parsimonious, intermediate, and complex. The use of the complex solution avoids using any "remainders" to simplify a truth table while the incorporation of the subset of remainders yields the most parsimonious solution of the truth table. Remainders are empty cells in the truth table. The truth table lists the logically possible combinations of causal conditions and the empirical outcome associated with each configuration. With seven simple antecedent conditions and one outcome condition as columns, and with all of them having two membership values (yes/no), a truth table includes a total of 256 combinations—from all yes responses to all no responses.

The complex option bars "counterfactual" cases altogether; the parsimonious one permits the inclusion of both easy and difficult counterfactuals, without any evaluation of their plausibility. A counterfactual case is a substantively relevant combination of causal conditions that nevertheless does not exist empirically; counterfactual analysis involves evaluating the outcome that such a case would exhibit if, in fact, it existed. The intermediate solution is a superset of the most complex solution and a subset of the most parsimonious. "[The intermediate solution] is optimal because it incorporates only easy counterfactuals, eschewing the difficult ones that have been incorporated into the most parsimonious solution. The intermediate solution thus strikes a balance between complexity and parsimony, using procedures that mimic the practice of conventional case-oriented comparative research" (Ragin, 2008, p. 171). Because the present study includes a number of cases much larger than found in nearly all studies using fsQCA, the findings for the intermediate and the complex solutions are identical in most instances. Thus, the findings in the next section are for both the intermediate and complex solutions for nearly all models.

The findings include raw coverage, unique coverage, and consistency membership scores for causal recipe models surpassing minimum recommended consistency thresholds (Ragin, 2008). Because some of the product certification programs have very few members in either of the two countries, the minimum acceptable solution frequency was set at one firm. The aim here is to explore the occurrence of causal configurations even for causal configurations representing only one firm.

4. Findings

The first set of findings focuses on modeling adoption and non-adoption models of product certification programs operating in both Colombia and Ecuador. The second set of findings focuses on modeling adoption and non-adoption of product certification programs operating either in Colombia or Ecuador. The modeling is done for each country separately. The final set of findings includes evidence on the predictive validity of the modeling using causal configurations. This section includes a discussion on whether or not the findings support or refute each of the six propositions in the theory of causal configurations of adoption and non-adoption. The results fully or partially support the propositions of the study's theory.

4.1. Support for P1: No Simple Antecedent Condition is Sufficient for Accurately Predicting a High Membership Score in the Outcome Condition

The findings support P1. No simple antecedent condition is sufficient for accurately predicting high membership scores for either adoption or non-adoption of any of the product certification programs for any of the three levels of fsQCA solutions—parsimonious, intermediate, or complex. Some complex antecedent models that meet or surpass the threshold consistency requirements (thresholds were set and tested for consistencies at 0.70, 0.75, and 0.80) do occur for each of the product certification programs. Details appear in Tables 4-5.

Table 4 reports the causal configurations for the six product certification programs that were in operation in 2009 in the cut-flower industries both in Colombia and Ecuador. The first set of causal configurations meeting the minimum consistency thresholds is for Rainforest

Alliance (RA). From Table 2, RA is a non-government organization (NGO) with certification programs for multiple products besides cut-flowers, such as coffee, forestry, and hotels. RA's cut-flower certification program has been in operation since 2007. The organization promotes adoption of its program among producers in South America (the upstream domain) and does marketing of its label among retailers and wholesalers in USA and Canada (downstream domain). In Table 4 the first model (model a) for RA and each of the other five certification programs is ~numcert_fz • expeu_fz • ~expros_fz• size_fz • ~colombia_fz and indicates that most-to-all firms (proportion >0.80) with a high score for this causal recipe have high product certification adoption membership scores. The causal recipe includes a score equal or higher than 0.80 for no prior certification membership AND exports to Europe AND not exports roses AND being a large firm AND not being a Colombian firm. Very few firms meet this causal recipe's set of requirements, but those that do so are firms which adopt the RA product certification. (Thus suffix, "_fz", appearing in the Tables 4 and 5 refers to fuzzy set scores; this suffix does not appear in the following discussions of specific models.)

Because fsQCA estimates asymmetric relationships, the computation of consistency is unaffected by firms that score high in adoption membership and low in this complex causal condition. The analysis recognizes that additional causal configurations frequently occur which associate with high scores in the outcome condition—adoption or non-adoption.

Table 4 here.

The additional causal configurations for RA that associate with high membership scores in adoption appear in first set of findings in Table 4. The set of findings for each of the additional product certification programs all include complex causal configurations—that is, causal configurations that include combinations of two or more simple antecedent conditions. Such high consistency of findings provides strong support for P1.

Figure 3 is illustrative of an X-Y plot for the causal recipe (numcert_fz•expusa_fz•size_fz•member_fz ≤ A) for adoption of Florverde (FV) with consistency above a 0.80 threshold and high coverage. The model supports the sensemaking view that firms with high membership scores on prior certification adoption AND exports to the USA AND large-in-size AND membership in the local industry trade organization will adopt FV. In total, 22 of 23 firms with membership scores on this causal recipe above 0.65 have adopted FV.

Figure 3 here.

Table 5 reports the findings for non-adoption of the same set of six product certification programs appearing in Table 4. Note in Table 5 that the solution coverage of the models for each product certification programs is higher than for the models in Table 4. For example, in Table 5 the solution coverage is 0.93 for the set of non-adoption models for RA and Table 4 has solution coverage of 0.68 for the set of adoption models for RV. Such findings are indicative of the idiosyncratic nature of early stage in the life cycle of product certification programs in the cut-flower industry in the two countries in the study and the limitations of the use of only objective-based antecedents in creating and testing models of adoption. Reasons for adoption are more likely to go beyond information from combinations of objective metrics than non-adoption; reasons for adoption may include the presence of personal relationship characteristics to a great extent than non-adoption. The addition of cognitive-based antecedents (e.g., knowledge of a neighbor who has adopted the product certification) would likely increase the coverage of the adoption models; such additional research is a suggestion for future research.

Table 5 here.

Figure 4 is illustrative of a non-adoption model for FV (~numcert_fz*~member_fz ≤ NA) that has high consistency (1.00) and substantial coverage (0.86). Not having prior certification

AND not being a member in a local industry trade organization serves as a double-whammy resulting in non-adoption of FV. Executives in FV may use such findings as supporting the need to encourage firms to join the local trade organization as a precursor to promoting FV certification.

Figure 4 here.

