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Group norms and policy norms trigger different autonomous motivations for Chinese investors in cryptocurrency investment

Yongzhi Gong¹, Xiaofei Tang¹ & En-Chung Chang²✉

Cryptocurrency has become a hot area of global investment. Despite the increasing regulation of cryptocurrencies, some investors are still obsessed with investing in cryptocurrencies, and the reasons behind this are worth exploring. Emerging studies from a cryptocurrency behavioural perspective demonstrate that investments in cryptocurrency are influenced by a variety of factors, but ignore the objective factor of the political environment. Based on social norms theory, this article explores the impact of group norms and policy norms on Chinese investors' autonomous motivation to invest in cryptocurrencies. This article adopts a questionnaire and investigates 727 Chinese investors. Research has found that: (1) Cryptocurrency investment is influenced by group norms and policy norms, and autonomous motivation serves as a mediator in the process. Group norms promote autonomous motivation among investors, thereby increasing cryptocurrency investment. Conversely, policy norms inhibit investors' autonomous motivation and reduce cryptocurrency investment. (2) Cryptocurrency knowledge plays a moderating role between social norms and autonomous motivation. The moderating effects of investors' subjective and objective knowledge of cryptocurrency in the model have no significant differences, showing a consistent suppressing effect on autonomous motivation. The findings suggest governments should focus on both regulations and public opinion. On the one hand, the government needs to strengthen and improve the laws and regulations related to cryptocurrencies. On the other hand, the government also needs to strengthen social supervision and exercise necessary control in the dissemination of cryptocurrency information.

¹School of Business Administration, Southwestern University of Finance and Economics, Chengdu, China. ²School of Business, Renmin University of China, Beijing, China. ✉email: ecchang@ruc.edu.cn

Introduction

Since the creation of the first cryptocurrency Bitcoin in 2008, the cryptocurrency market has experienced exponential growth in the past decade. As of May 2023, CoinMarketCap.com, a cryptocurrency tracking website, listed 23,913 cryptocurrencies, with a market cap of 118.78 billion dollars. Due to its uncertain price fluctuations and high expected profits (Blau, 2017), “cryptocurrency” has become one of the most attractive and fascinating buzzwords among speculative investors, and created more investment myths than anyone could have imagined (Xi et al., 2020).

The rapid growth of cryptocurrencies has attracted the attention of the media, individual investors, institutional investors and regulators (Almeida and Gonçalves, 2023), and has become an important and practical topic in the field of academic research (Angerer et al., 2021). Emerging literatures have included investor behaviour in the cryptocurrency market and have shown that user investment in cryptocurrencies is influenced by a variety of factors such as investor sentiment (Anamika et al., 2023; Mattke et al., 2021; Guégan and Renault, 2021; Akyildirim et al., 2021; Drobetz et al., 2019), herding effects (Shrotryia and Kalra, 2022; Yousaf and Yarovaya, 2022; Papadamou et al., 2021; Bouri et al., 2019), social influence (Osakwe et al., 2022; Gupta et al., 2021), financial knowledge (Zhao and Zhang, 2021), perceived behavioural control (Veerasingam and Teoh, 2023; Pham et al., 2021), trust and suspicion (Osakwe et al., 2022; Arli et al., 2021; Gupta et al., 2021; Chouk and Mani, 2019).

There is no doubt that these studies are important to our understanding of the psychological determinants behind cryptocurrency investments. However, the role of the policy environment, an objective factor, in investor behaviour has been overlooked by many studies (Shahzad et al., 2018; Arli et al., 2021; Ooi et al., 2021). Although cryptocurrencies appear to be a viable investment option, many countries around the world have tightened regulatory restrictions on cryptocurrencies due to their potential risks (Dabbous et al., 2022; Albayati et al., 2020; Shahzad et al., 2018), including China. China has required the resolute prevention and control of financial risks, including cracking down on Bitcoin mining and trading, to prevent individual risks from being transmitted to society (China Daily, 2021). Surprisingly, Chinese investors are fearlessly investing in cryptocurrencies despite government regulation, prompting us to investigate Chinese investors’ willingness to invest in cryptocurrencies and, in particular, the motivating factors behind it. Considering both group and policy factors, we investigate the impact of descriptive norms (namely group norms) and injunctive norms (namely policy norms) on cryptocurrency investment based on social norms theory and provide a new insight that investors purchase cryptocurrencies out of autonomous motivation.

We believe that group norms and policy norms will cause conflicting reactions from investors. On one hand, according to the social identity theory (Ashforth and Mael, 1989), group norms set an example for investors and satisfy the need for individual belonging, which triggers an autonomous motivation for investing in cryptocurrencies. On the other hand, based on normative focus theory (Cialdini et al., 1990), policy norms control cryptocurrency behaviour in the form of penalties that increase investors’ perception of risk in cryptocurrencies, thereby inhibiting their autonomous motivation and reducing cryptocurrency investment. In this paper, these two contradictory effects are juxtaposed as the ambivalence hypothesis (Bartikowski et al., 2021). This shows that when investors consider cryptocurrency, they experience psychological conflict among group norms, policy norms, and cryptocurrency investment. We focus on answering two questions: first, what is the mechanism by which social norms influence cryptocurrency investment? The second is whether there is a boundary condition that makes investors change their investments in cryptocurrencies. We tested these research questions on Chinese cryptocurrency users. In the political context where the government has repeatedly banned cryptocurrency, China is still one of the most important cryptocurrency markets in the world (Kaiser et al., 2018). This background provides us with a suitable place for testing the ambivalence hypothesis, as well as strong empirical support. The research model in this paper is shown in Fig. 1.

