

Exploring the Relationship Between Circular Economy Entrepreneurship and Sustainable Entrepreneurial Intention: The Theory of Planned Behaviour Approach

Hoang Thi Huong¹, Tran Cuong^{1*}, Dinh Hoang Minh^{1,2}

¹Faculty of Management, School of Economics, Hanoi University of Industry, Hanoi, Vietnam, ²School of Management, Nanjing University of Posts and Telecommunications, Nanjing, China. *Corresponding Author's Email: cuongt@hau.edu.vn

Abstract

Sustainable entrepreneurship aligned with the circular economy has recently attracted increasing attention from scholars and policymakers due to its potential contribution to long-term environmental and socio-economic development. However, empirical research examining the mechanisms through which circular economy entrepreneurship influences sustainable entrepreneurial intention remains limited, particularly in emerging economies. This study investigates the relationship between circular economy entrepreneurship (CEE) and sustainable entrepreneurial intention (SEI) by employing a mediating framework grounded in the Theory of Planned Behaviour (TPB). Specifically, the study examines the mediating roles of attitudes toward sustainable entrepreneurship (ATSE) and perceived behavioral control (PBC), while also considering the influence of subjective norms (SN). Data were collected from 701 university students from major higher education institutions in Hanoi, Vietnam and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings reveal that CEE positively influences SEI both directly ($\beta = 0.227$, $t = 6.310$, $p < 0.001$) and indirectly through ATSE ($\beta = 0.104$, $t = 3.870$, $p < 0.001$) and PBC ($\beta = 0.191$, $t = 8.063$, $p < 0.001$). In addition, subjective norms (SN) significantly affect both CEE ($\beta = 0.542$, $t = 18.909$, $p < 0.001$) and SEI ($\beta = 0.142$, $t = 4.697$, $p < 0.001$), highlighting the importance of social influence in shaping entrepreneurial orientation toward sustainability. The study contributes to the TPB literature by extending its application to the circular economy and sustainable entrepreneurship context. Furthermore, it offers important empirical evidence and practical implications for educators, policymakers and universities seeking to promote sustainable entrepreneurial ecosystems in Vietnam and other emerging economies.

Keywords: Attitudes Toward Sustainable Entrepreneurship, Circular Economic Entrepreneurship, Sustainable Entrepreneurial Intention, Theory of Planned Behaviour.

Introduction

In the word of resource depletion and economic downturns, nations worldwide have prioritized Sustainable Development Goals (SDGs) as a central strategy for economic growth (1). Sustainable development has been a critical topic of discussion among scholars and policymakers at international conferences (2). Indeed, national development objectives have expanded beyond merely maximizing profits to include environmental concerns, social equality and the sustainable use of renewable resources. Achieving these goals requires coordinated efforts from multiple stakeholders, including governments (3), entrepreneurs (4) and society at large (5). Among these stakeholders, scholars argue that potential entrepreneurs play an important role in advancing sustainable development. Businessman continuously seek to create innovative services and green

products that meet the rising require for sustainable consumption while generating profit. Moreover, they contribute significantly to workforce development and social equity (6, 7). However, achieving SDGs remains challenging due to several factors, including inadequate infrastructure (8), weak legal frameworks (9) and a shortage of highly skilled labour with sustainability expertise (10). To address these challenges, the circular economy (CE) model has appeared as an effective solution to optimizing resource management (11). Within the entrepreneurial landscape, the CE model has proven particularly relevant, as entrepreneurs integrate the principles of reduce-reuse-recycle into their business models (6). Recently, researchers have explored how potential entrepreneurs adopt CE principles to strike a balance between profitability,

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environmental sustainability and social responsibility. As a result, the concept of circular economy entrepreneurship (CEE) has emerged, which refers to how entrepreneurs identify and seize business prospects within the circular economy principles (12). Despite its increasing importance, the relationship between entrepreneurship, the circular economy and sustainability remains insufficiently explored. Notably, existing research provides limited insights into entrepreneurial behaviour under these conditions. Various studies have explored CEE from different perspectives. For instance, some studies examined CEE from a corporate standpoint, highlighting its role in enhancing corporate social responsibility, sustainable supply chain management and the sustainability of SMEs (4, 6, 12). From an educational perspective, some research emphasized the significant of education in encouraging students to engage in CE-based entrepreneurship in Europe (13, 14). These studies also identified challenges faced by educational institutions in implementing circular entrepreneurship education programs. From a start-up perspective, some scholars provided a solid theoretical foundation for CEE, defining its key aspects, opportunities and challenges, particularly in emerging markets (15-17). These studies confirmed that CE-based entrepreneurship is an inevitable trend, driven by increasing societal, consumer and governmental expectations.

However, despite these valuable insights, existing research has not directly addressed the influence of CEE in shaping sustainable entrepreneurial intentions (SEI), particularly among aspiring entrepreneurs. While previous studies have acknowledged the growing significance of CEE, they have primarily focused on organizational and education factors rather than individual entrepreneurial decision-making. This gap is particularly crucial because understanding the psychological and behavioral mechanisms that link CEE to entrepreneurial intention can provide deeper insights into how sustainability-driven entrepreneurship emerges and evolves. Addressing this gap is essential for both theory and practice. From the results, we can provide insight to stakeholders and entrepreneurs related to the conditions necessary to boots a thriving CE-driven entrepreneurial network. Therefore, our research seeks to bridge this critical gap by exploring the

way that CEE impacts SEI through key mediating factors, offering a novel perspective on the intersection of CE principles and entrepreneurial decision-making.

To bridge this gap, the present study tries to explore the link between CEE and SEI via a mediating mechanism, employing the Theory of Planned Behaviour (TPB). This approach offers a strong theoretical basis for examining the relationship, which has not been explored in previous studies. TPB is particularly well-suited for this research because entrepreneurship is a complex, strategic process that requires careful planning and consideration (18). TPB explains how individuals form intentions and behaviours based on a thoughtful evaluation of potential benefits and drawbacks before making decisions. Furthermore, prior studies on green and sustainable entrepreneurship have successfully utilized TPB (19, 20). By applying this theoretical lens, the study will shed further light on how potential entrepreneurs navigate the intersection of entrepreneurship, the circular economy and sustainability.

