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ABSTRACT

The strong dependence on finite resources increases research interest in a circular economy-oriented food system. Building on the theory of planned behavior, this study examines the factors influencing actors in the Ecuadorian fruit and vegetable sector to transition towards a circular economy. Data are collected through an online questionnaire comprising 22 items related to an extension of the theory of planned behavior and 9 organizational characteristics. In total, 306 firms in the fruit and vegetable sector were surveyed. Confirmatory factor analysis and a structural equation model evaluated data fitness and tested the research hypotheses. An analysis of variance tested differences across firm types and chain stages. Results show that the intention to move towards a circular economy is strongly affected by the perceived behavioral control of actors, followed by attitude and social pressure. Although interorganizational coordination is of less influence for behavioral intention, it positively affects actors' perceived control. The results show that beliefs essentially drive circular economy intention. Moreover, large companies put more faith in their own abilities, knowledge and resources, while SMEs rely on the quality of business relationships to participate in a circular economy.

1. Introduction

Climate change effects and increasing pressures on finite resources threaten the supply capacity of the agri-food system. The transition towards a circular economy offers a potential solution to the strong dependence of the agri-food sector on non-renewable resources, environmental externalities (Andersen, 2007) and waste generation (Fletcher et al., 2021; Zarbà et al., 2021). Such a shift would entail moving from a linear model - based on a take-make-waste of resources - to a circular model that decouples economic activity from the consumption of finite resources (Faccioli et al., 2020; Geissdoerfer et al., 2017; Gomes et al., 2022; Rodríguez-Espíndola et al., 2022). A circular model involves repair (Ghisellini and Ulgiati, 2020), reuse (Meneses et al., 2017), refurbishment (Ingebrigtsen and Jakobsen, 2006), or remanufacturing (Long et al., 2017) of materials or products through practices that reduce waste to a minimum and extend the lifecycle of goods. Simultaneously, a circular economy is expected to improve environmental quality, entrepreneurship (Ellen MacArthur, 2013) and social conditions.

Ecuador is one of the most active Latin American countries in stimulating the circular economy (Bianchi et al., 2019). In 2010 already, public entities launched the Integrated Solid Waste Management project in agro-industrial areas (Ridaura, 2020). Retailers, from their side, have put limits on single-use plastics in 2020 (Urquiaga et al., 2021). Despite this, the implementation of the circular economy in Ecuador is progressing slowly (Sucozhañay et al., 2022). According to Burneo et al. (2020), this is primarily due to barriers such as unawareness (Yáñez, 2021), unclear market opportunities, lack of financing, and an outdated business culture (Hidalgo-Crespo et al., 2021). The White Paper of Circular Economy, the country's most relevant inter-sectoral framework that defines strategic guidelines to achieve a model of restorative development for the country, entered into effect in 2021. The document contains a socio-environmental diagnosis of various sectors, including the fruit and vegetable (FV) industry. It also presents public-private initiatives such as revaluing by-products from banana and cocoa chains, which inspire a circular economy. However, little is said about how to foster coordinated circular practices and how these could differ from one supply stage to another.

This paper will focus on the FV sector of Central Ecuador, which includes several supply chain stages such as production, processing, wholesaling, retailing, and catering services. The sector provides an interesting case for investigating the intentions to participate in a

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circular economy. First, the FV sector contributes to the carbon footprint of the agri-food system due to greenhouse gas emissions and the use of fossil fuels for product transportation (Almeida-Guzmán and Díaz-Guevara, 2020; Iriarte et al., 2014). Second, several authors (e.g., Buenaño et al., 2021) claim that primary energy use is exceptionally high during the product's storage time in cold rooms. Third, agro-industrial waste of the sector represents 10% of the raw materials used, implying the waste of resources, such as land, water and energy (Moreno-Miranda and Dries, 2022b; Orejuela-Escobar et al., 2021). Fourth, on average, the sector's plastic imports represent seven times the volume of FV exports (Zambrano-Monserrate and Alejandra Ruano, 2020); in addition, 65% of the plastic used by the FV sector is single-use soft plastic, such as expanded polystyrene, which is difficult to recycle (Tan et al., 2021) and represents 11% of the total waste from the sector. Nevertheless, there are no studies yet that examine the willingness of actors in the FV sector to engage in a circular economy. This paper will expand the knowledge on this behavioral intention by developing and applying an extended Theory of Planned Behavior model.

The study builds on the Theory of Planned Behavior (TPB) developed by Ajzen (1991), which allows to analyze an actor's behavioral intention based on three dimensions: attitude, subjective norms, and perceived behavioral control. Several studies (e.g., Diéguez-Santana et al., 2022; Vega-Quezada et al., 2017) suggest that circular economy strategies for the Ecuadorian FV sector can be accomplished through agro-industry synergies, the exchange of materials between chain stages, and the transformation of by-products at an inter-organizational level. Therefore, we extend the TPB model by adding a fourth dimension that includes inter-organizational coordination within the FV sector as a determinant of agents' intentions. Data was collected using a survey of 306 FV sector actors (SMEs, farmers, distributors, and manufacturers). The analysis of the determinants of the intention to participate in a circular economy was done through: confirmatory factor analysis to evaluate the appropriateness of the data for the TPB constructs; composite reliability of study constructs to indicate the internal consistency of multiple items for each construct; structural equation modeling to investigate causal relationships between TPB model determinants and the behavioral intention; and an analysis of variance to allow the comparison of TPB model determinants between sector stages and business sizes.

The remainder of the paper is structured as follows. Section 2 presents the conceptual framework of the Theory of Planned Behavior model, its extension and the research hypotheses. Section 3 introduces the research methodology, while the empirical results are presented in Section 4. Section 5 contains the discussion, including the limitations of the research and future research avenues. Finally, Section 6 presents the conclusions.

2. Conceptual framework

2.1. Theory of planned behavior model

The theory of planned behavior (TPB) is based on the theory of reasoned action and it has been used to predict human behavior across various contexts. TPB predicts behavior based on intentions, attitudes, subjective norms, and behavioral control (Fig. 1).

According to the theory of reasoned action (Madden et al., 1992), a person's actual behavior in performing a particular action is directly guided by his or her behavioral intention. Behavioral intention is a measure of an individual's willingness to adopt specific behavior and is jointly determined by the subjective norms and attitude towards the behavior and the perceived behavioral control of the individual (Ajzen, 1991). TPB counteracts the limitations of earlier models of intended behavior that assume people's total control over their intentions, by including the element of perceived behavioral control as a determinant of behavioral intention (Ajzen, 2020).

2.2. Determinants of behavioral intention

Attitude refers to "*the degree of a person's favorable or unfavorable evaluation or appraisal of the behavior in question*" (Ajzen and Fisbbein, 1974, p. 15). Ajzen (1991) further claimed that a favorable or unfavorable attitude is directly related to beliefs about the likely consequences of behavior. According to Bosnjak et al. (2020), attitudes are often the result of experience or upbringing, and they can have a powerful influence over behavior.

Subjective norms refer to "*the perceived social pressure to perform or not to perform the behavior*" (Ajzen, 1991, p. 182). Hence, subjective norms are related to beliefs about the expectations of other people. Subjective norms can be separated into normative and informational influence; the former refers to the fact that people change their behavior to be liked and accepted by others, and the latter is the change in behavior that occurs when people conform their behavior to people whom they believe have accurate information (Burnkrant and Cousineau, 1975). Most TPB applications consider subjective norms to include only the normative influence (Madden et al., 1992).