Literature review and hypotheses

Cryptocurrency investment under social norms. Social norms are spread among group members through communication and represent a behavioural standard widely recognized by members of a certain group in a specific situation (Rimal and Lapinski, 2015; Lapinski and Rimal, 2005), providing reference information for individuals to act or not. According to the content of norms, social norms are distinguished into descriptive and injunctive norms. Descriptive norms are descriptions of behaviours that most people in the social environment are doing, and are an individual’s perception of the behaviour of the majority of the social group; whereas injunctive norms are ways of behaviour that a person should follow, and convey the standards of behaviour that society favours or opposes for a particular behaviour.

As an emerging financial instrument, cryptocurrencies are becoming more and more popular with investors (Khan et al., 2020). News related to cryptocurrency investment has spread wildly on the Internet and investors have gradually formed a specific social group. For cryptocurrency, descriptive norms thus represent to a certain extent the attitudes or atmosphere of social groups that actively invest in cryptocurrency, and thus form group norms. Many people, stimulated by group pressure and a

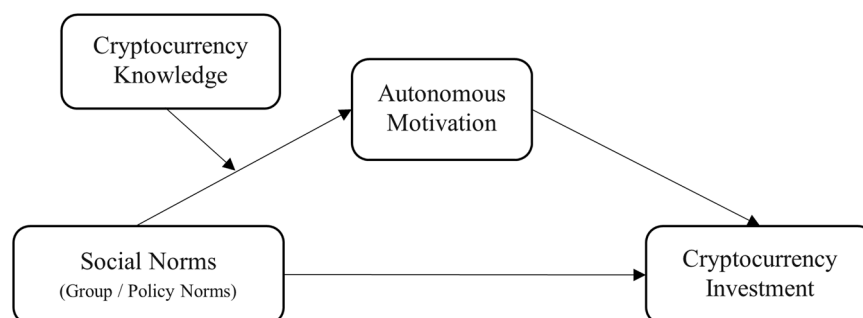


Fig. 1 Conceptual model. The model shows the relationship between the main variables. The arrows indicate the mechanism of influence between the variables.

large amount of public opinions, have also begun to invest in cryptocurrencies. Studies have shown that the peer effect (Van Rooij et al., 2011) or herding behaviour (Bouri et al., 2019; Gurdgiev and O’Loughlin, 2020) in investment will make it easier for people to invest in cryptocurrency. In addition, when people are active users of social media, the opinions of important reference groups will also enhance their confidence in investing in cryptocurrency, becoming their psychological reason for adopting cryptocurrency (Anser et al., 2020). The Bank of Canada’s survey for Bitcoin in 2017 indicated that “a friend around me owns Bitcoin” is one of the main driving forces for users to invest in Bitcoin (Henry et al., 2018). Therefore, group norms may be related to cryptocurrency investment.

In contrast to group norms, it has become the consensus of many governments that the supervision of cryptocurrency must be strengthened. Cryptocurrencies are forbidden in Bangladesh, Bolivia, Ecuador, and Nepal (Bitcoin, 2017). Australia has also recently enacted laws to include cryptocurrency transactions and institutions that facilitate transactions within the scope of money laundering and counter-terrorism financing laws (Breidbach and Tana, 2021). Like other economies, China is also working hard to regulate cryptocurrency to avoid the financial risks and economic shocks it brings, and thus form policy norms. In 2017, within 24 h after China announced the ban on initial coin offering (ICO), the market value of Ethereum (ETH) decreased by 6 billion US dollars, while in the same 24 h, the price of Bitcoin fell by \$200 (Okorie and Lin, 2020). In addition, the trading volume of China’s cryptocurrency exchanges has seen an unprecedented decline (Borri and Shakhnov, 2020). Okorie (2020) showed that the exogenous market pressure of China and other economies banning ICOs has significantly affected the Bitcoin market and changed the structure of the market. The government’s intervention in the cryptocurrency market can significantly change the relationship between the inherent rate of return and the transaction volume in the market, consequently reducing returns (Okorie and Lin, 2020). In summary, we propose the following hypotheses:

H_{1a}: Group norms promote cryptocurrency investment. That is, the positive attitudes and atmosphere of social groups towards cryptocurrency will increase cryptocurrency investment.

H_{1b}: Policy norms inhibit cryptocurrency investment. That is, the government’s regulatory restrictions or policy prohibitions on cryptocurrency will reduce cryptocurrency investment.