The TPB theory is widely used to explain human behaviour and decision-making processes. In the setting of entrepreneurship, the TPB is considered to provide a good explanation for the sustainable behaviours of potential entrepreneurs. Several research has used the TPB framework to investigate the start-up process among students in sustainable context (21-23). Therefore, from the perspective of this study, TPB offers a clear pathway for understanding how CEE shapes SEI. By considering the mediating mechanism of perceived behavioural control, subjective norms and attitudes, this study offers a broader view of how entrepreneurs' cognitive and social perceptions impact their intentions to engage in CE-based business ventures. By applying TPB, the research underscores the psychological mechanisms that lead from understanding of CE model to the intention to pursue sustainable entrepreneurship, addressing a significant gap in the literature (22). This theoretical framework also offers valuable insights for designing policies and educational programs that encourage sustainable entrepreneurship by addressing these key psychological factors.

Within the framework of the TPB, foundational factors related to cognition, values and

behavioural orientations are regarded as antecedents that shape three factors of TPB, which in turn lead to intention. In this study, circular economy entrepreneurship is conceptualized as an entrepreneurial orientation at the individual level, reflecting the extent to which individuals proactively identify opportunities, seek innovative solutions, collaborate and share knowledge related to the circular economy. Accordingly, CEE represents a set of directional pre-entrepreneurial orientations and behaviours that form the cognitive and social foundation for the core components of the TPB.

Methodology

Research Context

In response to the challenges of resource depletion, environmental pollution and the growing demand for sustainable development, many countries in Southeast Asia have promoted policies supporting innovation, green growth and the transition toward a circular economy. In Vietnam, the government has demonstrated a strong commitment by integrating circular economy principles into national development strategies (24). Decree No. 08/2022/ND-CP was issued to establish the criteria, implementation principles and incentive mechanisms for circular economy development. In addition, Vietnam has actively fostered its entrepreneurial ecosystem through initiatives such as Project 844 under Decision No. 844/QD-TTg, which aims to support the national innovation startup ecosystem, as well as startup incubators, entrepreneurship training programs and financial support networks for innovative ventures. These policies not only create favorable conditions for entrepreneurial activities but also encourage younger generations to pursue innovative business models that are environmentally and socially responsible.

However, the implementation of these policies remains relatively ineffective in practice. Vietnam has yet to develop a sufficiently strong entrepreneurial ecosystem to fully support sustainability-oriented ventures (25). Sustainable business ideas and innovations often face difficulties in accessing financial resources, as financial institutions frequently perceive them as high-risk investments. When external support mechanisms remain uncertain, entrepreneurial activities must increasingly rely on individual

initiative and proactive opportunity exploration, particularly in emerging areas such as the circular economy where sustainability considerations are becoming increasingly important. Therefore, examining sustainable entrepreneurial intention among university students in Vietnam is particularly important for understanding how future entrepreneurs respond to the transition toward a circular economy in emerging Southeast Asian economies.

Literature Review and Hypotheses

Development

In this study, circular economy entrepreneurship (CEE) is conceptualized as an individual-level entrepreneurial orientation toward circular economy principles. It reflects an individual's tendency to identify and exploit business opportunities, seek innovative solutions, collaborate with relevant stakeholders and create economic, environmental and social value through circular economy practices (6). Rather than solely pursuing profit, they strive to balance three key aspects: economic, environmental and social value. Therefore, circular economy entrepreneurship serves as an effective approach to optimizing the use of limited resources while minimizing negative environmental impacts (12). Entrepreneurs with strong CEE tendencies are more likely to align their business strategies with CE principles, simultaneously driving profitability and fulfilling their social responsibilities (15).

Entrepreneurship based on circular economy principles requires a multidimensional approach, as this model not only involves complex production processes and resource management but also operates in a context where government support remains limited (13, 14). Moreover, CE demands that entrepreneurs integrate social and environmental responsibility into their business practices, rather than focusing solely on economic profits. This necessitates a deep understanding, creativity and a willingness to take risks to capitalize on favorable conditions in the developing sustainable market. Previous studies have highlighted those traditional businesses face significant challenges in transitioning to a CE model due to limitations in awareness and financial capacity (15, 16). Therefore, start-up entrepreneurs, who tend to be more innovative and adaptable, are expected to serve as a crucial

function in implementing and promoting CE models in practice.

Although previous study has recognized the function of CE in fostering sustainable entrepreneurship, the specific link between CEE and SEI has not yet been systematically investigated. However, we find that individuals with a strong understanding of the CE models are more likely to develop SEI. Thus, this research focus on fills the theoretical gap by clarifying the influence of CEE on SEI and providing empirical evidence for this relationship in the start-up business landscape.

H1: CEE positively influences SEI.

The review process reveals a limitation in research evaluating the role of CEE in promoting sustainable entrepreneurship, particularly through an intermediary model like the TPB. However, several studies have shown that (ATSE) and PBC serve as effective mediating effects between input factors and sustainable entrepreneurial behaviour.

For example, the study demonstrated that altruism, Earlier studies indicate that students tend to develop stronger start-up intentions when entrepreneurship-related learning activities enhance their confidence and behavioural perceptions within the TPB framework (21). This mediation mechanism was also explored, which found that personal values, including self-enhancement and self-transcending values, promoted sustainable entrepreneurial intentions and behaviours (19). Although previous studies have examined how personal values influence sustainable entrepreneurial intention, they have not addressed environmental factors nor situated entrepreneurial intention in circular economy settings.