Perceived behavioral control refers to "*the degree to which an individual believes that he/she can perform a given behavior*" (Ajzen, 1991, p. 183). Control factors can be further categorized into internal and external constraining factors, with internal control being related to knowledge/self-efficacy and external control related to the environment (Shen and Chen, 2020).

2.3. Theory of planned behavior applied to the research context and hypotheses

Participation in a circular economy depends on the prospective outcomes. The attitude of a FV sector actor towards a circular economy might improve when its application is potentially beneficial. For example, an agro-industry actor may expect that circular practices can reduce pollution (Fogt Jacobsen et al., 2022), or a farmer could expect an improvement in his/her socio-economic condition as a result of a circular economy approach (Sharma et al., 2019). This study will capture the essence of the attitude of FV actors based on the perceived benefits of a circular economy. Subjective norms and perceived behavioral control are used to capture the effects of normative influences and the perceived capacity and autonomy of the FV sector actors,
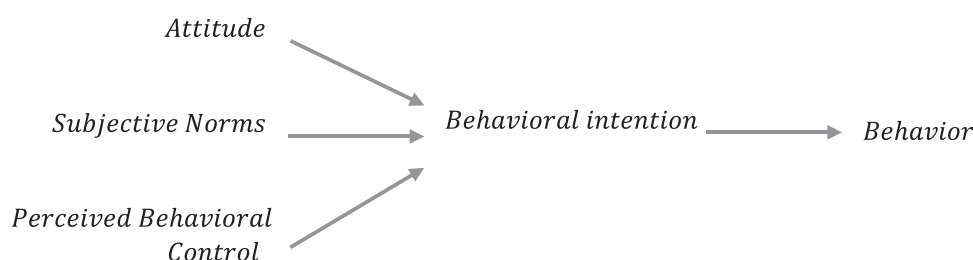

Fig. 1. Conceptual framework of TPB.
Source: Authors' own representation based on Ajzen (1991).

respectively. Examples of subjective norms influencing FV actors' behavior are environmental regulations implemented by the government and pressure from consumers demanding an improved ecological performance (Carfora et al., 2019; Kasargodu Anebagilu et al., 2021). This may provoke a sense of environmental consciousness, and the belief of individuals that they must improve the environment (Xu et al., 2022). The expertise and the ability to undertake new activities exemplify control factors of FV sector actors. Self-efficacy may be an aspect that can facilitate engagement in a circular economy (Faisal et al., 2020).

In addition, the development of a circular economy requires intensive interaction of the involved organizations. Hence, mechanisms that characterize inter-organizational coordination can influence the intention (or decision) to participate in a circular economy. For some authors, mechanisms such as trust (e.g., Kaynak et al., 2015) and commitment (e. g., Storer et al., 2004) are antecedents of behavioral intention. Other authors consider that formal mechanisms can provide individuals with clear contextual information about which behavior is valuable (Wu et al., 2017). Inter-organizational coordination also implies costs, which are perceived consequences that can, directly or indirectly, affect behavioral intentions (Lu, 2002). The extended TPB model is provided in Fig. 2. The hypotheses are summarized in Table 1.

3. Data and methodology

3.1. Case study

Ecuadorian farmers cultivate a broad range of FV. FV production requires specific agro-climatic conditions that range from cold to moderate, with annual precipitation of 800–1500 mm and an average temperature of 12–24 °C (Reinhardt et al., 2013). These optimal growing conditions are usually found at high altitudes of 2400–3100 m. The geographic areas that offer these conditions are located in the Inter-Andean valley (Moreno-Miranda and Dries, 2022a; Rodríguez-Echeverry and Leiton, 2021). The favorable conditions in this zone allow a year-round FV harvest. Cultivation practices are highly labor-intensive and household members are an essential asset for production (Moreno-Miranda et al., 2019). FV are inherently susceptible to physical damage and require careful handling during harvest and postharvest activities to avoid deterioration in quality.

Ecuador's FV processing is an important economic activity, contributing 13% to national manufacturing GDP (Herforth et al., 2015). Large technologically advanced processors compete with many small food processing firms that mainly rely on traditional production processes (April-Lalonde et al., 2020). The FV processing sector takes advantage of the agro-ecological zones to have raw materials throughout the year (Moreno-Miranda et al., 2022; Young, 2016). Unlike other sectors, the processing sector is characterized by the presence of multinational companies, which have entered through foreign direct investments, alongside many Ecuadorian firms.

The Ecuadorian FV market can be divided into four retail formats: supermarkets, grocery stores, small independent stores, and traditional wet markets. 34% of Ecuadorian consumers – 4.5 million people – shop for FV in a supermarket (Sánchez-González et al., 2022). The average monthly FV expenditure in this retail channel is USD 160. The market share of the supermarket format is 40%, placing Ecuador in a middle position in the Latin American context (Figueroa et al., 2020). The growing importance of supermarkets is driven by the entry of women into the labor market that demand higher-quality FV and more convenience and processed foods, and returning emigrants that have adopted foreign diets and lifestyles.

3.2. Variable measurement

The theory of planned behavior provides an accessible and empirically supported conceptual framework and is accompanied by well-established guidelines for measuring the constructs that comprise the

theory (e.g., Ajzen, 2020; Sok et al., 2021). We used these guidelines to design the survey instrument with 5-point Likert-type scales to establish measurements (e.g., "Adopting circular economy practices in the FV sector leads to benefits for the environment." 1 = strongly disagree, 5 = strongly agree). Appendix A shows details of the survey instrument.

Attitude was measured through the perception of potential benefits of a circular economy: environmental benefits, employment creation, entrepreneurship promotion, firms' empowerment, own benefits, sector benefits, and sector performance. Environmental benefits refer to any activity that maintains or restores the quality of the environment, for example, by reducing or eliminating pollution at the point of resource use (Brodt et al., 2013). Employment creation includes direct and indirect short- and long-term job creation (Dürr, 2017). Entrepreneurship promotion means sharing ideas, experiences and opportunities with entrepreneurial potential (de Sousa et al., 2018). Firm empowerment is the process of becoming more established within the industry (Macdonald, 2020). Own and sector benefits refer to gains for the own firm and sector peers. Sector performance consists of reaching a desired sector state within a certain period of time.

Subjective norms, or the sense of environmental consciousness provoked by societal pressure to participate in a circular economy, was measured by five perception items: peers/trade partners' pressure to strengthen network competitiveness, consumers' expectations for being more environmentally friendly, external stakeholders' expectations for being a circular economy-oriented actor, competitors' pressure on becoming a circular economy-oriented competitor, and sectors' pressure on becoming a circular economy-oriented FV sector. Peer/trade partners are organizations interested in creating synergies and sustainable business relationships over time, a network is a group of interconnected companies, entrepreneurs and freelancers whose objective is to generate new lines of communication and business. External stakeholders are those individuals and organizations interested in the socio-economic and environmental impact of a business.