The mediating effect of autonomous motivation. Autonomous motivation is the motivation of an individual to engage in a behaviour spontaneously and actively out of self-will and free choice (Ryan and Deci, 2000). When group members buy cryptocurrencies actively, the positive atmosphere sends a “positive signal” to investors, thus creating a “role model” in their minds. Motivated by role models, investors are motivated by intrinsic beliefs to invest on their own and are motivated to buy. At the same time, social groups are an important source of information for investors, and the behaviour of the group plays a non-negligible role in shaping the external environment of investors. Social learning theory suggests that individuals’ environment influences their motivation and behaviour to learn (Bandura, 1978). Proactive groups create a proactive investment environment for investors. Therefore, investors in this environment will be infected and are more likely to want to be like the proactive groups around them, striving to be “winners” in their

investments. Infected investors are then spontaneously motivated to invest, forming autonomous motivation. While in the context of cryptocurrencies, a series of regulatory policies set by the government may lead to a sharp decline in the ex-post returns and a decrease in the value of cryptocurrencies (Okorie and Lin, 2020), which will result in investors not capturing high returns or even losing material wealth. Investors’ exposure to external cues (policy risk and loss of wealth) enhances their self-control to purchase cryptocurrencies, thus inhibiting autonomous motivation (Sudzina et al., 2023).

In addition, research has shown that autonomous motivation is influenced by basic intrinsic needs such as autonomy, competence, and belonging. Among these, the need for autonomy refers to individuals having a sense of autonomous choice in their actions, rather than being controlled by others. The need to belong is defined as a person’s need to stay connected to others and to have a sense of belonging (Ryan and Deci, 2020). Group norms can strengthen an individual’s ties to the “group” and enhance a sense of belonging, and therefore may enhance autonomous motivation. Conversely, policy norms often compel individuals to adopt certain behaviours through rewards or punishments and do not support autonomous choices, thus policy norms usually negatively affect autonomous motivation (Chan et al., 2021; Pelletier and Aitken, 2014). Satisfaction of needs such as autonomy, competence, and belonging facilitate autonomous motivation, and autonomous motivation enhances individuals’ information-seeking (White et al., 2019), leading to greater enjoyment and more effort in the target activity (Dubnjakovic, 2018). Therefore, autonomous motivation may facilitate cryptocurrency investment. In summary, we propose the following hypothesis:

H₂: Autonomous motivation plays a mediating role between social norms and cryptocurrency investment.

The moderating effect of cryptocurrency knowledge. Investors’ financial knowledge can be divided into subjective knowledge (SK) and objective knowledge (OK), which will influence their decision-making (Park et al., 1994). Subjective knowledge refers to the degree of an investor’s understanding of the product, while objective knowledge refers to the characteristic information related to the product stored in the investor’s memory (Rezvani et al., 2012). In other words, objective knowledge describes what a person knows, while subjective knowledge reflects the degree of confidence a person has in their knowledge.

In an environment of uncertainty and complex choices, subjective knowledge is a stronger motivator of behaviour than objective knowledge. In the field of financial decision-making, Hadar et al. (2013) proved that the improvement of investors’ subjective knowledge can increase the willingness to invest under uncertainty. Nazifi et al. (2021) also concluded that Bitcoin, as a more familiar cryptocurrency, will bring greater satisfaction to investors than less familiar cryptocurrencies such as EOS. Therefore, the improvement of subjective knowledge may increase investors’ autonomous motivation to invest. In other words, a high level of subjective knowledge can increase autonomous motivation, thereby enhancing the positive effect of group norms on autonomous motivation and weakening the negative impact of policy norms on autonomous motivation.

Although subjective and objective knowledge is strongly correlated (Van Rooij et al., 2011), however, some studies have shown that subjective and objective knowledge are different knowledge structures and they are not always perfectly aligned (Ryu and Ko, 2019). If investors are exposed to too much product information, their objective knowledge may be improved, but

Table 1 Sample characteristics.

Characteristic	Category	Frequency	%	Sample size	Total %
Investment experience in cryptocurrency	Yes	326	44.8	727	100
	No	401	55.2		
Gender	Male	351	48.3	727	100
	Female	376	51.7		
Age (years)	Under 18	7	1.0	727	100
	18-25	96	13.2		
	26-30	102	14.0		
	31-40	181	24.9		
	41-50	199	27.4		
	51-60	117	16.1		
	Over 60 years old	25	3.4		
Education	High school and below	30	4.0	727	100
	Junior college	236	32.5		
	Undergraduate	258	35.5		
	Master	167	23.0		
	PhD	36	5.0		
Investment experience (years)	None	64	8.8	727	100
	<1	99	13.6		
	1-5	166	22.8		
	5-10	172	23.7		
	>10	226	31.1		
Investment expenditure (RMB)	0	61	8.4	727	100
	<10,000	43	5.9		
	10,000-50,000	182	25.0		
	50,000-100,000	166	22.8		
	>100,000	275	37.8		

they may be discouraged from cryptocurrency (Hadar et al., 2013). The survey by Henry et al. (2019) also found that Canadian investors had improved their basic knowledge of Bitcoin during the years 2017 and 2018, but only a few people had adopted and invested in Bitcoin since many non-owners recognized that Bitcoin had no government support. Therefore, investors' objective knowledge of financial decisions may reduce their autonomous motivation. That is to say, high objective knowledge can limit autonomy and guide people to manage their risky investments, thereby weakening the positive effect of group norms on autonomous motivation and enhancing the negative impact of policy norms on autonomous motivation. Based on the above reasoning, we propose the following hypotheses:

H_{3a}: Subjective knowledge (SK) of cryptocurrency positively moderates the effect of group norms on autonomous motivation, while it negatively moderates the effect of policy norms on autonomous motivation.

H_{3b}: Objective knowledge (OK) of cryptocurrency negatively moderates the effect of group norms on autonomous motivation, while it positively moderates the effect of policy norms on autonomous motivation.