The causal recipe models for adoption and non-adoption of product for the FlorEcuador and Florverde certification programs which operate only in Ecuador or Colombia respectively, using a pooled multi-national calibration, support the first proposition that no simple antecedent condition is sufficient for predicting adoption or non-adoption with high accuracy. Also, the causal recipe models for adoption of product certification programs in Colombia and Ecuador, respectively, using independent national calibrations of antecedent conditions support the first proposition that no simple antecedent condition is sufficient for predicting adoption or non-adoption with high accuracy.

4.2. Support for P2: No single (simple) Antecedent Condition is Necessary for Accurately Predicting High Scores in the Outcome Conditions

The findings support P2. No single antecedent condition is necessary for accurately predicting high scores in adoption or non-adoption. For example, notice in examining the causal configurations for adopting Rainforest Alliance (RA) in Table 4 that both numcert and ~numcert appear in different configurations. Similar findings occur for exporting roses and size of firm; “expros” versus “~expros” and size and ~size appear in different causal configurations for RA in Table 4. Similar findings occur for firms in Colombia versus Ecuador for RA in Table 5: Colombia and ~Colombia appear in different models for adopting RA.

The findings for the additional product certification programs consistently provide support for P2. Thus, the observation made by Ragin (2008) and Woodside (2013) that examining main and one set of interaction effects in statistical analysis may be misleading and fails to consider equifinality—complex causal conditions resulting in the same outcome—is supported here.

4.3. Support for P3: Combinatory (Complex) Antecedent Conditions (Configurations) are Sufficient but Not Necessary for Accurately Predicting High Scores in Adoption and Non-Adoption

The findings support P3. Multiple routes to adoption and non-adoption occur for all eight product certification standards. The presence of multiple combinatory causal conditions for eight separate organizations in two country contexts support the generalization of the equifinality proposition in the industry of cut-flowers.

Such findings support the perspective that the exception is the rule—not always but for most simple antecedent conditions. Thus, for example, ~numcert appears in 24 of the 34 causal models across the six certifying organizations in Table 4, while numcert appears in eight of these 34 models. Such findings refute the recommendation that a certifying organization should focus its attention generally on recruiting firms not having prior adoptions of product certifications. For instance, the implemented (achieved) strategy of Veriflora (VF) is marketing successfully only to ~numcert firms for ~numcert firms only appear in the causal models with high consistency for VF. The other five organizations operating both in Colombia and Ecuador have causal configurations that include both ~numcert and numcert.

The ~numcert condition appears frequently (but not always) among the causal models in non-adoption (e.g., Table 5). Such a finding might give cause for designing and marketing new certification standards nearly exclusively to firms already adopting prior certification programs. However, the reality of adoption is more complex than such a simple rule allows.

4.4. Support for P4: Causal Asymmetry Occurs for Adoption versus Non-Adoption

The findings support P4. Non-adoption causal configurations are not the mirror opposite of adoption causal configurations among two sets of models for each of the eight product certification standards. Table 4 includes models of causal configurations for non-adoption of the six standards operating in both Colombia and Ecuador that meet or surpass threshold consistencies. Note that in comparing the non-adoption models in Table 5 to the adoption models in Table 4 that the models in Table 5 more frequently contain three or four nodes in the models, while the adoption models in Table 4 contain four and five nodes more frequently. While still complex antecedent statements, the "no" decisions are simpler than the "yes" decisions.

The combination of "~numcert_fz•~member_fz" appears in some adoption and non-adoption models in Tables 4 and 5, respectively. All models in both tables require three to five nodes to distinguish adoption from non-adoption and vice versa. The following two models appear in Tables 4 and 5, respectively, for RA adoption and non-adoption:

Model d for RA adoption:

~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz

Model a for RA non-adoption:

~numcert_fz*~member_fz*colombia_fz.

These two models indicate that adoption is unlikely if the firm is Colombian. However, such a conclusion is overly simplistic. Table 4 includes four models surpassing the threshold for RA adoption that include "Colombia" rather than ~Colombia", such as Model b: numcert_fz•expusa_fz•size_fz•member_fz•colombia_fz, that is, prior adoption of certification standards AND high share exporting to the USA AND large size firm AND member of local industry trade organization AND Colombian firm.

Such causal models of adoption and non-adoption of specific product certification standards may appear too complex for referral and use in marketing the standards. However, such information likely can be memorized with practice or used in written checklists (cf. Gawande, 2009) for meetings between certification executives and cut-flower producing firms. Both the organizations marketing a given standard and the firm adopting or non-adopting a specific program may benefit from considering the profile of the specific firm within these causal configurations. Additional evidence supports P4 and these findings provide additional nuances in supporting P4. FlorEcuador (FE) operates only in Ecuador. The first adoption causal model for FE has four nodes (a: numcert_fz•expros_fz•size_fz•member_fz) and the first non-adoption causal model has three nodes (d: ~numcert_fz*expros_fz*~member_fz) (both appear in Table 6). Notice that in Table 6 "~numcert_fz•~member_fz" appears as nodes in one or more adoption and non-adoption models, while "numcert _fz•member_fz" appears only within an adoption model. The causal models indicate that the numcert_fz•member_fz combination alone is insufficient for adoption but substantially removed from the non-adoption decision. Such reasoning supports the causal asymmetry proposition (P4) that causes leading to adoption may be quite different from causes leading to non-adoption.

Tables 6-7 here.

Additional findings replicate and extend the relevance of the first four propositions in the theory—including P4. Patterns for more complex causal configurations for adoption versus non-adoption occur consistently. The conclusion is not to suggest that such referrals to causal configurations in checklists should substitute for effortful thinking and action but such checklists are likely to reduce errors of decision selection and omission (for details on see Gawande, 2009). As Gladwell (2010) proclaims, "Experts need checklists—literally—written guides that walk them through the key steps in any complex procedure." Learning causal models likely is a useful step toward becoming an expert. Visual displays for high-performing adoption and non-adoption causal models for FV using multi-national calibrations of data appear in Figures 3 and 4. The model for each figure appears on the respective X-axis. The models do indicate that local industry membership status and prior adoption in certification programs are parts of the causal models of both adoption and non-adoption. However, the former model includes additional antecedent conditional statements that the later model does not reference. Similar findings are apparent in visual displays of causal model findings for the other certification organizations. Generally, the adoption models are finer-grained than the non-adoption models—adoption versus non-adoption includes more complexity in the causal models.

The findings supporting the causal asymmetry proposition (P4) occurs in certification programs operating in both countries (Tables 4 and 5) as well as in standards operating in a single country (Table 6 and 7).