In addition to the above studies, a scholar provides important empirical evidence (22). Earlier work drew upon TPB together with the Value-Belief-Norm framework to explain how behavioural drivers influence sustainability-oriented actions. The study further highlighted that knowledge related to circular economy concepts positively shaped environmentally conscious behaviour. However, this research has so far only been examined at the perceptual level. Such a limitation may constrain the external validity of behaviour-related conclusions associated with CE practices. Our study extends the contribution by examining circular economic entrepreneurship not only in

terms of perception, but also in that individual continuously seek opportunities and share and exchange knowledge about the circular economy. Similarly, other study, another study conducted in Indonesia employed the TPB framework to examine how students' understanding of CE principles influenced their behaviour. The findings revealed that participants demonstrated relatively strong familiarity with circular economy concepts, but this did not translate into behaviour (26). Specifically, students tended to buy new items rather than recycle or repair them. These results imply that current understanding of CE-related behavioural patterns remains limited. Additionally, the framework omitted important behavioural and socially influenced cognitive factors commonly discussed in TPB research (26).

The literature generally supports the indirect contribution of ATSE and PBC to the formation of sustainable venture intention. However, empirical discussion surrounding CEE remains relatively limited. Furthermore, while some studies have assessed the role of CE awareness in relation to behaviour, these studies did not fully consider aspects of behavior in the circular economy context. Additionally, the use of TPB in research models and the contradictory results from above studies point to a significant research gap that needs to be addressed to clarify how CEE shapes sustainability-oriented entrepreneurial actions (26). Accordingly, the following hypotheses are developed:

H2: CEE has a positive impact on ATSE

H3: CEE has a positive impact on PBC

This construct reflects perceived support and approval from influential people within one's social circle and support those individuals perceive from important others such as family members, friends and close peers regarding entrepreneurial decisions. Circular economy entrepreneurship commonly takes place in rapidly evolving environments that demand ongoing learning and behavioural adjustment from entrepreneurs, innovate and support from the social environment plays a particularly important role in reducing perceived risk and strengthening motivation to act (27). When individuals perceive approval and encouragement from influential referent groups, they are more likely to proactively identify circular economy opportunities, experiment with sustainable entrepreneurial ideas and engage in activities

involving the sharing and exchange of knowledge related to the circular economy. According to some studies, SN have profound impact on personal's confident in entrepreneurship context (28). Based on this reasoning, we propose the following hypothesis.

H4: SN has a positive impact on CEE

Recently, researchers have increasingly emphasized the importance of sustainability-related behavioural perceptions in shaping entrepreneurial motivation. According to TPB-related evidence, favourable behavioural evaluation is closely associated with both venture creation intention and entrepreneurial action (18, 29).

This indicates that attitude is a strong predictor of individuals' future entrepreneurial intentions and actions (30, 31). Quantitative evidence suggests that students who positively evaluate sustainability-focused entrepreneurship tend to exhibit stronger intention toward future venture creation (19). In detail, students who hold strong beliefs and positive attitudes toward environmental protection, green behaviour and sustainability tend to view sustainable business creation as a potential career path upon graduation. Similarly, with the literature review approach, study revealed that sustainable entrepreneurial intentions and behaviours are strongly influenced by an entrepreneur's attitude toward social responsibility (7). Consequently, profit is no longer the sole priority, as sustainable values increasingly shape entrepreneurial decision-making. This reinforces the argument that attitudes shape the values individuals prioritize. A strong commitment to sustainability may encourage individuals to pursue entrepreneurial pathways that reflect their personal principles (32). These arguments suggest that sustainability-oriented individuals tend to pursue environmentally responsible business activities.

H5: ATSE has a positive impact on SEI.

When social support sustain entrepreneurship, the person is likely to develop an entrepreneurial intention in this direction to align with societal expectations (33). Furthermore, according to the Institutional Theory, social norms can create group

conformity and establish common behavioural trends within a community, especially in the context of an increasing emphasis on sustainable development (34). Additionally, sustainable entrepreneurial intentions can be shaped through favourable conditions, family support and societal encouragement (35, 36). As a result, potential entrepreneurs who learn and develop in an environment that values sustainability frequently consider environmentally responsible venture creation. Thus, the increasing emphasis on environmental and social responsibility has strengthened the influence of socially driven expectations on sustainability-focused entrepreneurial intention, where social and environmental responsibility is increasingly emphasized.

H6: SN has a positively impact on SEI.

According to the TPB, PBC supports the development of entrepreneurial willingness and subsequent business-related behaviour. People who perceive higher levels of personal capability and resource availability are generally more inclined toward sustainability-driven entrepreneurial engagement (20, 37). Past study shows that students demonstrating strong perceived control tend to experience fewer barriers when engaging in green business activities (19), therefore reinforcing sustainability-focused entrepreneurial motivation. A possible reason is that they possess stronger confidence regarding their capability to mobilize financial resources, manage risks and adapt to environmental requirements in business. Similarly, other study demonstrated that entrepreneurs with experience in sustainable development projects tend to have higher perceived control over their behaviour, which in turn enhances their motivation to pursue environmentally friendly business initiatives (38). In summary, PBC is not only a crucial factor influencing sustainable entrepreneurial intentions but also acts as a mediating mechanism that helps individuals overcome obstacles and strengthen their confidence in implementing business models that are environmentally and socially responsible.

H7: PBC has a positive impact on SEI.

Figure 1 provides an overview of the analytical framework.