Methodology

Sample and data collection. We targeted users who paid attention to cryptocurrency investment and collected data through an online research platform. In the process of data collection, the guidelines of Song and Parry (1996) were used. After reviewing the existing literature, we compiled an English questionnaire. To create the Chinese version of these measurement items, we adopted the translation and back translation technique to ensure concept equivalence and accuracy. The questionnaire was finalized through a pre-test in which a total of 256 questionnaires were collected. On this basis, we refined and improved the questionnaire and completed the survey process.

We issued this survey in June 2021 and collected data for a month. A total of 1100 questionnaires were collected, covering 31 provinces, municipalities, and autonomous regions in China. To ensure the validity of the samples, at the beginning of the questionnaire, we set items to test whether users knew about cryptocurrency investment. Through the screening process, 281 invalid cases were eliminated. In addition, based on the questionnaire traps identified by Krosnick (1991), the questionnaires are also screened according to the logical relationship between the items and whether a particular option was repeatedly selected to ensure the validity of the data. Seventy-two cases were excluded in this step, and 727 valid questionnaires were finally retained, for an effective recovery of 66%. As shown in Table 1, there was a small difference in the number of groups that had invested in cryptocurrency (44.8%) and those that had not invested in cryptocurrency but may be potential investors (55.2%). Gender difference was also relatively small (male 48.3%, female 51.7%). Therefore, the sample was sufficiently representative for the investigation of cryptocurrency investment.

Measures. Except for objective knowledge, all other constructs were measured by multiple items (see Appendix for details) and sorted in reverse order to minimize bias in the survey. Each item was rated on a seven-point Likert scale (1 = completely disagree; 7 = completely agree). Four items from Ryu and Ko (2019) were used to measure group norms. The scale assesses the influence of social groups on user investment. Based on previous research (Xie, 2019), we developed a scale of policy norms, including four items. We adopted an autonomous motivation measure from previous studies (Mustafa and Ali, 2019; Kuvaas, 2006). It consists of four items that reflect investors' autonomous motivation to participate in cryptocurrency investment. We adopted Ryu and Ko's (2019) four measurement items of subjective knowledge of Bitcoin. We also referred to their measurement methods of objective knowledge and developed 10 judgement questions about cryptocurrency knowledge with three options (true/false/do not

Table 2 Descriptive statistics and correlation analysis.

Construct	Mean(SD)	1	2	3	4	5	6	7	8	9	10
Group norms	4.34(1.60)										
Policy norms	4.80(1.63)	-0.016									
Autonomous motivation	4.03(1.65)	0.406**	-0.391**								
Subjective knowledge	3.87(1.49)	-0.003	0.139**	-0.284**							
Objective knowledge	1.54(0.49)	-0.103**	0.201**	-0.338**	0.386**						
Cryptocurrency investment	4.31(1.74)	0.396**	-0.101**	0.428**	-0.003	-0.098**					
Gender	1.52(0.50)	0.108**	0.015	0.03	0.017	-7	0.122**				
Age	4.27(1.38)	0.163**	0.04	0.152**	0.059	0.072	0.191**	0.088*			
Education	2.92(0.96)	0.065	0.222**	-0.102**	0.118**	0.262**	0.012	0.042	0.104**		
Investment expenditure	3.76(1.25)	0.170**	0.252**	0.042	0.121**	0.247**	0.161**	-0.044	0.428**	0.360**	
Investment experience	3.55(1.29)	0.151**	0.220**	0.008	0.117**	0.259**	0.120**	-0.039	0.374**	0.329**	0.677**

* $p < 0.05$; ** $p < 0.01$.

Table 3 Reliability and validity.

Construct	Item	α	KMO	CR	AVE	SAVE	Loading	t
Group norms	gn1	0.938	0.863	0.938	0.792	0.889	0.900***	69.231
	gn2						0.876***	46.052
	gn3						0.920***	76.667
	gn4						0.863***	57.533
Policy norms	pn1	0.955	0.840	0.955	0.841	0.917	0.903***	69.385
	pn2						0.917***	76.333
	pn3						0.940***	94.000
	pn4						0.908***	75.667
Subjective knowledge	sk1	0.947	0.851	0.947	0.818	0.904	0.890***	63.571
	sk2						0.881***	55.000
	sk3						0.945***	118.250
	sk4						0.900***	69.308
Autonomous motivation	am1	0.939	0.839	0.939	0.796	0.892	0.891***	63.642
	am2						0.902***	64.357
	am3						0.919***	83.545
	am4						0.856***	47.556
Cryptocurrency investment	ci1	0.941	0.772	0.941	0.843	0.918	0.917***	91.700
	ci2						0.925***	92.500
	ci3						0.912***	65.143

*** $p < 0.001$.

know). Cryptocurrency investment was measured with the three items from Palamida et al. (2018) to evaluate users' willingness to invest in cryptocurrencies. Finally, several control variables were considered, including gender, age, education, investment experience, and investment expenditure. These have been shown in previous studies to be factors that affect investment (Cole et al., 2014; Eckel and Füllbrunn, 2015; Korniotis and Kumar, 2011; Malmendier and Nagel, 2011; Titman et al., 2004).