5. Discussion

Reality usually includes more than one combination of conditions that lead to high values in an outcome condition (i.e., high values in a dependent variable). Thus, reality usually indicates that any insightful combination of conditions has an asymmetrical rather than a symmetrical relationship with an outcome condition. Equifinality is a perspective worthy of widespread adoption by researchers in all fields of management and behavioral science. The findings are highly supportive of the causal recipe theory of adoption and non-adoption of product certification standards. Such theory represents a paradigm shift away from symmetrical-focused net effects view and analysis to an asymmetric focus. Consequently, focusing on configurations of conditions may be necessary for advancing behavioral theory of the firm of contextual, structural, and strategic (Doty & Glick, 1994; Loe, Ferrell, & Mansfield, 2000) influences on outcomes. Firm level, industry level, and national (context) level data are necessary to enable both firm-level relevance and industry-level generalizability. The present study is unique in reporting case level data and industry population level data in two national contexts.

The study is rare in reporting data collection for multiple sources including firm-level data, industry trade organization data and certification program information. These data were complemented with qualitative data from interviews with representatives of firms and certifying organizations in both countries. The focus of objective verifiable antecedent conditions in this study represents both strength and a limitation. The focus of verifiability represents strength in that the study does not rely on non-verifiable post-hoc explanations of behavior by executives. The focus is a limitation for the same reason; the inclusion of emic (i.e., participating executives') explanations of configurations of adoption and non-adoption of specific certification standards at the firm level would increase the value of the study. Even though post hoc explanations of behavior are easy to give, even if they are often inaccurate, such explanations offer "folk theory-of-mind" (Malle, 2004) insights valuable for comparison purposes of how explanations vary by outcomes and among firms. This step remains for future research—possibly a few return trips to Colombia and Ecuador by the lead author or other researchers.

While no simple antecedent is a "critical or key success factor" (Cooper & Kleinschmidt, 2007) for adoption or a key failure factor for non-adoption, one routine configuration appears frequently across the certification organizations. Note that ~numcert_fz• ~member_fz alone is a combination that is insufficient in predicting adoption or non-adoption; however, ~numcert_fz•~member_fz•colombia_fz appears in five of the eight sets of findings among the non-adoption models and never among the adoption models. The path to non-adoption in Colombia goes through no prior certifications and no membership in local industry trade associations.

The findings support the general conclusion that a simple antecedent condition has a positive or negative influence on adoption or non-adoption is overly simplistic. Impacts of simple antecedent conditions depend on the presence, absence, or negation of additional simple antecedent conditions within alternative complex antecedent statements. The findings of the present study provide additional confirmation of Fiss's research in management of Ragin's (2008) causal asymmetry proposition—causes leading to the presence of an outcome of interest may be quite different from those leading to the absence of the outcome. The causal configurations leading to non-adoption are worth examining separately from adoption for they are not mirror opposites of adoption. The negations of all signs of antecedent conditions in an adoption causal recipe with high consistency will be unlikely to provide high consistency in non-adoption—reality is more complex than this proposition.

Besides collecting data on how executives in the certification organizations and firms in the industry interpret the causal recipe findings, additional research on the causal configurations of customer firms in North America and Europe in accepting or rejecting certified cut-flower suppliers would be useful in confirming and extending the value of each certification program in accomplishing its objectives of environmental protection and achieving highly humane labor practices. Many firms adopt these certifications due to pressures from external stakeholders in different markets. Customer firms can demand the label as a requisite to engage in business-to-business relationships or to pay a price premium. The union of research on suppliers' behavior on certification adoption with their business-to-business customers as well as final consumers of cut-flowers offers exciting opportunities for future research. Such a study would increase our understanding on the dynamics of the market for certifications.

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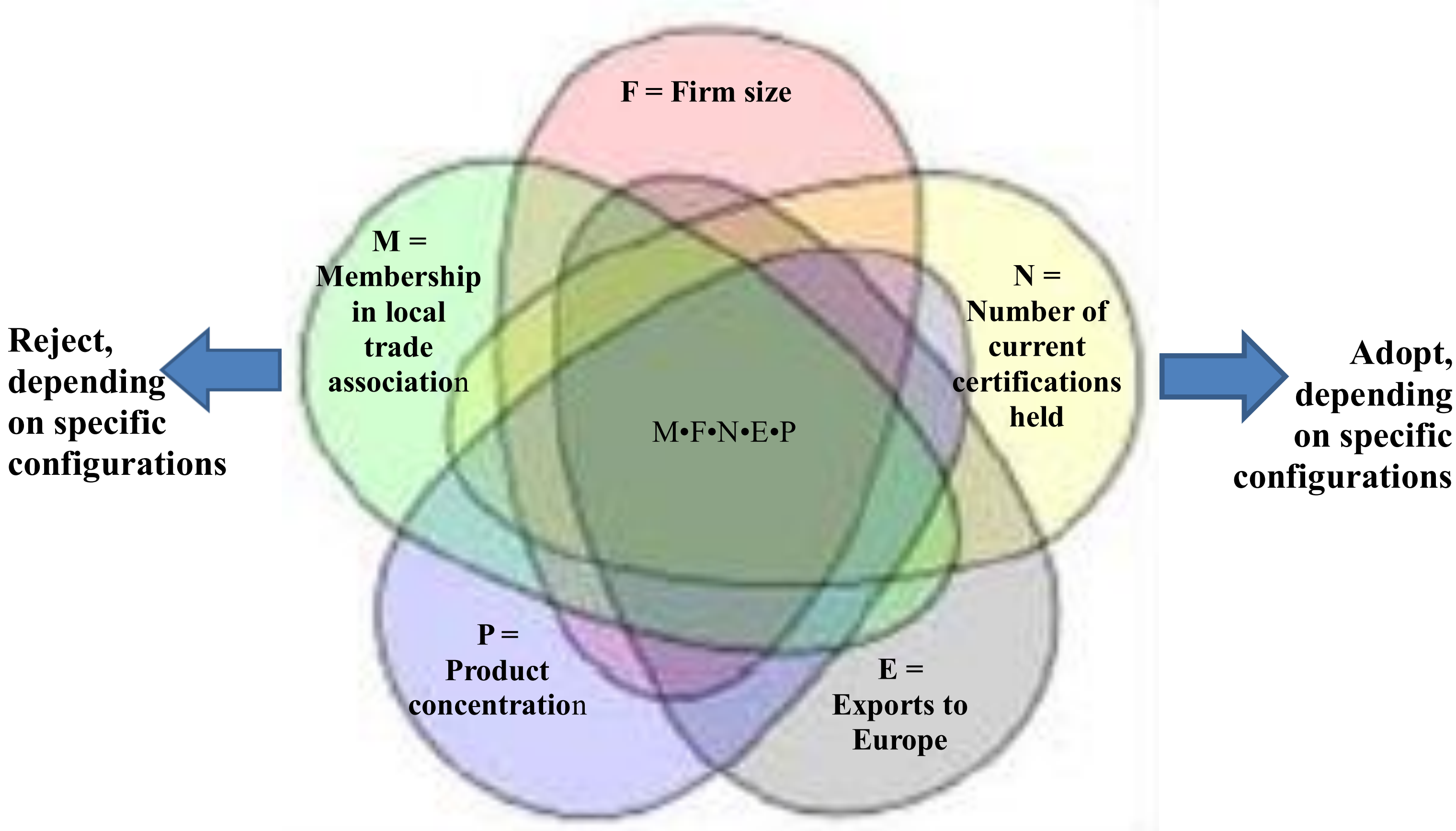