> The FV sector actors' perception of factors that control the ease of carrying out a circular economy was measured by three items: circular economy awareness; resources and know-how needed for a circular supply system transition; and autonomy to adopt the circular economy approach. Circular economy awareness is the concern and interest in circular economy development (Sharma et al., 2019). Know-how is the technical and administrative knowledge needed to carry out a circular economy (Bechky, 2006). Resources are sources of supply, support, or aid that an actor can readily draw upon to develop a circular economy. Autonomy is an actor's capacity to operate according to the principles of a circular economy (Baccar et al., 2019).

The actors' perception of the inter-organizational coordination within the sector that is needed to participate in a circular economy was measured by four items: relational mechanisms such as trust, commitment, and relationship quality; ability to establish formal agreements; effort in coordination; and guarantee of proper coordination. The relational mechanism is a mutually reinforcing process of communicating for task integration (Claggett and Karahanna, 2018). A formal agreement is a mechanism that usually consists of a contract with legally enforceable terms (Czernek et al., 2017). Coordination effort is an attempt to synchronize activities where factors such as time, level of information, and resources are essential (Um and Kim, 2019). Proper coordination is the organization of a complex action to enable participants to work together effectively (Moreno-Miranda and Dries, 2022a).

Three items measured the actors' intention to participate in a circular economy: willingness to introduce the circular economy approach; the choice to carry out activities that link the circular economy in operations; and the effort to keep the circular economy approach in operations. A circular economy requires responsive actors that provide solutions to current societal demands. The willingness to introduce a new approach means being open to new ideas or change (Kasargodu
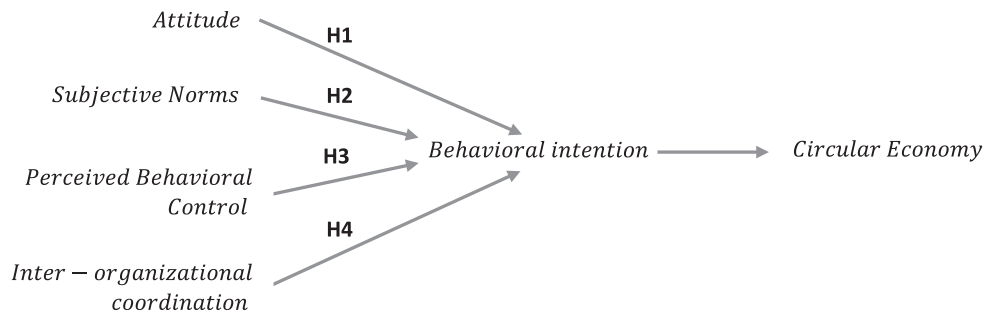
Fig. 2. The extended TPB model on FV sector actors' intention to participate in a circular economy.
Source: Authors' own representation.

Table 1
Research hypotheses.

Hypothesis	Description
H1	FV sector actors' attitudes towards potential circular economy benefits will positively affect the intention to participate in a circular economy.
H2	The sense of environmental consciousness provoked by stakeholders' pressure produces subjective norms that will positively influence FV sector actors' intention to participate in a circular economy.
H3	*The FV sector actors' perception of control will positively influence actors' intention to participate in a circular economy.*
H4	The perception of actors on the quality of inter-organizational coordination in the FV sector will positively affect *actors' intention to participate in a circular economy.*

Source: Authors' own representation.

Anebagilu et al., 2021).

3.3. Model operationalization

3.3.1. Questionnaire

The variables were elicited from FV sector actors through a questionnaire. The questionnaire included two sections: the first tackled demographic and corporate aspects. The second contained items to assess the constructs of the extended TPB model. Appendixes A and B show details of the questions, which were translated to Spanish (respondents' native language) and checked by two experts to ensure complete understanding. The survey was pilot-tested through exploratory interviews with five FV sector actors and then applied through a web-based survey to FV sector participants.

3.3.2. Sampling

The investigation had two sources of respondents, students of master's programs and professionals who are members of professional associations. The group of students that were surveyed are enrolled in an MBA program at one of five Ecuadorian universities.[1] These academic institutions select students for their programs based on their experience in the FV sector. The selection process includes an interview and an aptitude test on business management skills. The association's members that were surveyed are part of the Ecuadorian Association of Food Manufacturers (ANFAB) and the Regional Union of Professionals in the Agri-food sector (CRINAL). ANFAB has functioned for 20 years, it has >2000 members, and focuses on training its members, and commercial networking. With >30 years of experience, CRINAL focuses on raising the technical level of practitioners through specialized training on food supply. The membership base exceeds 500 individuals. We randomly selected 410 enterprise representatives from the combined sample of

students and professionals, and collected 306 responses (response rate of 74.6%).

3.3.3. Data collection

We collected data through the pre-tested questionnaire and using the Qualtrics Soft tool. Data collection took place from mid-February to mid-April 2022. The dates for distributing the questionnaire were agreed upon with the heads of the MBA programs and professional associations who urged potential respondents to participate in the survey. We recommended that each respondent look for a private space and enough time to answer the questionnaire. Participants were first introduced to general information on the research and its objective. Each participant provided a single response representing one organization. This is consistent with the approach taken by other researchers in this area, (e. g., Wilhelm et al., 2016). Table 2 shows the characteristics of the respondents and of the organization that they represent.

3.4. Methodology for analysis

3.4.1. Reliability testing

Following the suggestions of Hair et al. (2009), we examine the reliability of the study constructs by estimating their average variance extracted (AVE) and composite reliability (CR), which indicate the internal consistency of multiple indicators. These statistics were estimated by using the 306 responses related to the extended measurement model. Values equal to or >0.60 indicate good AVE and CR values (O'Leary-Kelly and Vokurka, 1998; Spooren et al., 2007).

3.4.2. Confirmatory factor analysis

Based on Wallace's approach (Wallace et al., 2004), a confirmatory factor analysis of the extended measurement model was conducted using SPSS AMOS 24 with the five latent variables (the TPB constructs). The analysis used maximum likelihood as the main estimation method (Browne, 1987). Maximum likelihood adjusts chi-square estimates for the presence of non-normality using the asymptotic covariance matrix; therefore, it generates more accurate test statistics under conditions of non-normality (Curran et al., 1996). The overall goodness of fit was measured using different measures (Bollen, 1989; Hair, 1998); namely, $\chi 2$/ degree of freedom ratio (CMIN/DF), Comparative Fit Index (CFI), the Normed Fit Index (NFI), and root mean square error of approximation (RMSEA). The values for CFI and NFI should be higher than 0.8 (Byrne, 2016). RMSEA values for good model fit should be lower than or equal to 0.06 (Hu and Bentler, 1999).

3.4.3. Structural equation modeling

A structural equation model (SEM) of the hypothetical model shown in Fig. 2 is constructed to test the research hypotheses. SEM assesses the model's predictive validity (Hoyle, 1995; Jadhav et al., 2018). The latent variables (extended TPB model constructs) are indicated in the model by the corresponding observed variables. A Maximum Likelihood approach was used as the primary estimation method using the sample

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[1] Technical University of Ambato – UTA, Central University of Ecuador – UCE, Armed Forces University – ESPE, Technical University of the North – UTN and Litoral Polytechnic University – ESPOL.

Table 2

Characteristics of the FV sector respondents' sample.