Results

Measurement model. A measurement model including independent variables, moderators, mediators, control variables and dependent variables was constructed. Firstly, we conducted descriptive statistics and correlation analyses, as shown in Table 2. Then, we conducted reliability and validity analyses. The results (see Table 3) showed that Cronbach's α value of each variable was >0.9 , and the KMO value was >0.7 , indicating that the scale had good reliability and validity. Confirmatory factor analysis was conducted through structural equation modelling to test construct validity. The results showed that the standardized factor loading of each variable was >0.8 and the

composite reliability (CR) was >0.9 , consistent with α . The average variance extraction (AVE) of each variable was >0.7 , and the convergence validity was supported. Each square root of AVE (SAVE) was greater than the correlation coefficient between the corresponding variable and other variables, indicating that each variable had good discriminant validity. In addition, the overall fitting degree of the research model reached an acceptable level ($\chi^2 = 471.08$, $\chi^2/DF = 3.32$, GFI = 0.93, CFI = 0.98, IFI = 0.98, RMSEA = 0.06). In general, the measurement model was suitable for further analysis.

The main effect of social norms. We constructed a model of the relationship between group norms, policy norms, and investment behaviour. The main effect of the model was verified by examining the influences of group norms and policy norms on cryptocurrency investment. We took the average value of items belonging to each construct to perform the multiple linear regression. The results (Table 4) showed that the research model well explained the influence of independent variables on dependent variables ($F(7719) = 25.172$, $p < 0.001$, $R^2 = 0.197$), group norms had a significant positive effect on investment behaviour

Table 4 Linear regression of group norms and policy norms.

Construct	Non-standardized β	Standard error	Standardized β	t	P	VIF
Constant	1.965	0.342		5.752	0.000	
Group norms	0.384	0.037	0.354	10.303	0.000	1.058
Policy norms	-0.128	0.038	-0.120	-3.415	0.001	1.106
Investment experience	0.002	0.062	0.002	0.039	0.969	1.925
Investment expenditure	0.152	0.068	0.110	2.246	0.025	2.129
Gender	0.294	0.118	0.085	2.486	0.013	1.036
Age	0.110	0.048	0.087	2.303	0.022	1.288
Education	-0.066	0.067	-0.037	-0.998	0.319	1.200
R ²	0.197					
F	25.172					

Table 5 Mediating effect of autonomous motivation.

Construct	Model 1		Model 2	
	Non-standardized β	p	Non-standardized β	p
Constant	2.585 (0.302)	0.000	5.008 (0.309)	0.000
Group norms	0.416 (0.035)	0.000		
Policy norms			-0.417 (0.036)	0.000
Investment experience	-0.083 (0.059)	0.162	-0.011 (0.059)	0.853
Investment expenditure	0.011 (0.064)	0.863	0.165 (0.064)	0.011
Gender	-0.071 (0.112)	0.528	0.109 (0.112)	0.329
Age	0.144 (0.045)	0.001	0.146 (0.045)	0.001
Education	-0.211 (0.063)	0.001	-0.116 (0.063)	0.067
R ²	0.194		0.193	
F	28.901	0.000	28.617	0.000

Standard errors are in parentheses.

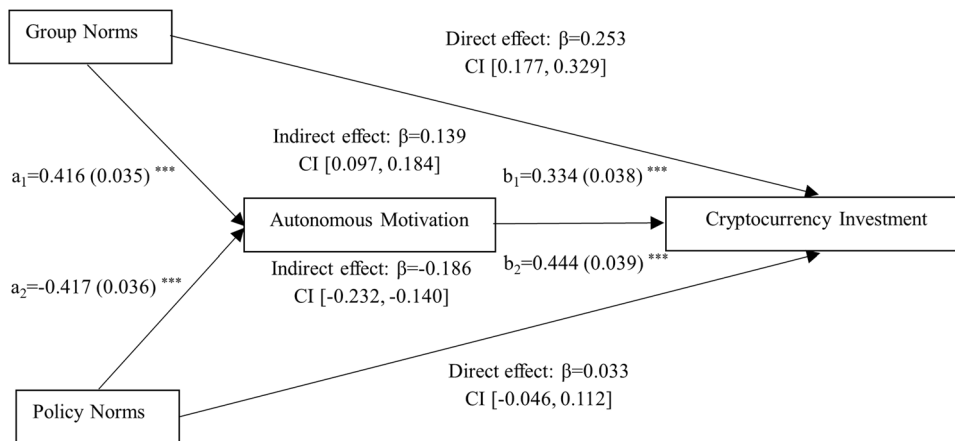
($\beta = 0.354, p < 0.001$), and policy norms had a significant negative suppressing effect on investment behaviour ($\beta = -0.12, p < 0.01$). Therefore, H_{1a} and H_{1b} were supported.

Mediating effect of autonomous motivation. Bootstrap was used to further explore the relationships among group norms, policy norms, autonomous motivation, and cryptocurrency investment. Using Process analysis, the confidence interval of the research was set to 95%, and the sample size was 5000. As shown in Table 5 and Fig. 2, after controlling for other factors, group norms significantly increased investors' autonomous motivation (Model 1, $\beta = 0.416, p < 0.001$). The direct effect of group norms on cryptocurrency investment was 0.253, and the confidence interval was [0.177, 0.329], excluding 0, indicating that group norms had a significant positive impact on cryptocurrency investment. Also, the indirect effect of group norms on cryptocurrency investment was 0.139, and the confidence interval was [0.097, 0.184] and did not contain 0. Therefore, autonomous motivation partially mediated the influence of group norms on cryptocurrency investment. In addition, policy norms had a significant suppressing effect on cryptocurrency investment (Model 2, $\beta = -0.417, p < 0.001$). The direct effect of policy norms on cryptocurrency investment was 0.033, and the confidence interval was [-0.046, 0.112], including 0, indicating that under the mediation of autonomous motivation, policy norms had no significant direct impact on cryptocurrency investment. The indirect effect was -0.186, and the confidence interval was [-0.232, -0.140], excluding 0, indicating that autonomous motivation completely mediated the impact of policy norms on cryptocurrency investment. H₂ was supported.