Figure 1
Theory of Causal Recipes Associating with Acceptance versus Rejection of International Product Certification Standards Focusing on Five Potential Adopter Characteristics

Notes. Considering crisp set conditions (Yes/No, Not present), $3^5 = 243$ potential simple and complex recipes occur. Possible hypotheses of adoption: $F \bullet N \bullet {\sim}E \bullet P \bullet M \leq A + {\sim}F \bullet N \bullet E \bullet P \bullet M \leq A$. Possible hypotheses of rejection: ${\sim}F \bullet {\sim}N \bullet {\sim}M \bullet P \bullet {\sim}M \leq R + {\sim}F \bullet {\sim}N \bullet {\sim}M \bullet P \bullet {\sim}M \leq R$. The mid-level dot (•) signifies the logical "and", the tilde (~) signifies "not", and the "+" signifies "or". For fuzzy set conditions for the five antecedent conditions, the majority of firms will not have membership scores high (> 0.80) for all five positively stated conditions.

Table 1
Computing Consistency and Coverage in Fuzzy-Set Qualitative Comparative Analysis

x_calibrated	y_calibrated	minimum (Xi, Yi)	
0.02	0.98	0.02	
0.03	0.98	0.03	
0.25	0.98	0.25	
0.97	0.98	0.97	
0.98	0.98	0.98	
0.02	0.5	0.02	
0.07	0.5	0.05	
0.1	0.5	0.05	
0.32	0.5	0.32	
0.41	0.5	0.41	
0.02	0.02	0.02	
0.03	0.02	0.02	
0.05	0.02	0.02	
0.07	0.02	0.02	
0.1	0.02	0.02	
∑ = 3.44	7.5	3.2	
Consistency (Xi ≤ Yi) =	∑ [min(Xi, Yi)]/∑(Xi)	3.2/3.44 =	0.93
Coverage (Xi≤Yi)=	∑[min(Xi,Yi)]/∑(Yi)	3.2/7.5 =	0.43

Note. Data are same as the final two columns in Table 1. The small differences in the consistency and coverage indexes in Table 2 and Figure 1b are due to rounding.

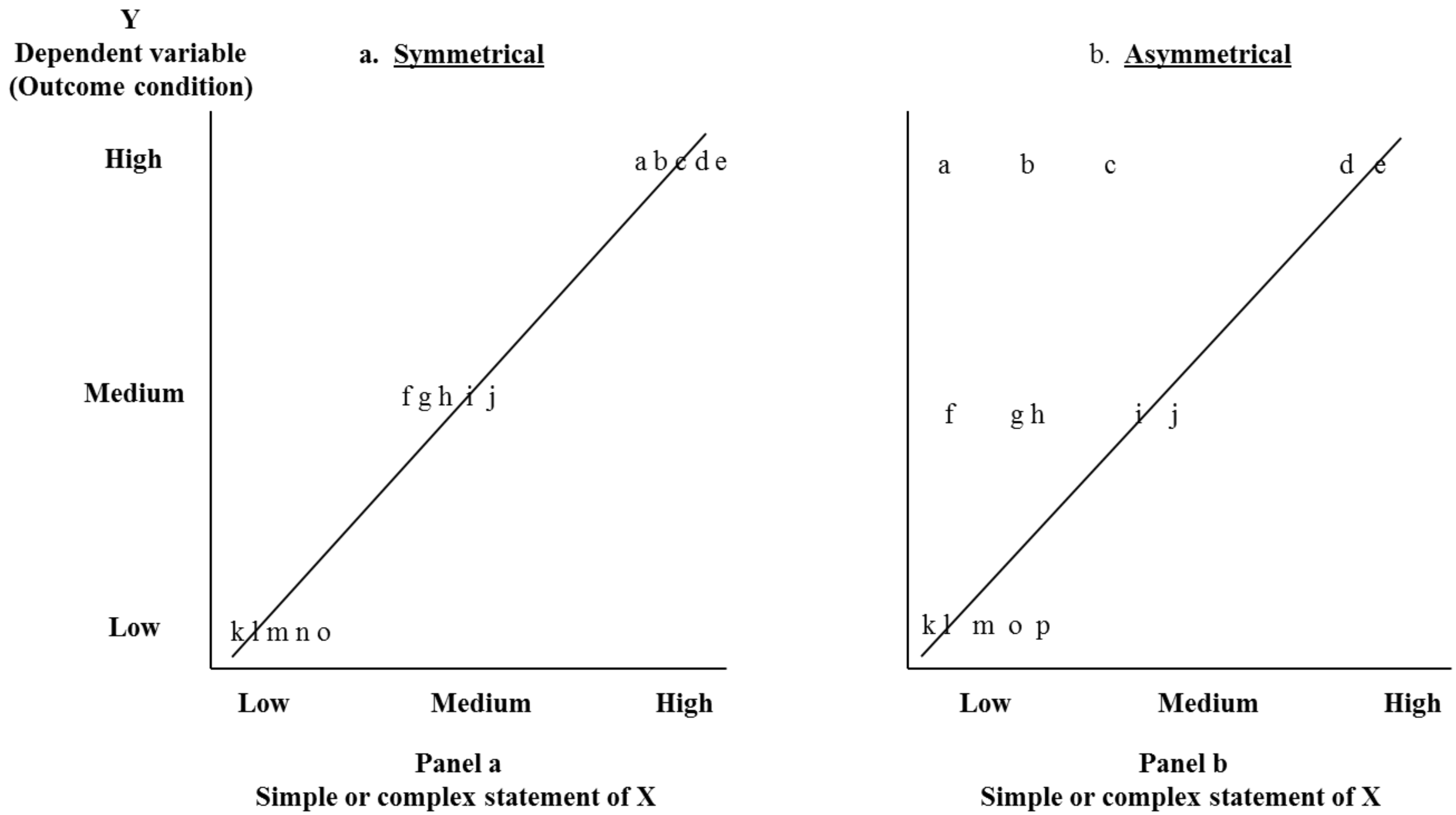


Figure 2a
Symmetrical and Asymmetrical Relationships
between X and Y for 15 Cases of Synthetic Data