Characteristic	$N = 306$
Business position	
Owner	88 (28.5)
CEO	6 (2.0)
Owner manager	74 (24.6)
Executive committee	64 (21.7)
Business manager	46 (14.3)
Other	28 (9.0)
Location (region)	
Highland	174 (56.8)
Coast	119 (39.2)
Amazon	13 (4.0)
Years active	
<5	57 (18.5)
5–10	23 (7.4)
10.1–20	102 (33.3)
>20	124 (40.7)
Business size	
SME	270 (88.4)
Large firm	36 (11.6)
Number of employees	
<10 employees	84 (27.3)
11 to 50 employees	109 (35.9)
51 to 100 employees	61 (19.8)
>100 employees	52 (17.3)
Ownership structure	
Sole proprietorship	120 (39.3)
Partnership	96 (31.4)
Cooperative	39 (12.7)
Limited Liability company	51 (16.6)
Sector stage	
Production	79 (25.8)
Processing	128 (41.8)
Wholesale	47 (15.3)
Retail	28 (9.1)
Transport/logistic	16 (5.2)
Catering	8 (2.6)

xx (xx) – absolute number (percentage) of respondents per characteristic.

Source: Authors' survey.

covariance matrix and the corresponding asymptotic covariance matrix.

In addition, we follow the approach by Minton et al. (2018) to test the potential mediation role of attitude in the relationship between social norms and behavioral intentions. Moreover, we add a SEM path to the extended TPB model that connects inter-organizational coordination and perceived behavioral control. This is in line with Cop et al. (2020) who observed that perceived behavioral control is likely to be inactive when organizational support is weak. The additional SEM paths lead to the estimation of the adjusted SEM model.

3.4.4. Comparative analysis

The behavioral intention to participate in a circular economy is expected to differ between FV sector actors. Our analysis, therefore, compares the scores of the TPB model determinants of respondents across different business sizes and supply chain stages. The comparative analysis aims to identify differences in circular economy behavioral intentions. We use a robust ANOVA to identify significant differences in scores of the TPB model determinants between businesses of different sizes and in different chain stages.

4. Results

4.1. Data description

Table 3 presents the average scores for the respondents' intention to participate in a circular economy and the determinants. The surveyed managers' intentions reflect the organizations' planned behavior.

The attitude towards obtaining potential benefits from maintaining or restoring environmental quality, generating gains for the sector, and reaching a desired sector performance received the highest mean scores. This indicates that FV sector actors mainly see the circular economy as a way to overcome environmental concerns, with the potential to create benefits for the sector as a whole.

Regarding social norms, the highest pressure is felt from peers/trade partners. This confirms that as circular economy principles are being introduced, sustainable relationships across chain stages and peers are seen as crucial. Somewhat surprisingly, pressures from the consumer side, which is generally considered paramount in agri-food sector development, was found to be the least important in respondents' considerations.

For those surveyed, business autonomy obtained the highest average score among the elements of behavioral control. However, the know-how and resources necessary to carry out a circular economy may be missing and therefore a barrier for circular economy implementation (3.05). This shows that despite having autonomy in their operations, the actors are aware of the limitations that could hinder the sector's circular economy.

Concerning the inter-organizational construct, responses show that suitable coordination (average score 4.12) and relational quality (average score 4.11) are needed to implement a circular economy. Formal agreements, on the other hand, received the lowest average score (3.56). This suggests that formal mechanisms are not seen as suitable means to guarantee activities beyond conventional transactions.

4.2. Composite reliability and validity of the model constructs

Table 4 shows the extended TPB model constructs' composite reliability and validity results. AVE values have acceptable scores above 0.60. Only the SN construct shows a low AVE value (0.57), which is just below the recommended threshold. The CR results range from 0.74 to 0.92 and exceed the recommended threshold (0.60). These results confirm the data's convergent validity.[2]

Confirmatory factor analysis (CFA) indexes indicate that the data fit the model well (see Table 5). The comparative fit index (CFI) is 0.94 (CFI > 0.90) and displays a relatively good model fit. The normed fit index (NFI) is 0.91 (NFI > 0.90), which suggests the model of interest improves the fit by 91% relative to a null model (model with uncorrelated variables) and the parsimony-adjusted index (RMSEA) is 0.048 (RMSEA <0.06) indicating that the sample size does not weaken the model. Table 5 shows correlations (from the confirmatory factor analysis - CFA) between the constructs. All constructs from the extended TPB model are positively and significantly correlated to circular economy intention. The strongest correlation is between perceived behavioral control and circular economy intention (0.76), and between attitude and circular economy intention (0.72). Appendix C shows details of the CFA.

4.3. Structural equation model – SEM

Fig. 3 shows the structural equations model, which presents an adequate fit to the data as shown by the model fit indexes. This implies

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[2] Convergent validity reflects the extent to which two measures capture a common construct (Carlson and Herdman, 2012).

Table 3
Mean value per TPB model construct and Likert-scale score for 306 FV sector respondents.

Variable		Mean	S.D.	Score				
				1	2	3	4	5
Attitude								
1. Environmental benefits	AT1	4.21	1.04	4 (1.3)	28 (9.1)	51 (16.6)	75 (24.5)	148 (48.4)
2. Employment	AT2	3.63	1.15	9 (2.9)	43 (14.1)	78 (25.5)	75 (24.5)	101 (33.0)
3. Entrepreneurship	AT3	3.89	0.99	7 (2.3)	33 (10.7)	66 (21.6)	80 (26.1)	120 (39.2)
4. Own benefits	AT4	3.97	0.95	3 (1.0)	33 (10.8)	58 (18.9)	88 (28.7)	124 (40.5)
5. Firms empowerment	AT5	3.80	1.08	7 (2.3)	34 (11.1)	73 (23.8)	92 (30.1)	100 (32.7)
6. Sector benefits	AT6	4.05	0.98	1 (1.0)	20 (6.5)	80 (26.1)	78 (25.5)	127 (41.5)
7. Sector performance	AT7	4.02	0.87	2 (1.0)	25 (8.2)	56 (18.3)	104 (33.9)	119 (38.9)
Subjective norms								
8. Peers/partners pressure	SN1	4.10	0.94	2 (1.0)	19 (6.2)	53 (17.3)	104 (33.9)	128 (41.8)
9. Consumer expectation	SN2	3.32	1.23	20 (6.5)	38 (12.4)	84 (27.5)	62 (20.3)	102 (33.3)
10. Stakeholder pressure	SN3	3.84	1.07	9 (2.9)	25 (8.2)	77 (25.1)	91 (29.7)	104 (33.9)
11. Competitor pressure	SN4	3.56	1.12	15 (4.9)	39 (12.7)	85 (27.7)	95 (31.1)	72 (23.5)
12. Sector pressure	SN5	3.88	1.09	11 (3.6)	23 (7.5)	58 (18.9)	99 (32.4)	115 (37.6)
Perceived Behavioral Control								
13. Awareness	PBC1	3.34	0.87	9 (2.9)	31 (10.1)	76 (24.8)	91 (29.7)	99 (32.4)
14. Know-how and resources	PBC2	3.05	1.12	10 (3.3)	35 (11.4)	67 (21.9)	82 (26.8)	112 (36.6)
15. Autonomy	PBC3	3.54	1.03	6 (1.9)	24 (7.8)	72 (23.5)	92 (30.1)	112 (36.6)
Inter-organizational coordination								
16. Relational quality	IO1	4.11	0.83	3 (1.0)	24 (7.8)	48 (15.6)	92 (30.1)	139 (45.4)
17. Formal agreement	IO2	3.56	0.95	3 (1.0)	27 (8.8)	76 (24.8)	96 (31.3)	104 (33.9)
18. Coordination effort	IO3	3.92	1.01	4 (1.3)	26 (8.5)	69 (22.5)	98 (32.1)	109 (35.6)
19. Coordination suitable	IO4	4.12	0.95	2 (1.0)	18 (5.8)	57 (18.9)	91 (29.7)	136 (44.4)
Behavioral intention (BI)								
20. Intention to participate in CE	BI1	4.35	0.93	6 (1.9)	12 (3.9)	58 (19.0)	96 (31.3)	134 (43.7)
21. Intend use CE	BI2	4.15	1.02	4 (1.3)	25 (8.2)	57 (18.9)	89 (28.7)	131 (42.8)
22. Effort keep CE	BI3	4.06	0.94	4 (1.3)	21 (6.8)	50 (16.3)	97 (31.6)	134 (43.7)

Note. CE means circular economy. S.D. means standard deviation. xx (xx) – absolute number (percentage) of respondents per Likert scale value.
Source: Authors' survey.