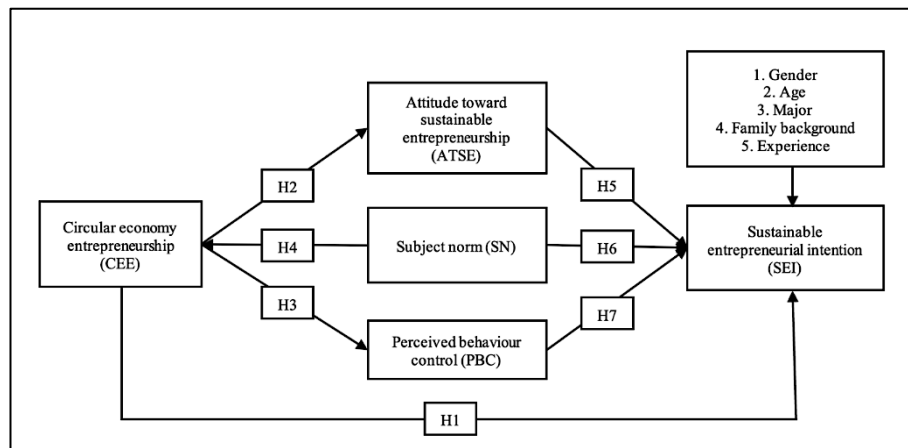


Figure 1: Impact of CEE on SEI via TPB

Data Collection and Sampling

Participants in this study consisted of university students studying in Hanoi, Vietnam (GPS code: 21.0285° N, 105.8048° E). The use of students as a sample to test the hypotheses is based on several reasons. Earlier studies often emphasize the entrepreneurial potential associated with undergraduate students, as they are highly proactive and willing to face challenges (39), particularly in the context of sustainable development, where societal expectations are continuously rising. Second, students represent a large population, which is suitable for the limited resources of the research team.

The study employed a stratified convenience sampling approach. First, seven universities in Hanoi were selected based on the VNUR rankings to ensure representation across institutions with different levels of academic reputation and educational quality (40). Detailed information on the seven selected universities is presented in Table 1 below. Subsequently, respondents within each selected university were recruited using convenience sampling based on accessibility and

willingness to participate. The study adopted an equal allocation approach, with 200 questionnaires per university rather than proportional allocation based on the student population size of each institution. Therefore, the expected total sample size was 1,400 responses. In the survey, the author declared the objectives of the study and explained several important terms. All participants were informed that survey completion was optional and that the resulting data would only support research activities.

The empirical survey was implemented during the period of October 2024 - October 2025. After finalizing the collection procedure, the author obtained 914 survey forms (a response rate of 65.3%). Prior to analysis, the collected questionnaires were screened to identify careless responses. Surveys exhibiting straight-lining patterns like repeatedly selecting the same scale point across items or implausible response patterns indicating a lack of respondent attention were removed. Following this data-filtering procedure, 701 valid questionnaires were retained for analysis.

Table 1: Information of Selected Universities Based on VNUR Rankings

University	National Rank	Institutional Type	Main Academic Orientation
Vietnam National University, Hanoi	1	Public University	Multidisciplinary education and research
Hanoi University of Science and Technology	4	Public University	Engineering, technology and applied sciences
Hanoi National University of Education	7	Public University	Teacher education, education sciences and social sciences
Thuongmai University	8	Public University	Business, commerce, management and economics
Thuyloi University	13	Public University	Engineering, water resources, environment and infrastructure

National Economics University	16	Public University	Economics, business, management and entrepreneurship
Hanoi University of Industry	19	Public University	Applied engineering, technology

Scales Development

The measurement items used in this study were derived from existing literature to ensure acceptable reliability and validity. Specifically, the 'Circular Economy Entrepreneurship' scale, which consists of five items (12). A set of six statements was used to evaluate Attitude toward Sustainable Entrepreneurship (41). The 'Perceived Behavioral Control' scale, consisting of six items (42). The "Subjective norm" scale, which consists of three items (43). To measure SEI, the study applied six questionnaire items derived from earlier research (42).

The questionnaire applied a five-category response structure for all observed variables. Considerable attention was given to wording refinement to make the statements understandable for respondents. In addition, the measurement items originated from prior empirical literature where acceptable reliability and validity had already been reported.

Since the original questionnaire was developed in English, the measurement items were translated into Vietnamese with support from two linguistic specialists. After completing separate translation versions, both experts reviewed and refined the wording to produce a unified Vietnamese questionnaire.

Prior to the official survey, a pilot test was carried out with a small group of respondents. Participant feedback was used to revise unclear expressions and improve item comprehension. This preliminary stage also helped evaluate the suitability of the measurement items before the large-scale data collection process.

Data Analysis

In this research SmartPLS 4 was selected for data analysis. PLS-SEM was selected instead of covariance-based SEM (CB-SEM) for several recommendation (44). First, the study is primarily prediction-oriented, aiming to explain and predict sustainable entrepreneurial intention from circular economy entrepreneurship and TPB-related factors. Second, the proposed model incorporates multiple latent constructs and mediation relationships, making PLS-SEM

particularly suitable for handling relatively complex structural models.

Third, PLS-SEM is less restrictive regarding multivariate normality assumptions and is appropriate for survey data measured using Likert-type scales. Therefore, PLS-SEM was considered the most appropriate analytical technique for the objectives of this study.

Before evaluating the structural relationships, the study first examined the adequacy of the measurement model. Item reliability was assessed using standardized loading estimates to determine whether the observed indicators sufficiently represented the corresponding latent variables (44). Reliability evaluation focused on the internal consistency of the measurement constructs using established SEM criteria. The resulting estimates met commonly accepted methodological recommendations. Furthermore, the analysis confirmed adequate convergence among indicators representing the same construct. To ensure that the latent variables were empirically distinguishable, comparisons were made between inter-construct associations and the variance retained within each construct. The findings supported satisfactory discriminant properties for all constructs in the model (45).

Model prediction accuracy was evaluated through the coefficient of determination, which reflects the proportion of variance explained by the predictor constructs. To further examine the relative importance of each structural path, effect size statistics were also estimated. The resulting values were interpreted according to established recommendations in SEM-related methodological literature.

CMB Testing

Several preventive approaches were employed to reduce the likelihood of method-related bias in the survey responses. During questionnaire administration, respondents received assurance regarding response privacy and confidentiality to minimize socially desirable answering tendencies. Furthermore, a statistical examination based on factor extraction techniques was conducted after data collection. The analysis revealed that the variance explained by the dominant factor

remained at an acceptable level, suggesting that method bias did not substantially affect the empirical findings.