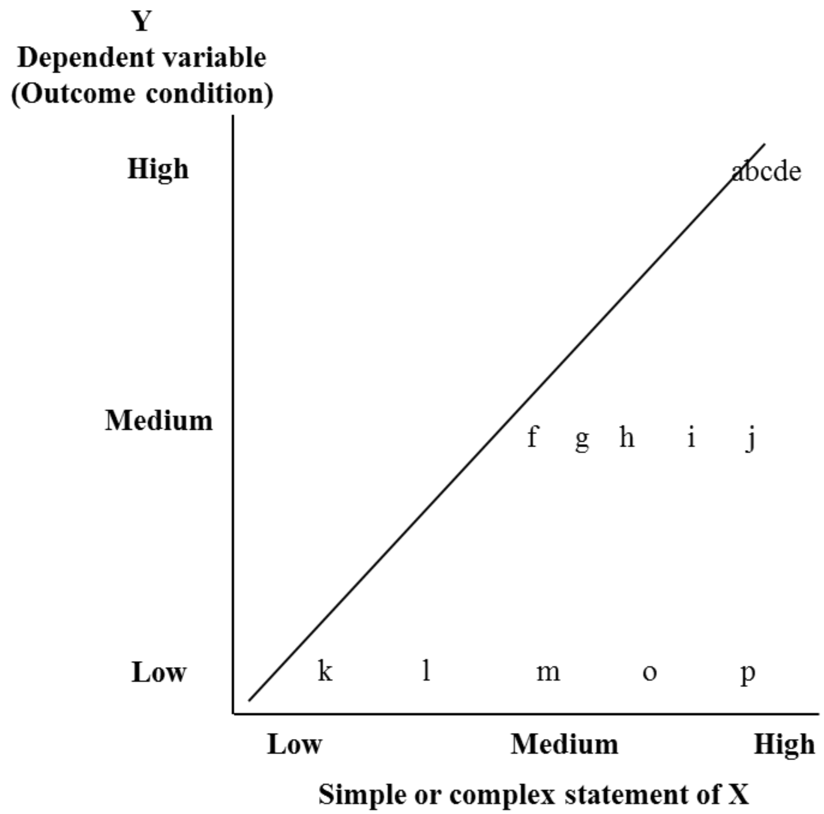


Figure 2b
Asymmetric-Necessary Relationship for 15 Cases of Synthetic Data

Table 2
Characteristics of Ten Certification Programs Competing in the Cut-Flower Industry

Label	Name of label	Type of sponsor organization	Release date	Upstream domain		Downstream domain	
				Beginning	Current	Beginning	Current
	Milieu Project Sierteelt (MPS)	Industry association/NGO	1995	Local (Netherlands)	Europe and developing countries	Netherlands (flower auction)	Netherlands (flower auction) and Northern Europe
	Kenya Flower Council (KFC)	Industry association	1996	Local (Kenya)	Local (Kenya)	N.A.	Europe
	Flower Label Program (FLP)	Industry association/NGO	1996	Developing countries	Developing countries and Europe	German speaking countries	German speaking countries
	FlorVerde (FV)	Industry association	1998	Local (Colombia)	Local (Colombia) [1]	N.A.	Europe and USA
	Flor Ecuador (FE)	Industry association	2001	Local (Ecuador)	Local (Ecuador)	N.A.	N.A.
	Fair Trade (FLO)	NGO	2001	Developing countries	Developing countries	Switzerland (supermarkets)	Europe and USA
	GlobalGap (GG)	Private organization	2003	Worldwide	Worldwide	European retailers (mainly UK)	European retailers and USA
	Fair Flower Fair Plants (FFP)	Industry association/NGO	2005	Europe and developing countries	Europe and developing countries	Nordic countries	Europe
	Veriflora (VF)	Private organization	2005	USA and South America	USA and South America	USA and Canada	USA and Canada
	Rainforest Alliance (RFA)	NGO	2007	South America	South America	USA	USA

Table 3

Calibration Scale for Antecedents and the Outcome Condition for Multi-National and Independent Country Populations

Multi-National sample (n=1,241)	**certified**	**firm size**	**% exp_roses**	**% exp_europe**	**% exp_usa**	**# other_cert**	**membership**	**Colombia**
0.95	0.95	5,000,000	0.95	0.200	0.60	4.00	0.95	0.95
0.50	0.50	250,000	0.60	0.050	0.20	1.00	0.50	0.50
0.05	0.05	2,000	0.10	0.010	0.05	0.01	0.05	0.05
Ecuadorian firms (n=483)	**certified**	**firm_size**	**not %_exp_roses**	**% exp_europe**	**% exp_usa**	**# other_cert**	**membership**	
0.95	0.95	4,000,000		0.500	0.95	2.00	0.95	
0.50	0.50	410,000	1 – original values	0.050	0.75	1.00	0.50	
0.05	0.05	1,300		0.001	0.01	0.05	0.05	
Colombian firms (n=758)	**certified**	**firm_size**	**not %_exp_roses**	**not %_exp_europe**	**% exp_usa**	**# other_cert**	**membership**	
0.95	0.95	6,000,000			0.80	2.00	0.95	
0.50	0.50	165,000	1 - original values	1 - original values	0.40	1.00	0.50	
0.05	0.05	1,000			0.05	0.05	0.05	

Table 4

Models (fsQCA) Predicting Adoption Using Pooled Multi-National Calibration for Six Product Certification Standards Number of Firms (n) = 1,241

Models for Adoption by Program	raw coverage	unique coverage	consistency
Rainforest Alliance (RA) / n_certified_for_ra = 64			
a. ~numcert_fz•expeu_fz•~expros_fz•size_fz•~colombia_fz	0.32	0.00	0.80
b. numcert_fz•expusa_fz•size_fz•member_fz•colombia_fz	0.62	0.15	0.80
c. expeu_fz•expros_fz•size_fz•member_fz•colombia_fz	0.35	0.01	0.79
d. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.37	0.00	0.80
e. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.39	0.00	0.91
f. ~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.33	0.00	0.88
g. numcert_fz•expusa_fz•~expeu_fz•expros_fz•size_fz•colombia_fz	0.43	0.00	0.82
(0.80) / solution coverage: 0.68 / solution consistency: 0.53			
Flower Label Program (FLP) / n certified for flp = 47			
a. ~numcert_fz•expeu_fz•~expros_fz•size_fz•~colombia_fz	0.38	0.00	0.80
b. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.44	0.00	0.80
c. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.46	0.00	0.91
d. numcert_fz•expusa_fz•expros_fz•size_fz•~member_fz•~colombia_fz	0.50	0.02	0.79
e. ~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.39	0.00	0.87
f. numcert_fz•~expusa_fz•~expeu_fz•expros_fz•size_fz•member_fz•~colombia_fz	0.45	0.00	0.84
(0.80) / solution coverage: 0.55 / solution consistency: 0.44			
Veriflora (VF) / n certified for vf = 20			
a. ~numcert_fz•expeu_fz•~expros_fz•size_fz•~colombia_fz	0.55	0.00	0.80
b. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.65	0.00	0.80
c. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.66	0.00	0.91
d. ~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.57	0.00	0.87
(0.80) / solution coverage: 0.72 / solution consistency: 0.47			