Table 4
Reliability and validity analysis.

Measure	AT	SN	PBC	IO	IB
Mean	3.94	3.74	3.31	3.93	4.19
S.D.	0.17	0.27	0.20	0.23	0.12
AVE	0.62	0.57	0.72	0.69	0.71
CR	0.92	0.82	0.74	0.79	0.87

Note. AT, SN, PBC, IO and IB refer to attitude, subjective norms, perceived behavioral control, inter-organizational coordination and circular economy intention, respectively. S.D. means standard deviation. AVE means average variance extracted and CR is composite reliability.
Source: Authors' own representation.

Table 5
Correlations of the extended TPB model constructs.

Constructs	Code	AT	SN	PBC	IO	BI
Attitude	AT	1				
Subjective norms	SN	0.41*	1			
Perceived behavioral control	PBC	0.36*	0.69**	1		
Inter-organizational coordination	IO	0.30*	0.43*	0.44*	1	
Behavioral intention	BI	0.72**	0.61***	0.76***	0.56**	1

CFA Fit indices: $\chi2 = 288.7$; df $= 237$; $p < 0.001$; RMSEA $= 0.048$; CFI $=0.94$; NFI $= 0.91$.
Note. *, **, *** denote coefficients significant at 0.1, 0.05 and 0.01 level.
Source: Authors' own representation.

that the extended TPB model could reasonably predict the FV sector actors' intentions to participate in a circular economy approach.

The estimated path coefficients for the structural equation show that the four constructs (AT, SN, PBC, IO) are all significantly related to the intention to participate in a circular economy (BI) and explain 75% of the variance in behavioral intention ($R^2 = 0.748$). All the coefficients are positive. While comparing the four path coefficients, the impact of perceived behavioral control (including awareness, know-how, resources and autonomy) is the most important determinant for FV sector actors to participate in a circular economy. Attitude (including environmental, employment, entrepreneurship, and empowerment benefits) is the second most relevant construct for the circular economy intention. Next, we compare the TPB model with an adjusted version by adding paths from SN to AT and from IO to PBC.

4.3.1. Adjusted TPB model

Fig. 4 shows the adjusted TPB model (TPB$_m$). Results of the adjusted version indicate an adequate fit to the data. Compared with the initial extended TPB model, the revised model shows a relatively better fit of the data. The standardized coefficients that link social pressure (SN) and attitude towards a circular economy (AT) (B = 0.43; $p < 0.05$) and inter-organizational coordination and perceived behavioral control (PBC) (B = 0.44; p < 0.05) are positive and significant. We use this adjusted model, with the higher explanatory power for circular economy behavioral intention ($R^2 = 0.767$), for hypotheses testing.

4.4. Hypotheses testing

Table 6 shows the results of the hypotheses testing. The standardized coefficients show that the relationships between the determinants of the
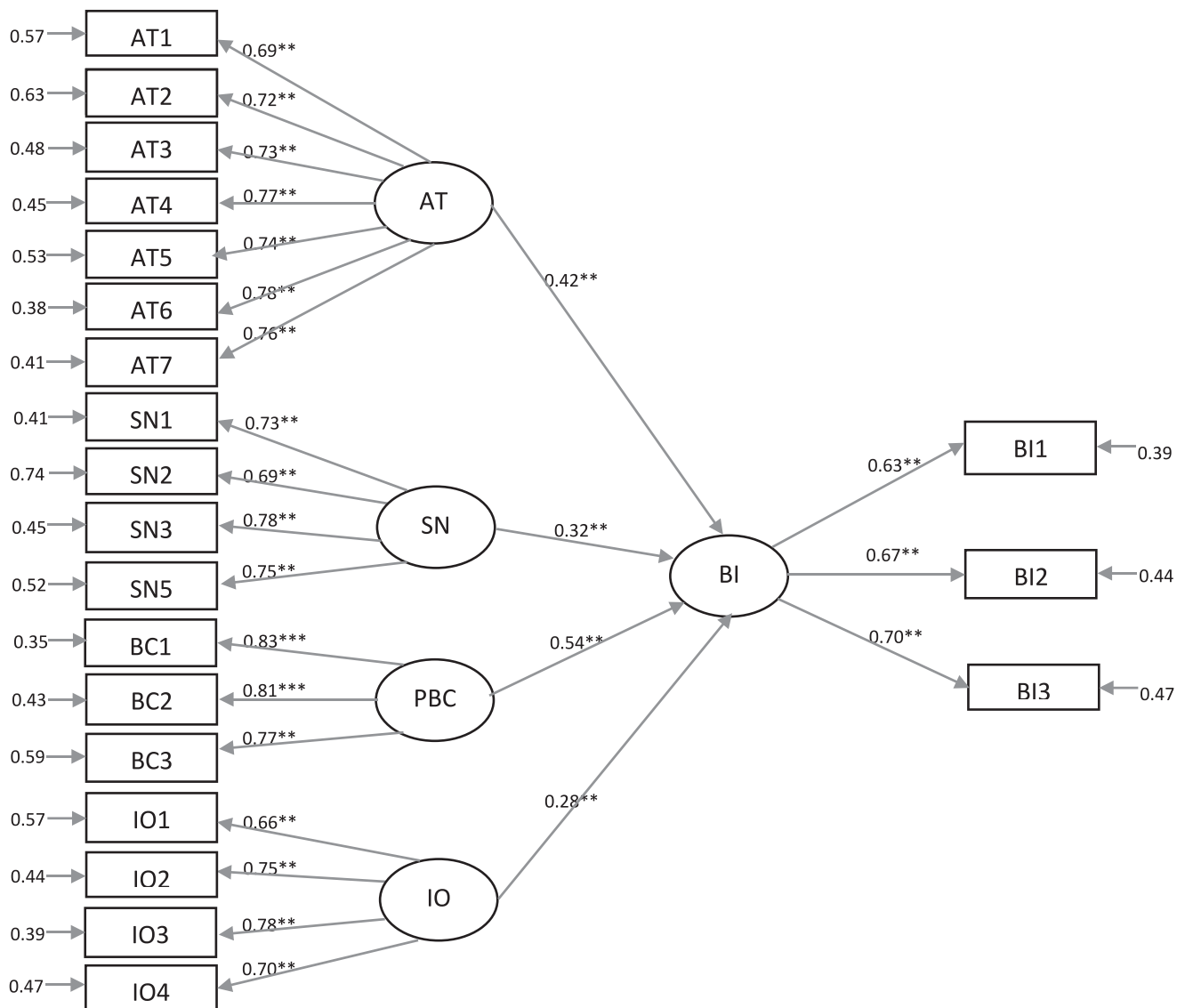
Fig. 3. The structural equation model.
Fit indices: $\chi^2 = 527.7$; df $= 237$; $p < 0.001$; $RMSEA = 0.052$; $CFI = 0.927$; $NFI = 0.909$; $R^2 = 0.748$.
Note. AT, SN, PBC, IO and BI means attitude, subjective norms, perceived behavioral control, inter-organizational coordination and behavioral intention item, respectively. A circle means latent variable. A rectangle means observed variable. Long arrows depict path coefficients. Short arrows on the far-left and far-right sides are the corresponding variable errors. **, *** denote coefficients significant at 0.05 and 0.01 level.
Source: Authors' own representation.