Moderating effect of cryptocurrency knowledge. Based on previous research (Ryu and Ko, 2019), we divided investors' cryptocurrency knowledge into subjective knowledge (SK) and objective knowledge (OK). The bootstrap method was also employed to test the moderating effects of subjective knowledge and objective knowledge respectively. Since subjective knowledge is a continuous variable, the involved continuous variables were centralized to reduce the problem of collinearity. On the basis of considering relevant control variables, we tested the moderating effects of subjective knowledge between group norms and autonomous motivation (Model 1 in Table 6) and that between policy norms and autonomous motivation (Model 2 in Table 6) respectively. Since the investigation of objective knowledge was carried out by judging true or false, we used the number of questions that respondents answered correctly and divided respondents' objective knowledge into high and low levels. Among the 10 objective questions related to cryptocurrency, respondents who answered fewer than 5 questions correctly were considered as having low objective knowledge and coded as 0; respondents who answered 5 or more questions correctly were considered as having high objective knowledge and coded as 1. After controlling for other factors, we tested the moderating effect of objective knowledge between group norms and autonomous motivation (Model 3 in Table 6) and that between policy norms and autonomous motivation (Model 4 in Table 6).

As shown in Model 1 of Table 6, group norms had a positive effect on autonomous motivation ($\beta = 0.429, p < 0.001$), while the interaction between group norms and subjective knowledge significantly inhibited users' autonomous motivation ($\beta = -0.174, p < 0.001$), indicating that subjective knowledge negatively moderated the effect of group norms on autonomous motivation. A simple slope analysis showed that the slope of the positive influence of group norms on autonomous motivation was significantly smaller for the high subjective knowledge group than for the low subjective knowledge group (Fig. 3). In Model 2, policy norms were shown to have a negative effect on autonomous motivation ($\beta = -0.356, p < 0.001$), and the interaction of policy norms and subjective knowledge also had a suppressing effect on autonomous motivation ($\beta = -0.145, p < 0.001$), indicating that subjective knowledge positively moderated the effect of policy norms on autonomous motivation. A simple slope analysis showed that the slope of the negative influence of policy norms on autonomous motivation was steeper in the high subjective knowledge condition than in the low subjective knowledge condition (Fig. 3). The above results exactly contradicted the hypothesis, and H_{3a} was not supported.

For objective knowledge, group norms had a positive impact on autonomous motivation ($\beta = 0.517, p < 0.001$, Model 3), while the interaction between group norms and objective knowledge inhibited users' autonomous motivation ($\beta = -0.269, p < 0.001$), indicating that objective knowledge negatively moderated the



Note: ***p<.001; standard errors in parentheses

Fig. 2 Mediating effect of autonomous motivation. The confidence intervals for autonomous motivation in both group norms and policy norms paths do not contain 0, indicating a significant indirect effect of autonomous motivation with a mediating effect.

Table 6 Moderating effect of cryptocurrency knowledge.

Construct	Model 1	Model 2	Model 3	Model 4
Constant	3.931*** (0.270)	2.915*** (0.277)	1.882*** (0.348)	4.160*** (0.357)
Group norms	0.429*** (0.032)		0.517*** (0.050)	
Policy norms		-0.356*** (0.034)		-0.231*** (0.055)
Subjective knowledge	-0.297*** (0.034)	-0.233*** (0.036)		
Objective knowledge			0.175 (0.307)	0.055 (0.337)
Subjective knowledge × Group norms	-0.174*** (0.020)			
Subjective knowledge × Policy norms		-0.145*** (0.022)		
Objective knowledge × Group norms			-0.269*** (0.066)	
Objective knowledge × Policy norms				-0.235*** (0.069)
Investment experience	-0.035 (0.054)	-0.010 (0.055)	-0.009 (0.056)	0.063 (0.056)
Investment expenditure	0.023 (0.058)	0.175** (0.060)	0.059 (0.060)	0.188** (0.060)
Gender	0.001 (0.102)	0.114 (0.105)	-0.015 (0.106)	0.109 (0.105)
Age	0.142*** (0.041)	0.144*** (0.042)	0.131** (0.043)	0.127** (0.042)
Education	-0.160** (0.057)	-0.083 (0.059)	-0.106 (0.060)	-0.013 (0.060)
R ²	0.335	0.295	0.287	0.290
F	45.204***	37.620***	36.182***	36.665***

Standard errors are in parentheses.
p < 0.01; *p < 0.001.

effect of group norms on autonomous motivation. This was further confirmed by simple slope analysis, which revealed that the slope of the positive influence of group norms on autonomous motivation was flatter for users with high objective knowledge than for users with low objective knowledge (Fig. 4). In Model 4, policy norms were found to have a negative impact on autonomous motivation ($\beta = -0.231, p < 0.001$), and the interaction between policy norms and objective knowledge also inhibited autonomous motivation ($\beta = -0.235, p < 0.001$), implying that objective knowledge positively moderated the effect of policy norms on autonomous motivation. A simple slope analysis showed that the slope of the negative influence of policy norms on autonomous motivation was significantly smaller for users with high objective knowledge than for those with low objective knowledge (Fig. 4). The above results were consistent with the hypothesis, and H_{3b} was supported.