Models (fsQCA) Predicting Adoption Using Pooled Multi-National Calibration for Six Product Certification Standards Number of Firms (n = 1,241)

Models for Adoption by Program	raw coverage	unique coverage	consistency
Milieu Programma Sierteelt (MPS) / n certified for mps = 13			
a. ~numcert_fz•expeu_fz•~expros_fz•size_fz•~colombia_fz	0.63	0.00	0.80
b. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.73	0.00	0.80
c. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.75	0.00	0.91
d.~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.65	0.00	0.87
e. numcert_fz•expusa_fz•~expeu_fz•expros_fz•size_fz•~member_fz•colombia_fz	0.65	0.00	0.83
(0.80) / solution coverage: 0.75 / solution consistency: 0.48			
Fair Trade (FT) / n_certified_for_vf = 10			
a. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~colombia_fz	0.67	0.00	0.80
b. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.77	0.00	0.80
c. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.80	0.00	0.91
d. ~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.69	0.00	0.87
e. numcert_fz•expusa_fz•expeu_fz•expros_fz•size_fz•~member_fz•~colombia_fz	0.68	0.01	0.81
f. numcert_fz•expusa_fz•~expeu_fz•expros_fz•size_fz•~member_fz•colombia_fz	0.69	0.00	0.83
(0.80) / solution coverage: 0.82 / solution consistency: 0.45			
Fair Flower Fair Plants (FFP) n_certified_by_ffp = 5			
a. ~numcert_fz•expeu_fz•~expros_fz•size_fz•~colombia_fz	0.74	0.00	0.80
b. ~numcert_fz•~expusa_fz•~expros_fz•~size_fz•~member_fz•~colombia_fz	0.86	0.00	0.80
c. ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz•~colombia_fz	0.89	0.00	0.91
d. ~numcert_fz•~expusa_fz•~expeu_fz•~expros_fz•size_fz•member_fz•colombia_fz	0.77	0.00	0.87
e/ numcert_fz•expusa_fz•~expeu_fz•expros_fz•size_fz•~member_fz•colombia_fz	0.77	0.00	0.83
(0.80) / solution coverage: 0.89 / solution consistency: 0.48			

Table 5

Models (fsQCA) Predicting Non-Adoption Using Pooled Multi-National Calibration for Six Product Certification Standards
Number of Firms (n) = 1,241

Models for Non-Adoption by Program	raw coverage	unique coverage	consistency
Rainforest Alliance (RA) / n_certified_for_ra = 64			
a. ~numcert_fz*~member_fz*colombia_fz	0.52	0.03	0.99
b. ~numcert_fz*expeu_fz*size_fz	0.17	0.00	0.98
c. ~numcert_fz*~expusa_fz*~size_fz*~member_fz	0.21	0.00	1.00
d. ~numcert_fz*expusa_fz*expros_fz*~colombia_fz	0.28	0.01	0.99
e. ~numcert_fz*expeu_fz*expros_fz*~colombia_fz	0.14	0.00	0.98
f. ~numcert_fz*expusa_fz*size_fz*~member_fz	0.20	0.00	0.98
g. ~numcert_fz*~expros_fz*size_fz*colombia_fz	0.16	0.00	0.94
h. expusa_fz*expros_fz*size_fz*~colombia_fz	0.17	0.00	0.94
i. expusa_fz*~expeu_fz*expros_fz*size_fz	0.16	0.00	0.91
j. expros_fz*size_fz*member_fz*~colombia_fz	0.12	0.00	0.93
h. expeu_fz*expros_fz*size_fz*member_fz	0.10	0.00	0.93
j. ~numcert_fz*expusa_fz*~expeu_fz*~expros_fz*colombia_fz	0.28	0.01	0.96
k. ~numcert_fz*~expusa_fz*expeu_fz*~expros_fz*colombia_fz	0.11	0.00	0.99
l. expusa_fz*expeu_fz*size_fz*member_fz*colombia_fz	0.04	0.00	0.94
m. ~numcert_fz*expros_fz*~member_fz	0.42	0.02	0.99
n. ~numcert_fz*expros_fz*size_fz*~colombia_fz	0.16	0.00	0.98
(0.80) / solution coverage: 0.93 / solution consistency: 0.97			
Flower Label Program (FLP) / n_certified_for_flp = 47			
a. ~numcert_fz*~member_fz*colombia_fz	0.51	0.03	1.00
b. ~numcert_fz*expeu_fz*size_fz	0.16	0.00	0.95
c. ~numcert_fz*~expusa_fz*~size_fz*~member_fz	0.21	0.00	0.99
d. ~numcert_fz*expusa_fz*expros_fz*~colombia_fz	0.27	0.01	0.97
e. ~numcert_fz*expeu_fz*expros_fz*~colombia_fz	0.13	0.00	0.94
f. ~numcert_fz*expusa_fz*size_fz*~member_fz	0.20	0.00	0.99
g. ~numcert_fz*~expros_fz*size_fz*colombia_fz	0.17	0.00	1.00
h. expusa_fz*~expeu_fz*expros_fz*size_fz	0.17	0.01	0.95
i. expusa_fz*size_fz*member_fz*colombia_fz	0.10	0.02	1.00
j. ~numcert_fz*expusa_fz*~expeu_fz*~expros_fz*colombia_fz	0.29	0.01	1.00
k. ~numcert_fz*~expusa_fz*expeu_fz*~expros_fz*colombia_fz	0.11	0.00	1.00
l. expusa_fz*expros_fz*size_fz*~member_fz*~colombia_fz	0.09	0.00	0.96
m. ~expusa_fz*expros_fz*size_fz*member_fz*~colombia_fz	0.05	0.00	0.86
n. ~expusa_fz*expeu_fz*expros_fz*size_fz*member_fz	0.05	0.00	0.87
p. ~numcert_fz*expros_fz*~member_fz	0.42	0.02	0.99
q. ~numcert_fz*expros_fz*size_fz*~colombia_fz	0.15	0.00	0.94
(0.80) / solution coverage: 0.93 / solution consistency: 0.98			