Results

Demographic Characteristics

The descriptive statistics from Table 2 indicate that the sample is relatively balanced and appropriate for research on entrepreneurship in a university context. The sample included a slightly higher proportion of women than men, accounting for 54.6 percent and 45.4 percent, respectively. Regarding age, the 21 to 23 age group represents the largest proportion of the sample, comprising nearly half of the respondents, followed by those

aged above 23, suggesting that the sample mainly consists of final year students and recent graduates. With respect to academic major, most respondents are enrolled in business management, followed by economics, indicating a strong alignment with the entrepreneurial focus of the study. Approximately one third of the respondent report having a family business background, while most do not. Similarly, only a minority report prior entrepreneurial experience, suggesting that the sample largely reflects individuals at the pre-entrepreneurial stage. This respondent profile fits the analytical direction of the study concerning entrepreneurial tendencies and intention formation.

Table 2: Demographic Characteristics (N = 701)

Variables	Item	Frequency	Percentage (%)
Gender	Male	318	45.4
	Female	383	54.6
Age	18 to 20	63	9.0
	21 to 23	347	49.5
	Above 23	291	41.5
Major	Economics	177	25.2
	Business management	412	58.8
	Other	112	16.0
Family business background	Yes	236	33.7
	No	465	66.3
Entrepreneurial experience	Yes	168	24.0
	No	533	76.0

Reliability and Converge Validity

The findings reported in Table 3 support the adequacy of the measurement model for all latent constructs. Outer loading and cross-loading from Supplementary Table 1 (Appendix) estimates remained above the commonly accepted benchmark, suggesting that the observed variables

appropriately reflected their corresponding constructs. Reliability evaluation further produced satisfactory internal consistency estimates across all dimensions included in the model. Moreover, the variance captured by each construct exceeded the recommended methodological level, supporting acceptable convergence among the indicators.

Table 3: Reliability and Converge Validity

Variables	Items	Outer Loadings	Cronbach's Alpha	C.R	AVE
Attitudes Toward Sustainable Entrepreneurship (ATSE)	ATSE1	0.882	0.921	0.923	0.717
	ATSE2	0.854			
	ATSE3	0.848			
	ATSE4	0.830			
	ATSE5	0.864			
	ATSE6	0.799			
Sustainable Entrepreneurial Intention (SEI)	SEI1	0.840	0.921	0.922	0.717
	SEI2	0.821			
	SEI3	0.879			
	SEI4	0.809			
	SEI5	0.860			
	SEI6	0.868			
Subjective Norm (SN)	SN1	0.901	0.847	0.851	0.766

	SN2	0.867			
	SN3	0.857			
Perceived Behaviour Control (PBC)	PBC1	0.795	0.905	0.908	0.678
	PBC2	0.791			
	PBC3	0.823			
	PBC4	0.839			
	PBC5	0.810			
	PBC6	0.879			
Circular Economy Entrepreneurship (CEE)	CEE1	0.838	0.888	0.892	0.691
	CEE2	0.790			
	CEE3	0.831			
	CEE4	0.806			
	CEE5	0.888			

Note: AVE = Average Variance Extracted, C.R = Composite Reliability.

Discriminant Validity

Regarding to evidence from Table 4, the HTMT analysis demonstrates satisfactory construct distinctiveness across the proposed framework. The estimated HTMT coefficients did not exceed

the methodological reference level, indicating limited conceptual redundancy among the latent dimensions. Consequently, the measurement structure was considered appropriate for the next stage of structural assessment.

Table 4: HTMT Assessment

Structure	ATSE	CEE	PBC	SEI	SN
ATSE					
CEE	0.685				
PBC	0.730	0.643			
SEI	0.670	0.681	0.725		
SN	0.602	0.622	0.618	0.623	

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention, SN = Subjective Norm.

Assessment of Multicollinearity

As show in Table 5, the analysis further examined potential collinearity among the explanatory constructs. Since all VIF estimates remained within

acceptable methodological limits, the structural relationships were considered free from serious collinearity concerns. Therefore, multicollinearity is not a concern and the estimated path coefficients can be interpreted reliably.

Table 5: Assessment of Multicollinearity

Structure	ATSE	CEE	PBC	SEI	SN
ATSE				2.188	
CEE	1.000		1.000	1.894	
PBC				2.067	
SEI					
SN		1.000		1.638	

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention, SN = Subjective Norm.

R Square and R Square Adjusted Testing

Variance explanation estimates reported in Table 6 demonstrate that the proposed framework possesses satisfactory predictive performance. The structural relationships accounted for a substantial proportion of variability in ATSE and

PBC, suggesting that CEE meaningfully contributes to these TPB-related dimensions. In addition, SN showed acceptable predictive contribution toward CEE. The strongest predictive outcome emerged for SEI, where the framework captured more than half of the observed variability. The limited difference between the original and adjusted coefficients further supports model stability.

Table 6: R Square and R Square Adjusted

Structure	R-square	R-square adjusted
ATSE	0.388	0.387
CEE	0.293	0.292
PBC	0.335	0.334
SEI	0.554	0.552

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention.

F Square Testing

The obtained effect size reported from Table 7 estimates reflect both modest and substantial contributions among the explanatory constructs. Specifically, CEE has a large effect on ATSE ($f^2 = 0.633$) and PBC ($f^2 = 0.503$), while its effect on SEI is small ($f^2 = 0.067$). SN shows a medium effect on

CEE ($f^2 = 0.415$) and a small effect on SEI ($f^2 = 0.033$). In addition, ATSE ($f^2 = 0.028$) and PBC ($f^2 = 0.118$) exhibit small effects on SEI. Overall, the f square results highlight the central role of CEE in explaining variance in the mediating constructs, while the TPB components provide complementary explanatory power for sustainable entrepreneurial intention.

Table 7: F Square

Structure	ATSE	CEE	PBC	SEI	SN
ATSE				0.028	
CEE	0.633		0.503	0.067	
PBC				0.118	
SEI					
SN		0.415		0.033	

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention.