Discussion and conclusion

The results of this research show that the behaviour of users investing in cryptocurrency is autonomous. Users who are more affected by group norms will react autonomously and then

increase their cryptocurrency investment. Users who are more affected by policy norms will control and reduce their autonomous motivation, resulting in lower cryptocurrency investment. To prevent cryptocurrency investment, the government’s policy norms are very important. If strict policy norms are not formulated, autonomous motivation cannot be suppressed, leading to the occurrence of cryptocurrency investment. Moreover, this research proves the importance of cryptocurrency knowledge in the cognitive process of users’ cryptocurrency investment. Specifically, objective knowledge weakens the autonomous motivation to invest, thereby inhibiting cryptocurrency investment. However, contrary to the hypothesis, subjective knowledge does not strengthen autonomous motivation but weakens it. One possible explanation is that subjective knowledge is usually consistent with objective knowledge, and it is to a certain extent a reflection of objective knowledge, therefore presenting a similar moderation mechanism to that of objective knowledge.

Our study is one of the few studies to examine cryptocurrency investment behaviour from the perspective of users, which expands the current research scope on cryptocurrency behaviour. Although previous studies have contributed to the investigation of cryptocurrency, most of them ignored the objective influence of the

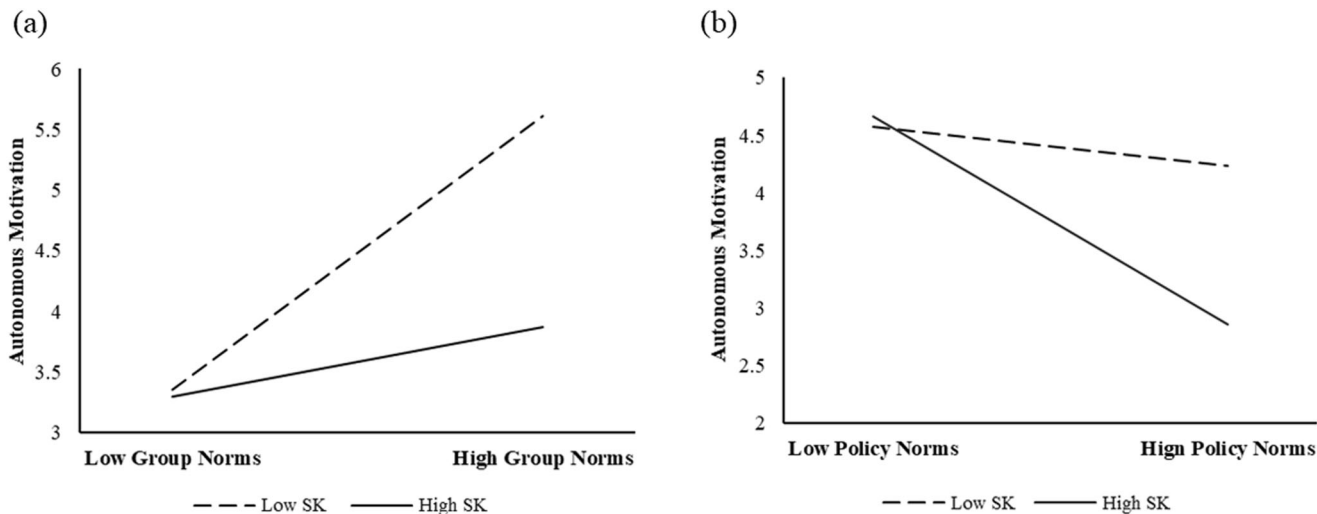


Fig. 3 Moderating effect of subjective knowledge. **a** Shows the moderating role of subjective knowledge in the relationship between group norms and autonomous motivation. **b** Shows the moderating role of subjective knowledge in the relationship between policy norms and autonomous motivation.