Table 5 (continuation)

Models (fsQCA) Predicting Non-Adoption Using Pooled Multi-National Calibration for Six Product Certification Standards
Number of Firms (n) = 1,241

Models for Non-Adoption by Program	raw coverage	unique coverage	consistency
Fair Flower Fair Plants (FFP) n_certified_by_ffp = 5			
a. ~numcert_fz*~member_fz*colombia_fz	0.50	0.03	1.00
b. ~numcert_fz*expeu_fz*size_fz	0.17	0.00	1.00
c. ~numcert_fz*~expusa_fz*~size_fz*~member_fz	0.20	0.00	1.00
e. ~numcert_fz*expusa_fz*expros_fz*~colombia_fz	0.27	0.01	1.00
f. ~numcert_fz*expeu_fz*expros_fz*~colombia_fz	0.14	0.00	1.00
g. ~numcert_fz*expusa_fz*size_fz*~member_fz	0.20	0.00	1.00
h. ~numcert_fz*~expros_fz*size_fz*colombia_fz	0.17	0.00	1.00
i. expusa_fz*expros_fz*size_fz*~colombia_fz	0.17	0.00	0.99
j. expusa_fz*~expeu_fz*expros_fz*size_fz	0.17	0.01	1.00
k. expros_fz*size_fz*member_fz*~colombia_fz	0.12	0.00	0.98
i. expeu_fz*expros_fz*size_fz*member_fz	0.10	0.00	0.97
j. ~numcert_fz*expusa_fz*~expeu_fz*~expros_fz*colombia_fz	0.28	0.01	1.00
k. ~numcert_fz*~expusa_fz*expeu_fz*~expros_fz*colombia_fz	0.10	0.00	1.00
l. ~numcert_fz*expros_fz*~member_fz	0.41	0.02	1.00
m. ~numcert_fz*expros_fz*size_fz*~colombia_fz	0.15	0.00	1.00
(0.80) / solution coverage: 0.911 /solution consistency: 1.00			

Table 6

Results for Flor Ecuador (FE) Using Pooled Multi-National Calibration

n_Ecuadorian_firms=483 / n_certified_FE = 91 (FE only available in Ecuador)

Adoption Models	**raw coverage**	**unique coverage**	**consistency**
(a) numcert_fz•expros_fz•size_fz•member_fz	0.68	0.53	0.91
(b) ~numcert_fz•expusa_fz•~expros_fz•size_fz•~member_fz	0.14	0.00	0.81
(c) ~numcert_fz•expeu_fz•~expros_fz•size_fz•member_fz	0.14	0.00	0.92
(0.80) / solution coverage: 0.67 / solution consistency: 0.80			
Non-Adoption Models	**raw coverage**	**unique coverage**	**consistency**
(d) ~numcert_fz*expros_fz*~member_fz	0.73	0.39	1.00
(e) ~numcert_fz*~expusa_fz*~size_fz*~member_fz	0.22	0.01	1.00
(f) ~numcert_fz*expusa_fz*size_fz*~member_fz	0.22	0.00	1.00
(g) ~numcert_fz*expeu_fz*~expros_fz*size_fz	0.05	0.01	0.95
(h) expusa_fz*~expeu_fz*expros_fz*size_fz*~member_fz	0.18	0.00	1.00
(0.80) / solution coverage: 0.76 / solution consistency: 1.0			

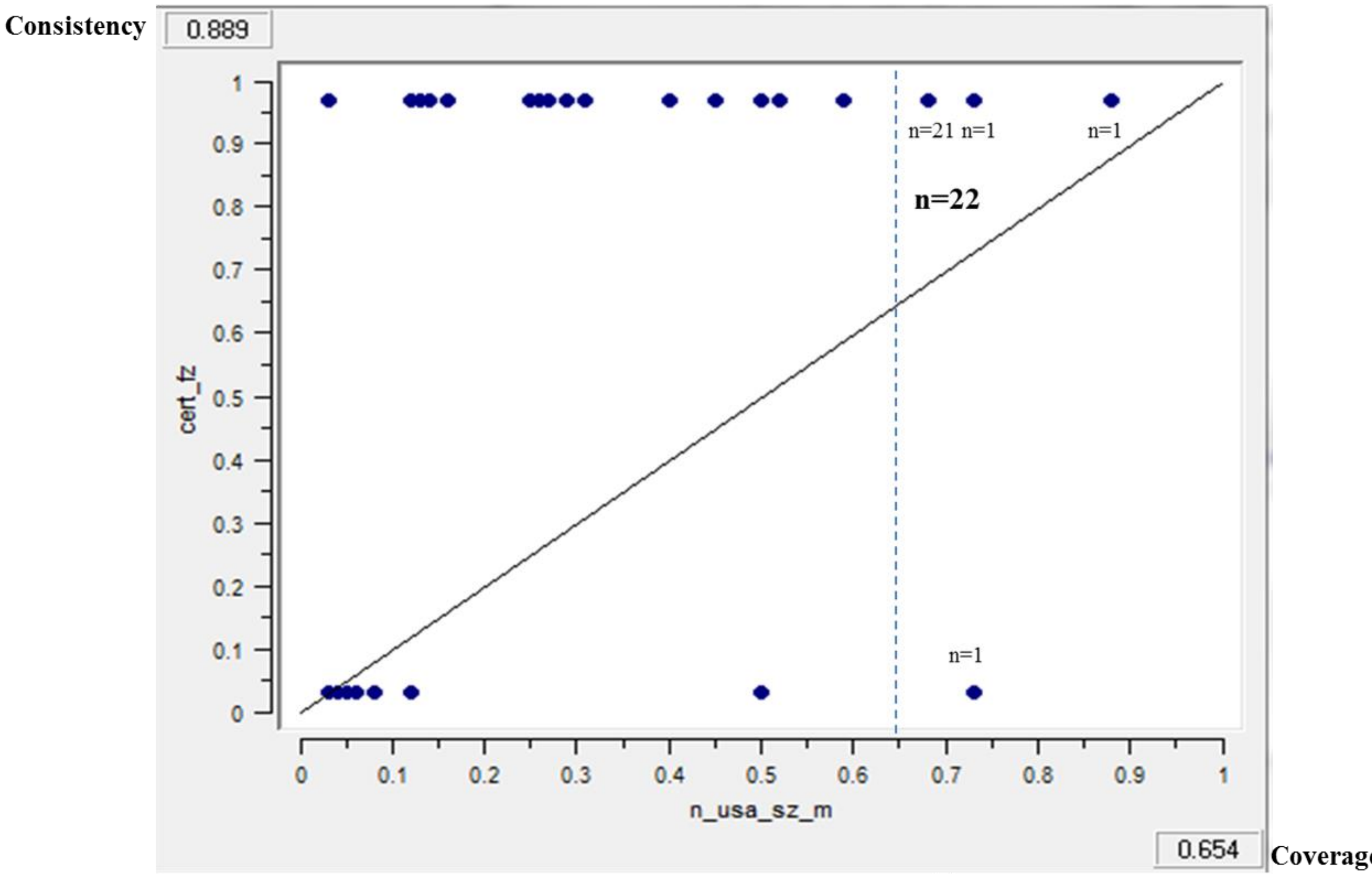
Table 7

Results for Florverde (FV) Using Pooled Multi-National Calibration

n_Colombian_firms=758 / n_certified_FV = 65 (FV only available in Colombia)