Assessment of Predictive Relevance (Q^2)

The predictive relevance of the model was assessed using the PLSpredict procedure. As shown in Table 8, all Q^2 predict values were greater than zero, indicating that the model possesses predictive relevance for all endogenous constructs. Specifically, CEE ($Q^2 = 0.291$), ATSE ($Q^2 = 0.245$) and PBC ($Q^2 = 0.241$) demonstrate

moderate predictive relevance, whereas SEI ($Q^2 = 0.093$) exhibits a lower but still acceptable level of predictive relevance. Although SEI exhibits a lower Q^2 value than the other constructs, the result remains acceptable because entrepreneurial intention is inherently complex and influenced by numerous contextual factors. This is particularly evident among university students, whose entrepreneurial aspirations may not always translate into actual venture creation.

Table 8: Predictive Relevance Assessment

Construct	Q^2 predict
ATSE	0.245
CEE	0.291
PBC	0.241
SEI	0.093

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention

Goodness-of-Fit Testing

Evaluation of the global model fit statistics indicates satisfactory compatibility between the structural framework and the empirical

observations. As shown in Table 9, both SRMR and NFI estimates satisfied widely accepted SEM recommendations, supporting the suitability of the proposed analytical structure.

Table 9: Goodness-of-Fit

	Saturated model	Estimated model
SRMR	0.034	0.099
d_ULS	0.418	3.455
d_G	0.180	0.249
Chi-square	735.676	923.997
NFI	0.942	0.928

Hypotheses Testing

After implementing the resampling-based estimation procedure and controlling for additional factors, the empirical findings consistently supported all hypothesized paths in the structural framework, as shown in Table 10 and Figure 2.

Specifically, CEE has a positive effect on SEI ($\beta = 0.227$, $t = 6.310$, $p < 0.001$), ATSE ($\beta = 0.623$, $t = 25.216$, $p < 0.001$) and PBC ($\beta = 0.578$, $t = 21.901$, $p < 0.001$). In addition, SN positively influences CEE ($\beta = 0.542$, $t = 18.909$, $p < 0.001$).

The TPB components ATSE ($\beta = 0.170$, $t = 4.470$, $p < 0.001$), SN ($\beta = 0.142$, $t = 4.697$, $p < 0.001$) and PBC ($\beta = 0.336$, $t = 9.208$, $p < 0.001$) all show significant positive effects on SEI.

Regarding control variables, age, entrepreneurial experience, family business background and gender exhibit significant negative effects on SEI, whereas major shows no significant effect. These results confirm the robustness of the hypothesized relationships after accounting for individual level characteristics.

Table 10: Hypothesis Evaluation

Hypotheses	Path	β	SD	t-value	p-value
H1	CEE $\rightarrow$ SEI	0.227	0.036	6.310	0.000
H2	CEE $\rightarrow$ ATSE	0.623	0.025	25.216	0.000
H3	CEE $\rightarrow$ PBC	0.578	0.026	21.901	0.000
H4	SN $\rightarrow$ CEE	0.542	0.029	18.909	0.000
H5	ATSE $\rightarrow$ SEI	0.170	0.038	4.470	0.000
H6	SN $\rightarrow$ SEI	0.142	0.030	4.697	0.000
H7	PBC $\rightarrow$ SEI	0.336	0.036	9.208	0.000
	Age $\rightarrow$ SEI	-0.117	0.022	5.248	0.000
	EntExp $\rightarrow$ SEI	-0.265	0.055	4.792	0.000
	FamilyBG $\rightarrow$ SEI	-0.260	0.050	5.184	0.000
	Gender $\rightarrow$ SEI	-0.233	0.049	4.807	0.000
	Major $\rightarrow$ SEI	0.032	0.025	1.293	0.196

Note: SD = Standard Deviation.

Mediation link test

Additional analysis of the indirect structural paths revealed meaningful mediation effects within the proposed framework. The result from Table 11 shows that both behavioural evaluation and perceived capability demonstrated important

explanatory functions in connecting CEE with sustainability-oriented entrepreneurial motivation. These results suggest that the influence of circular economy entrepreneurship is not entirely direct but also operates through TPB-related psychological mechanisms.

Table 11: Mediation Link Test

Relationship	β	SD	t-value	p-value
CEE $\rightarrow$ ATSE $\rightarrow$ SEI	0.104	0.027	3.870	0.000
CEE $\rightarrow$ PBC $\rightarrow$ SEI	0.191	0.024	8.063	0.000

Note: SD = Standard Deviation.

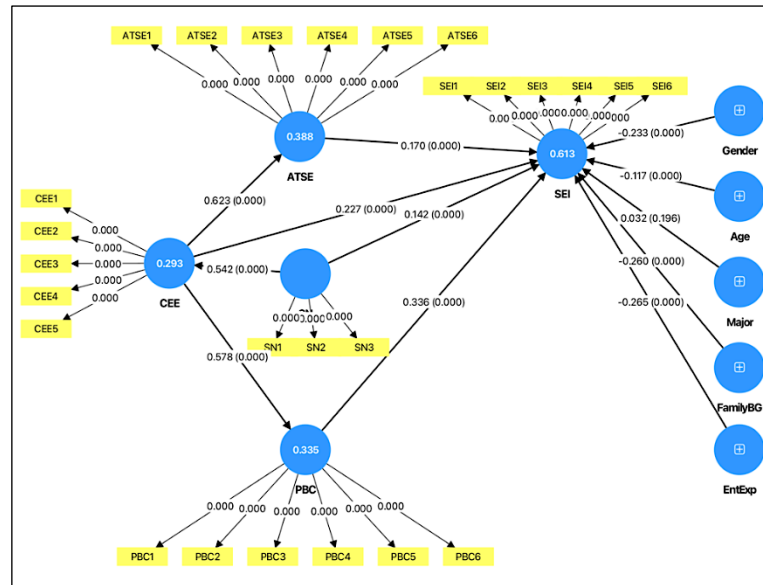


Figure 2: Structural Model

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention, SN = Subjective Norm.