adjusted TPB model, namely, attitude (AT), social pressure (SN), perceived behavioral control (PCB) and inter-organizational coordination (IO), and the response variable of behavioral intention (BI - circular economy participation intention) are all positive and significant. Therefore, the results support hypotheses 1 to 4.

In addition, and as can be seen in Fig. 4, the estimates of the standardized coefficients show that the direct effect of perceived behavioral control on circular economy behavior intention is larger than that of perceived attitude (A), social pressure (SN), and inter-organizational coordination (IO). Furthermore, social pressure (SN) and inter-organizational coordination (IO) have a positive, indirect effect on circular economy behavior intention, through attitude and perceived behavioral control, respectively. This result suggests that attitude and perceived behavioral control have a mediating role that influences FV sector actors' intention to participate in a circular economy.

4.5. Comparison by business size and sector stage

Table 7 shows the results of the one-way ANOVA to determine the differences between SMEs and large companies and between supply chain stages for the extended TPB model. The examined supply chain stages were production, processing, and distribution. Distribution included wholesale, retail, transport/logistics, and catering companies.

Results for the attitude, subjective norms, perceived behavioral control, inter-organizational coordination, and behavioral intention scores show significant differences between the two business sizes and the three chain stages. Processing actors present the best attitude towards the potential benefits of the circular economy for the sector as a whole. Large firms and distributors perceive the highest pressure from peers/trade partners, stakeholders (e.g., NGOs), and consumers to become more environmentally friendly. Processing and large firms perceive more control over what is needed (e.g., knowledge and resources) to implement circular economy practices. SMEs perceive relational quality as key to developing a circular economy, while large firms
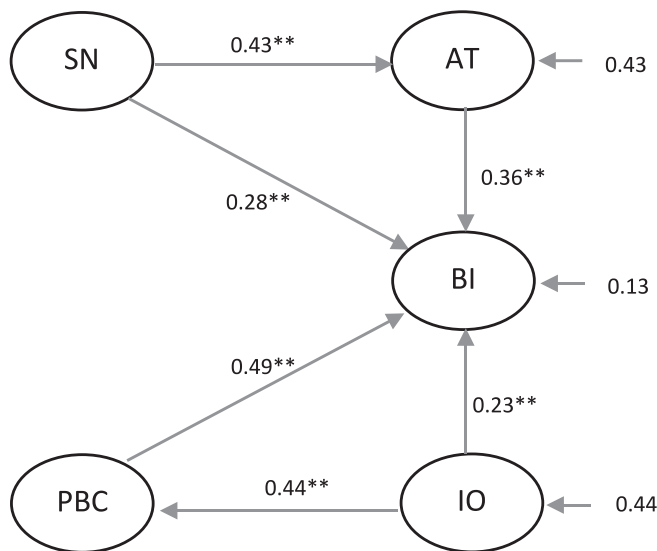
Fig. 4. The path coefficients and fit indices of the adjusted TPB$_m$ model.
Fit indices $\chi^2 = 532.8$; df $= 237$; $p < 0.001$; $RMSEA = 0.048$; $CFI = 0.949$; $NFI = 0.913$; $R^2 = 0.767$
Note. AT, SN, PBC, IO and BI means attitude, subjective norms, perceived behavioral control, inter-organizational coordination and behavioral intention, respectively. A circle means latent variable. Long arrows reflect respondents' differences. Short arrows on the far-right sides are the corresponding variable errors. ** denote coefficients significant at 0.05 level.
Source: Authors' own representation.

Table 6
Path coefficient estimates and hypotheses testing results.

Paths	Coefficient	S.D.	t-value	Hypotheses
AT ➔ BI	0.36**	0.035	2.71	H1: supported
SN ➔ BI	0.28**	0.022	2.29	H2: supported
PBC ➔ BI	0.49**	0.014	3.39	H3: supported
IO ➔ BI	0.23**	0.019	1.94	H4: supported
SN ➔ AT	0.43**	0.033	5.52	Added path
IO ➔ PCB	0.44**	0.023	5.55	Added path

Note. AT, SN, PBC, IO and BI means attitude, subjective norms, perceived behavioral control, inter-organizational coordination and behavioral intention, respectively. ** denote coefficients significant at 0.05 level.
Source: Authors' own representation.

believe that formal agreements and proper coordination are essential to adopting a circular economy. Finally, large companies, distributors and processors show a higher willingness to introduce or maintain the circular economy in their activities.

5. Discussion

5.1. Main findings

The present study tested the appropriateness of the TPB for explaining FV sector actors' intentions to participate in a circular economy. Firm leaders' attitudes are considered a determining factor that boosts firms' ecological performance (Bombiak, 2019). The research findings support this claim; managers' and owners' attitudes towards circular economy benefits, such as environment, entrepreneurship, and employment, positively affect firms' willingness to become more circular economy-oriented.

According to Centobelli et al. (2021), external or social pressure is the most significant influencing factor on enterprise performance. Our research finds that social pressure is not the most influencing factor in adopting circular economy practices, which is in line with the

contributions of Atanasovska et al. (2022) and Shang et al. (2022). Nevertheless, managers' attitudes are significantly influenced by social pressures. Government, for instance, may use different instruments (e.g., minimum price for recovered materials or tariff schemes for biomass) to encourage companies to implement low-impact environmental practices rather than merely using regulation and sanctions. Trade partners can influence firms' attitudes by presenting market opportunities in the circular economy, or NGOs can support environmentally friendly industries (Minton et al., 2018).

Perceived behavioral control over adopting a circular economy was the most significant determinant and predictor of behavioral intention. This finding is in line with the results of Kautonen et al. (2013) who analyzed the entrepreneurial sector. An FV actor with control over tangible and intangible assets can rationally moderate its behavior and participate in sectoral circular economy approaches. The results also showed that the lower the perceived autonomy, the less inclined actors are to participate in a circular economy. Other researchers (e.g., Elie-Dit-Cosaque et al., 2011) agree that autonomy eases adaptation to perform new activities. However, perceived behavioral control is not isolated. The adjusted TPB model showed a significant and positive path from inter-organizational coordination to behavioral control. This finding coincides with previous studies (e.g., Cop et al., 2020). FV actors' control and decisions are influenced by their relationships with external key partners such as suppliers, peers, and customers.