Adoption Models	**raw coverage**	**unique coverage**	**consistency**
(i) numcert_fz•expusa_fz•size_fz•member_fz	0.65	0.31	0.89
(j) expeu_fz•expros_fz•size_fz•member_fz	0.29	0.02	0.79
(k) ~numcert_fz•~expusa_fz•~ expeu_fz•~expros_fz•size_fz•member_fz	0.25	0.00	0.88
(0.80) /solution coverage: 0.67 / solution consistency: 0.80			
Non-Adoption Models	**raw coverage**	**unique coverage**	**consistency**
(l) ~numcert_fz*~member_fz	0.86	0.34	1.00
(m) ~numcert_fz*expeu_fz*size_fz	0.13	0.01	0.88
(n) ~numcert_fz*~expusa_fz*expeu_fz*~expros_fz	0.16	0.01	0.94
(o) ~numcert_fz*~expusa_fz*~expros_fz*size_fz	0.10	0.00	0.90
(p) expeu_fz*expros_fz*size_fz*member_fz	0.04	0.00	0.80
(q) ~numcert_fz*expusa_fz*~expeu_fz*~expros_fz*~size_fz	0.34	0.01	0.98
(r) expusa_fz*~expeu_fz*expros_fz*size_fz*~member_fz	0.10	0.00	1.00
(0.80) / solution coverage: 0.92 / solution consistency: 0.97			

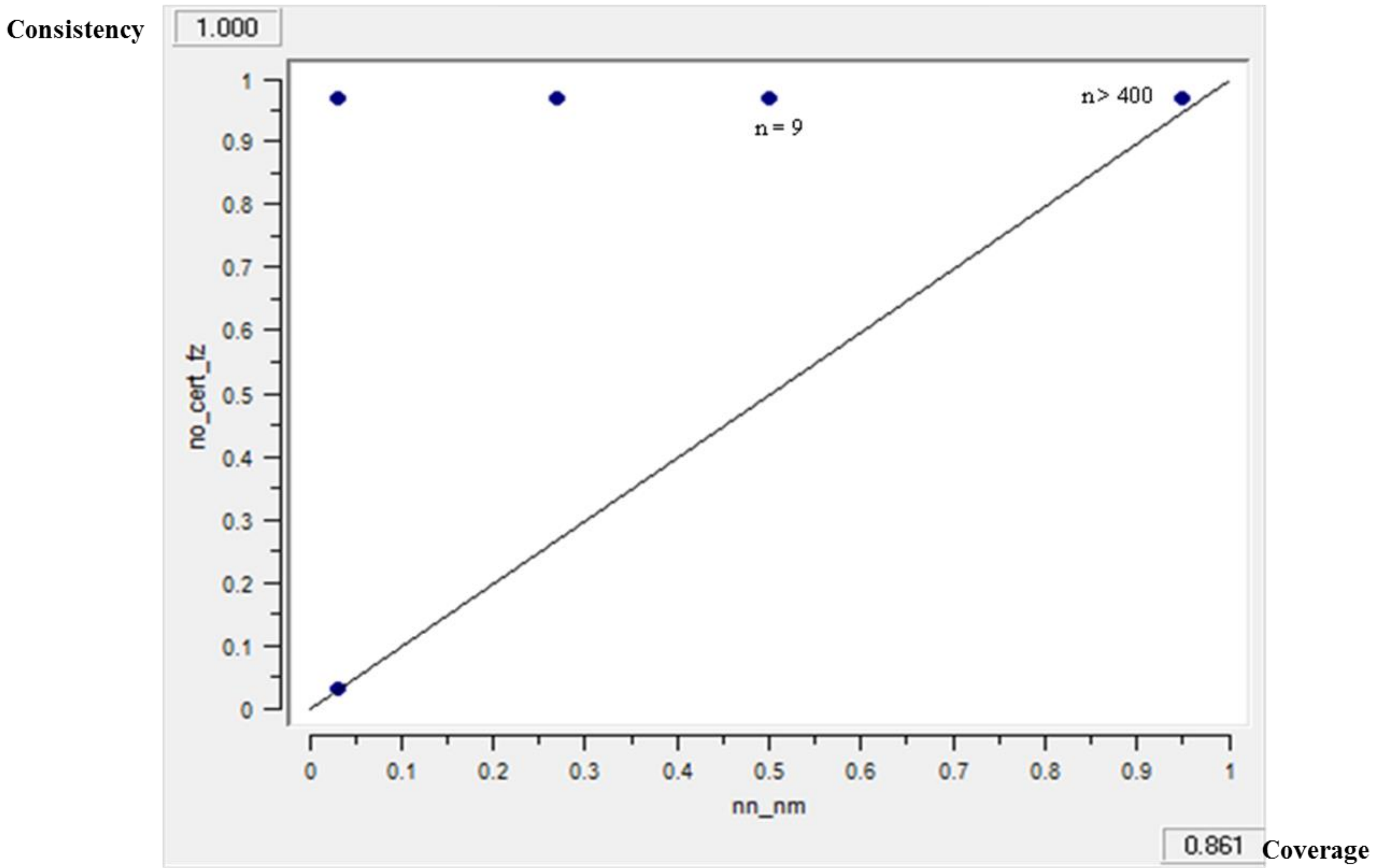
Figure 3
Colombia Florverde (FV) Highly Useful Model for Predicting Colombian Adoption (n = 758) Using the Pooled Multi-National Calibration



Adoption Model: N•USA•S•M ≤ A

Key. N = number of prior certifications; USA = export to USA; S = size of firm;
M = member of local industry trade association; A = adoption of FV product certification

Figure 4
Colombia Florverde (FV) Highly Useful Model for Predicting Colombia Non-Adoption (n = 758)
Using the Pooled Multi-National Calibration



Non-Adoption Model: NN•NM ≤ NA

Key. NN negation of prior product certification programs; NM = not a member of the local trade association; NA = non-adoption of Florverde (FV)