Discussion

The empirical results highlight the importance of circular economy entrepreneurship in shaping sustainability-driven entrepreneurial motivation. By incorporating TPB-related behavioural dimensions, the study provides additional understanding of how sustainability-oriented entrepreneurial intention emerges in CE-related environments.

The first hypothesis, which examines the relationship of CEE and SEI, demonstrates a significant and a favourable association exists between the two variables. The results confirm that individuals exposed to and actively engaging with CE principles are generally more inclined toward green and socially responsible venture creation. This finding is important as it contributes to the existing body of research by demonstrating that CEE, which is focused on sustainability and reducing environmental impacts, acts as an important driver of sustainability-oriented entrepreneurial motivation. The relationship between CEE and SEI supports the idea that entrepreneurs who are knowledgeable about and influenced by circular economy practices show stronger intention toward sustainability-oriented business activities. The study's findings are particularly significant in that they fill a gap in the literature. Prior entrepreneurship research has predominantly emphasized general entrepreneurial motivation, whereas the contribution of CEE to

sustainability-focused entrepreneurial intention remains relatively underexplored. This study highlights that by integrating circular economy principles, individuals not only engage in entrepreneurial activity but do so with a focus on long-term sustainable goals. This result is explored for the first time, but it is partly supported by several research (6, 12).

Empirical evidence supports significant positive associations between SN, CEE and SEI. Specifically, SN exerts a strong influence on CEE, suggesting that support and approval from important others, such as family members, peers and socially important groups may significantly encourage involvement in entrepreneurship-related activities linked to circular economy development. In addition, SN also has a direct effect on sustainable entrepreneurial intention. Perceived support from surrounding social networks may encourage individuals to become more interested in sustainability-focused entrepreneurship. At the same time, SN appears to influence entrepreneurial motivation through both direct behavioural influence and indirect involvement in CE-oriented entrepreneurial engagement.

The research findings show that CEE positively influences PBC, ATSE. PBC and ATSE also positively influence SEI. This suggests that the mediating role of the TPB model effectively explains the relationship of CEE and SEI.

Beyond this direct effect, our results demonstrate that CEE exerts its influence through key TPB

mediators. Specifically, higher CEE was associated with more positive ATSE, favoring sustainable ventures. In practical terms, students who learn about and practice CE principles become more convinced that sustainability is an important goal in business and they perceive greater social support for green entrepreneurship. This is supported by prior findings on circular economy awareness (26).

Additionally, PBC was also elevated by CEE and had the strongest effect on SEI. In other words, students exposed to circular entrepreneurship felt slightly more capable and empowered to pursue sustainable ventures and this self-efficacy strongly predicted their intentions. This pattern is consistent with TPB, when potential entrepreneurs feel confidence they have the skills, resources and autonomy needed for sustainable entrepreneurship, they report much higher SEI. Previous research similarly highlights the central role of PBC or self-efficacy. For instance, study noted that students with high perceived control face fewer barriers in green ventures, boosting their SEI (19).

Several control variables were found to exert meaningful influence on SEI. Specifically, male respondents exhibit higher entrepreneurial intention than females, suggesting differences in risk taking propensity and entrepreneurial motivation across genders (27). Age has a negative effect on SEI, indicating that younger individuals tend to display stronger entrepreneurial intentions. In addition, a stronger tendency toward sustainability-oriented entrepreneurship was observed among participants with entrepreneurial family exposure and prior business-related experience. Such evidence points to the contribution of experiential and environmental factors in shaping entrepreneurial motivation.

Theoretical Implications

The study adds to TPB-based entrepreneurship research by incorporating circular economy considerations into the analytical framework. By incorporating CEE as a new independent variable, we demonstrate that TPB, traditionally applied to general entrepreneurial intentions, which can robustly explain sustainability-driven entrepreneurship intentions. Our data show that CEE initiatives are a key antecedent of the TPB mediators: students' engagement with CE directly enhances attitudes toward green entrepreneur-

ship and perceived normative support, thereby indirectly shaping SEI. This suggests that TPB's explanatory power is strengthened by accounting for CE-related inputs.

Second, the study is among the first to empirically validate the CEE–SEI relationship. Prior literature on CE entrepreneurship was largely theoretical or focused on firms. By surveying students, we pioneer evidence that CE orientation can motivate the next generation of sustainable entrepreneurs. This fills a gap identified by recent reviews and scientometric analyses namely, a lack of micro-level, behavioral studies on circular entrepreneurship.

Third, by confirming the mediating roles from ATSE and PBC, we clarify the psychological pathways from CE engagement to entrepreneurial action. These mediating results underscore that CEE influences intention not just directly but through cognition and social context, offering a more nuanced TPB model for sustainable entrepreneurship. In sum, our work bridges research on the circular economy with the rich TPB literature on entrepreneurship, showing that sustainability-oriented entrepreneurial cognition is shaped by exposure to CE principles.

Practical Implications

The empirical evidence offers several useful considerations for those aiming to strengthen sustainable entrepreneurship through policy, education and business support initiatives.

Firstly, design targeted incentives and policies to promote circular entrepreneurship. For example, subsidies, tax breaks or grants for start-ups that adopt CE practices can lower entry barriers and strengthen entrepreneurs perceived behavioural control. Research suggests that such subsidies and policy incentives act as enabling conditions that enhance the impact of CE entrepreneurship on sustainability outcomes. Governments might also incorporate circular economy criteria into public procurement, award eco-innovation prizes, or fund CE incubators. These measures would signal societal approval for green ventures and provide resources/knowledge, thus stimulating more students and nascent entrepreneurs to pursue sustainable start-ups.