The complexity of supply chains and actors' interdependent actions to reach goals make coordination among organizations increasingly important. The research findings show that inter-organizational coordination affects the actors' intention to participate in a circular economy, showing that the development of the circular economy needs efforts of coordination. This is in line with Alexander (1993) and Howard et al. (2022) findings. Inter-organizational coordination also has a positive and significant impact on actors' perceived behavioral control. De Ven and Walker (1984), in their study, claimed that business directors recognized the need for other organizations' support, cooperation, or resources to survive. Future research could further explore this relationship between inter-organizational coordination mechanisms and the adoption of circular economy practices.

In the comparative analysis, we find substantial variation. The environmental contribution of the circular economy explains the relatively better attitude of large firms and processors towards behavioral intention. This is in line with Bassi and Dias (2020). The social pressure of sector peers/trade partners and consumers seems to affect large firms more than SMEs, which is also shown by Gaur et al. (2019) in their research. At the same time, distribution actors are more affected by pressure from stakeholders such as the government, investors, and NGOs. Large firms and processors perceive more control over the resources needed to adapt to a circular economy. Other researchers (e.g., Romero-Hernández and Romero, 2018) confirm that large corporations have already independently started adopting waste management practices and circular economy strategies motivated by their corporate social responsibility goals. The training in resource management with an environmental orientation, certifications such as the B Corporation certificate, and company investments in environmentally friendly technologies also evidence the change in large firms. SMEs rely on the quality of the relationship with their partners to participate in a circular economy; for large companies and distributors, the cost, time, and effort required are decisive to be circular economy-oriented. Finally, large firms, actors in the distribution stage, and processors are likely to adopt and implement a circular economy with less difficulty.

5.2. Research limitations

The current study includes some limitations that need further research. First, this study examined general FV sector actors' intentions to participate in a circular economy approach. FV actors in different subsectors may have different decision-making processes, and aspects such

Table 7
ANOVA results for TPB model items per business size and chain stage.

	Business size			Chain stage			
	One way ANOVA	SME	Large firm	One way ANOVA	Production	Processing	Distribution
	F(1; 305)			F(1; 305)			
Environmental benefits	0.125	4.061	4.11	1.114	3.97	4.18	3.90
Employment	0.115	3.75	3.69	0.297	3.67	3.80	3.73
Entrepreneurship	0.346	3.87	3.96	0.582	3.73	3.96	3.76
Own benefits	0.239	3.98	3.91	0.215	3.93	3.98	3.93
Firms empowerment	1.568	3.76	3.94	0.654	3.68	3.84	3.80
Sector benefits	0.429	3.99	4.08	2.022*	3.84	4.12	3.88
Sector performance	0.583	3.99	4.09	0.363	3.99	4.07	3.90
Peers/partners pressure	3.861**	4.04	4.29	1.074	4.07	4.09	4.10
Consumer expectation	3.638**	3.55	3.88	1.742*	3.11	3.27	3.63
Stakeholder pressure	0.873	3.81	3.94	2.271**	3.51	3.81	3.84
Sector pressure	2.433	3.87	4.09	2.775**	3.51	3.95	3.97
Awareness	9.814***	3.7	4.15	2.255**	3.44	3.83	3.81
Know-how and resources	9.456***	3.76	4.22	5.559***	3.22	3.93	3.86
Autonomy	4.249**	3.86	4.15	2.397**	3.56	4.08	3.95
Relational quality	0.622*	4.38	4.12	3.131**	3.76	4.02	4.21
Formal agreement	0.420	3.86	3.96	4.581***	3.39	3.89	3.97
Coordination effort	0.104*	3.92	4.13	2.071*	3.54	3.84	4.01
Coordination suitable	7.360***	4.04	4.39	3.825***	3.68	4.09	4.22
Intention in CE	3.452**	4.05	4.29	1.201	4.03	4.13	4.17
Intend use CE	2.017	3.96	4.17	2.303*	4.03	4.06	4.10
Effort keep CE	0.472	4.07	4.13	2.961**	4.00	4.24	4.14

Note. *, **, *** denote coefficients significant at 0.1, 0.05 and 0.01 level.
Source: Authors' own representation.

as location or FV product may influence their intentions and behavior. Hence, it might be meaningful to test the proposed model by considering differences in geographical region and FV product in future research. Second, the measurement of circular economy behavior intention in the current study used a limited number of variables; thus, it is recommended to include more measurement items in future research (e.g., how likely is your participation?). Third, another valuable approach to this research would be to take a longitudinal perspective and identify the timeframes for the effects of the extended TPB model constructs. Finally, it can be an exciting extension to examine specific effects of intra-organizational mechanisms characterized by relational and formal co-ordination or by differentiating private and public coordination and learn how they complement each other to promote a circular economy-oriented firm's profile in future research.

6. Conclusions and policy implications

Understanding FV sector actors' intentions to participate in a circular economy is essential to put circular economy activities and strategies into motion in Ecuador. This research applied the theory of planned behavior framework to explain FV sector actors' intentions to participate in circular economy projects. Based on the structural equation model, the study showed that attitudes towards a circular economy, social pressure, actors' perception of control to develop a circular economy, and inter-organizational coordination had a positive and significant effect on circular economy intentions. The direct effect of perceived behavioral control was the largest. Further findings indicated positive indirect effects, first from social pressure via attitude, and second, from inter-organizational coordination via perceived behavioral control.

The findings can help policymakers understand the drivers of FV

sector actors' intention to participate in circular economy initiatives. Given the positive and significant impact of perceived behavioral control on actors' intentions, it is essential to facilitate tools, resources, and training to actors to influence their behavioral intention and engagement. The current promotion of circular economy strategies is mainly based on the White Book of the Circular Economy of the Republic of Ecuador. The draft takes the circular economy principles as a baseline for national agri-food policy, provides a political context, and assigns specific responsibilities to government agencies and stakeholders. However, the impact of circular economy strategies and policies should be supported by funds that stimulate green entrepreneurship or product eco-design. Tax exemptions could, for instance, incentivize the reduction of the carbon footprint of food logistics by sharing transport means among actors. Clearly, the government should do more to develop green agri-food chains, for instance, by coordinating initiatives such as the reuse of materials or the exchange of by-products to strengthen a circular economy based on synergies between industries.

Declaration of Competing Interest

No potential competing interest was reported by the authors.

Data availability

Data will be made available on request.

Appendix A. Survey questions used to collect data on respondents' and firms' general information

| Part 1: General information	Please choose one of the alternatives and fill the empty spaces where needed
What position do you hold in the business?	• Owner • CEO (Chief executive officer) • Owner manager • Executive Committee member • Manager of the business • Other, please indicate………………………..
Rate from 1 to 5 (1 being a little and 5 being a lot) how much influence do you have on the strategic decisions of the business?	
Indicate in which city (e.g., Quito) the business is located.	• ………………………………………
Approximately, how many years has the business been active in the FV sector?	• ………………………………………
Indicate the size of the business.	• Micro, small and medium enterprise (SME) • Large company
Approximately, how many full-time employees does the business have?	• <10 employees • Between 11 and 50 employees • Between 51 and 100 employees • >100 employees
Indicate the ownership structure of the business.	• Sole proprietorship • Partnership • Cooperative • Limited Liability company • Other, please indicate…………….
What is the main fruit and/or vegetable in the company's business portfolio? (e.g., blackberry).	• ………………………………………
In which stage of the supply chain does the company operate?	• Production • Processing • Wholesale • Retail • Transport and logistics • Catering /restoration Other, please indicate………….