Secondly, integrate circular economy and sustainability content into entrepreneurship curricula and training. In practice, universities and vocational programs can introduce modules on

circular design, zero-waste business models and life cycle thinking. Incorporating project-based learning (e.g., design challenges on waste reduction) or collaborations with green businesses can make these concepts concrete. Importantly, instruction should also foster sustainability-oriented values and self-efficacy. As one study advises, educational programs must emphasize the importance of personal values in the education of potential entrepreneurs to raise sustainable entrepreneurial intentions. This might involve reflective exercises on environmental ethics, mentorship from eco-entrepreneurs and skill-building workshops in sustainable innovation. By strengthening students' beliefs that they can pursue and should pursue sustainable business ideas, education can substantially raise future SEI. Finally, cultivate an organizational culture and business model grounded in circular principles. Practically, this means designing products and processes according to cradle-to-cradle principles for instance, using recycled or renewable inputs, creating durable products and planning for full lifecycle reuse. Such circular strategies improve resource efficiency and often open new market niches. In fact, sustainable business models attract eco-conscious consumers while enhancing brand value and market positioning. Entrepreneurs should therefore market their green commitments openly (e.g., through eco-labels, sustainability reporting, or storytelling) to harness positive consumer and investor attention. Additionally, forming partnerships or networks (such as CE-focused start-up incubators and industry consortia) can bolster perceived behavioural control by providing technical know-how and collaborative support. In sum, by making circularity a central company value and communicating it externally, entrepreneurs can gain competitive advantage and fulfil consumer demand for sustainable products.

Conclusion

In conclusion, the empirical findings support the behavioural relevance of CEE in the development of sustainability-focused entrepreneurial intention. Within the TPB framework, CE-oriented entrepreneurial engagement appears closely associated with sustainability-related entrepreneurial motivation, demonstrating that exposure

to circular economy principles positively influence attitudes and behavioural self-perception, leading to greater sustainability-related entrepreneurial motivation. By establishing the mediating effects of these factors, the study adds further evidence regarding the formation of sustainability-focused entrepreneurial intention and offers guidance for policy-related decision making, education and business practices aimed at fostering sustainable business ventures.

Limitation and Further Research

Despite offering valuable insights into the relationship between CEE and SEI, this study is not without limitations. First, the research sample was confined to university students in Hanoi, Vietnam, which may limit the generalizability of the findings to other regions, demographic groups, or more experienced entrepreneurs. Future studies should consider a more diverse sample that includes entrepreneurs at different stages of their careers, across various industries and geographical locations, to enhance external validity. Second, the study relied exclusively on self-reported data, which may be subject to social desirability bias or respondents' overestimation of their sustainable intentions. Longitudinal designs or experimental approaches could be employed in future research to track actual entrepreneurial behavior over time. Although our study demonstrates the relationship between CEE and SEI, it does not assess the extent to which intention translates into actual behavior. Future research may examine this interaction to further clarify the entrepreneurial process in the context of the circular economy. Another limitation is that the study focused on university students and examined entrepreneurial intention rather than actual entrepreneurial behavior. Since entrepreneurial intentions do not always translate into venture creation, future studies should investigate actual entrepreneurs or startup.

Abbreviations

PLS-SEM: Partial Least Squares Structural Equation Modeling, SEM: Structural Equation Modeling.

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Author Contributions

Hoang Thi Huong: Conceptualization, Research Design, Data Analysis, Data Collection, Manuscript Drafting, Tran Cuong: Data Collection, Questionnaire Development, Preliminary Data Processing, Dinh Hoang Minh: Literature Review, Hypothesis Development, Interpretation of Results. All authors read, revised and approved the final version of the manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest related to the publication of this manuscript.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Artificial Intelligence (AI) Assistance Process

Generative AI and AI-assisted technologies were employed to enhance the clarity, grammar and readability of the manuscript. The authors carefully reviewed, edited and verified all content generated with these tools and they take full academic responsibility for the integrity and originality of the work

Ethics Approval

The study followed ethical research standards and participation by students was voluntary. All respondents were informed about the purpose of the research and confidentiality was ensured.

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Appendix

Supplementary Table 1: Cross-Loading

	ATSE	CEE	PBC	SEI	SN
ATSE1	0.882	0.560	0.608	0.547	0.479
ATSE2	0.854	0.556	0.585	0.537	0.471
ATSE3	0.848	0.537	0.563	0.512	0.452
ATSE4	0.830	0.508	0.537	0.505	0.423
ATSE5	0.864	0.523	0.575	0.552	0.446
ATSE6	0.799	0.474	0.521	0.483	0.434
CEE1	0.552	0.838	0.473	0.524	0.473
CEE2	0.471	0.790	0.453	0.484	0.428
CEE3	0.508	0.831	0.466	0.495	0.430
CEE4	0.464	0.806	0.465	0.498	0.421
CEE5	0.581	0.888	0.541	0.558	0.493
PBC1	0.519	0.453	0.795	0.512	0.455
PBC2	0.495	0.437	0.791	0.504	0.398
PBC3	0.558	0.489	0.823	0.539	0.484
PBC4	0.583	0.479	0.839	0.560	0.396
PBC5	0.535	0.466	0.810	0.544	0.464
PBC6	0.603	0.528	0.879	0.610	0.482
SEI1	0.526	0.513	0.550	0.840	0.451
SEI2	0.479	0.534	0.550	0.821	0.447
SEI3	0.558	0.541	0.597	0.879	0.518
SEI4	0.507	0.483	0.540	0.809	0.415
SEI5	0.509	0.515	0.557	0.860	0.472
SEI6	0.555	0.543	0.573	0.868	0.497
SN1	0.499	0.493	0.515	0.525	0.901
SN2	0.453	0.483	0.462	0.476	0.867
SN3	0.445	0.443	0.444	0.446	0.857

Note: ATSE = Attitudes Toward Sustainable Entrepreneurship, CEE = Circular Economy Entrepreneurship, PBC = Perceived Behaviour Control, SEI = Sustainable Entrepreneurial Intention, SN = Subjective Norm.