Source: Authors' own representation.

Appendix B. Survey questions used to collect data on firms' attitude, subjective norms, perceived behavioral control, inter-organizational coordination and behavioral intention

Part 2: Circular economy in the FV sector	Please write the number that best describes your opinion.
Adopting circular economy practices in the FV sector leads to benefits for the environment.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices in the FV sector creates new work places.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices in the FV sector promotes entrepreneurship.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices is beneficial for my business.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices in the FV sector empowers actors in the FV sector.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices is beneficial for the FV sector.	Strongly disagree 1 2 3 4 5 Strongly agree
Adopting circular economy practices improves the performance of the FV sector.	Strongly disagree 1 2 3 4 5 Strongly agree
Peers and trade partners believe that FV sector has to strengthen its competitiveness by circular economy initiatives.	Strongly disagree 1 2 3 4 5 Strongly agree
Consumers believe that the FV sector excessively pollutes, and thus its products and operations should be more environmentally friendly.	Strongly disagree 1 2 3 4 5 Strongly agree
Stakeholders (public, NGOs, investors) expect my business to become circular-oriented.	Strongly disagree 1 2 3 4 5 Strongly agree
My business is under pressure because it lags behind other businesses in implementing circular economy practices.	Strongly disagree 1 2 3 4 5 Strongly agree
The FV sector is under pressure because it lags behind other sectors in implementing circular economy practices.	Strongly disagree 1 2 3 4 5 Strongly agree
My business is aware about the initiatives in the circular economy.	Strongly disagree 1 2 3 4 5 Strongly agree
My business has the necessary resources and know-how to transition to a circular supply system.	Strongly disagree 1 2 3 4 5 Strongly agree
Whether or not to adopt the circular economy approach is entirely down to my business.	Strongly disagree 1 2 3 4 5 Strongly agree
My business's ability to perform circular economy initiatives depends on the trust, commitment, and quality of the relationships with trade partners.	Strongly disagree 1 2 3 4 5 Strongly agree
My business's ability to perform circular economy initiatives depends on the ability to establish formal agreements with trade partners.	Strongly disagree 1 2 3 4 5 Strongly agree
The costs, information, time, and effort required in coordinating circular practices will define whether or not my business will engage in circular economy initiatives.	Strongly disagree 1 2 3 4 5 Strongly agree
My business will only implement circular practices if its partners guarantee suitable coordination for this.	Strongly disagree 1 2 3 4 5 Strongly agree
My business is willing to introduce the circular economy approach in its operations.	Strongly disagree 1 2 3 4 5 Strongly agree
My business intends to carry out activities that introduce the circular economy approach in its operations.	Strongly disagree 1 2 3 4 5 Strongly agree
My business will make an effort to keep a circular economy approach in its operations.	Strongly disagree 1 2 3 4 5 Strongly agree

Source: Authors' own representation.

Appendix C. Confirmatory factor analysis
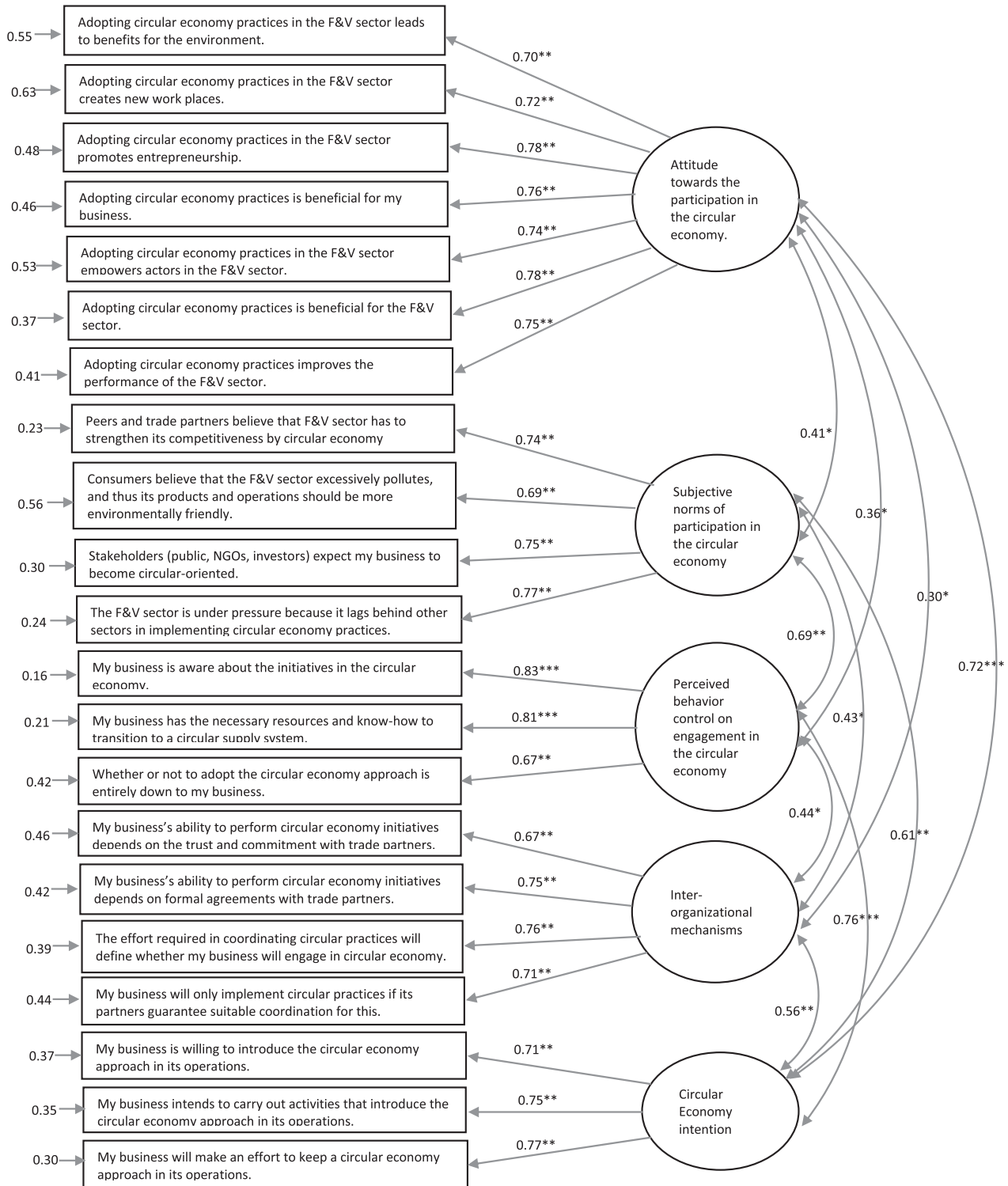
Fit indices: χ2 = 288.7; df = 237; p < 0.001; RMSEA = 0.045, CFI =0.94; NFI = 0.92.

Note. A circle and rectangle means latent and observed variables. A single-headed arrow reflects respondents' differences. The bi-directional arrow means correlation. A small arrow on the far-left side is the corresponding error. *, **, *** denote coefficients significant at 0.1, 0.05 and 0.01 level.

Source: Authors' own representation.

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