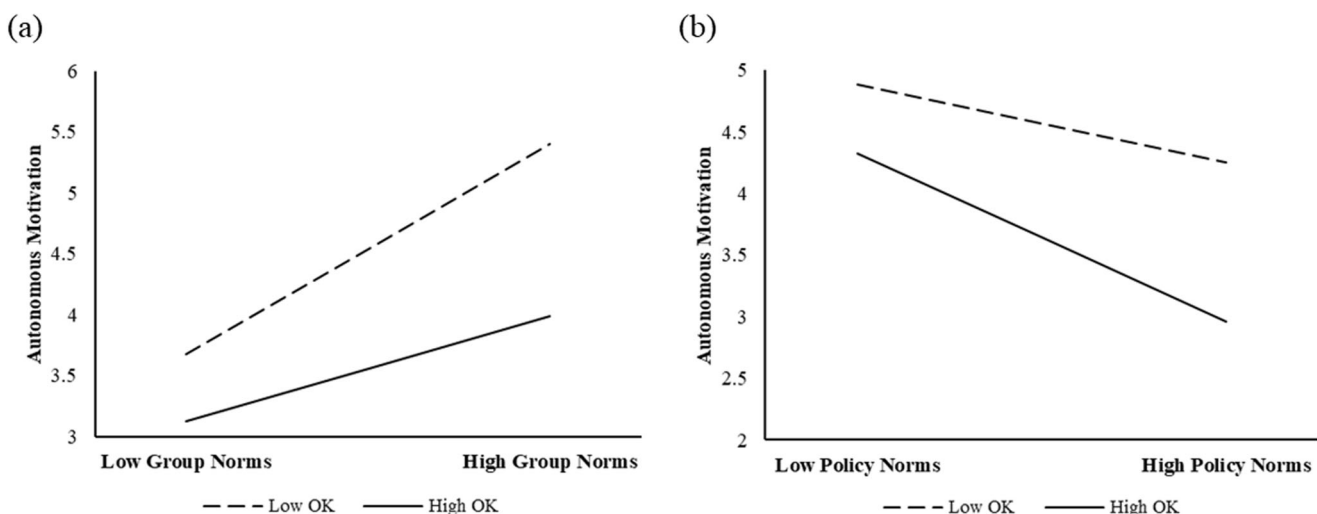


Fig. 4 Moderating effect of objective knowledge. **a** Shows the moderating role of objective knowledge in the relationship between group norms and autonomous motivation. **b** Shows the moderating role of objective knowledge in the relationship between policy norms and autonomous motivation.

political environment. Based on social norms theory, we considered both group and policy factors and provides new insight, that users' investment in cryptocurrency is affected by group norms and policy norms. Therefore, this research supplements the existing literature on the use of macro variables and explains investors' decisions on cryptocurrency investment. Cryptocurrency investment has become an irreversible trend, and its anticipated global persistence enhances the theoretical value of this research.

Our research provides new insights into understanding the behavioural mechanisms of users investing in cryptocurrencies. Previous studies have explored the psychological mechanisms of cryptocurrency investment in terms of trust, perceived risk, and perceived behavioural control. In contrast, we empirically analysed the role of autonomous motivation in users' cryptocurrency investment behaviour based on self-determination theory. Our results showed that users who invest in cryptocurrencies are influenced by autonomous motivations because they want to satisfy their internal needs, such as a sense of belonging. Furthermore, self-determination theory is often applied in the fields of education and work, and we extend the applicability of self-determination theory by applying it to consumer investments, especially in emerging cryptocurrencies.

We also identify a boundary condition that influences users' investment in cryptocurrencies, that is, their cryptocurrency knowledge. We showed that users tend to invest less in cryptocurrencies when they have a higher level of cryptocurrency knowledge (either subjective or objective), as they are more self-controlled and less motivated by autonomy. Although it has been demonstrated that financial knowledge plays an important role in users' investment in cryptocurrencies, there is a distinction between cryptocurrency knowledge and it. Financial knowledge may be an investor's understanding of financial information, while cryptocurrency knowledge is an investor's knowledge of the cryptocurrency product itself. That is, a user may have a wealth of financial knowledge but not necessarily a wealth of cryptocurrency knowledge. At this level, our study also enriches the literatures on consumer investment knowledge and provides new perspectives.

The findings suggest governments should focus on both regulations and public opinion. On the one hand, the government needs to strengthen and improve the laws and regulations related to cryptocurrencies. It is also necessary to make simultaneous amendments and improvements to other related laws and to write cryptocurrency into the law as soon as possible so that the law can

be followed and enforced. On the other hand, the government also needs to strengthen social supervision and exercise necessary control in the dissemination of cryptocurrency information. Some investors are teaching investment experience and advocating cryptocurrency investment in online forums and communities, which inevitably leads some potential targets to invest in cryptocurrencies after being exposed to such information. In response, the government can shut down website platforms dedicated to cryptocurrency marketing and advocacy and publishing tutorials on cross-border speculation in cryptocurrencies. At the same time, the government also needs to clean up and dispose of illegal and irregular information, accounts, and websites that speculate on cryptocurrencies, and increase its efforts to correct information content and accounts that induce cryptocurrency investments. In addition, the government needs to popularize and strengthen cryptocurrency knowledge education to enhance national financial literacy. Users with little financial literacy are willing to pursue high-risk investments, so people with lower cryptocurrency knowledge show a stronger motivation for autonomy, resulting in cryptocurrency investment. Investments that lack knowledge of cryptocurrencies should be strictly monitored and regulated. In this regard, what the government should do is promote and popularize the principles and knowledge related to cryptocurrencies and the essential differences between cryptocurrencies and other financial instruments in order to improve the subjective and objective knowledge of investors. For example, the government can promote and popularize cryptocurrency knowledge by making science videos online and holding regular educational seminars offline.

This study has several limitations. We adopted a questionnaire survey, which relied on the self-reported data of the participants. Because the participants may have exaggerated or downplayed their behavioural responses, the actual values of the constructs may be overestimated or underestimated. Future research may consider big data methods such as data mining to objectively measure these constructs so as to reduce research bias and provide more robust results. In addition, since the research on cryptocurrency is still in its early stages, the measurement methods of cryptocurrency investment have not been fully tested. Furthermore, we used the top ten cryptocurrencies in terms of market value to represent cryptocurrency in general during the survey. However, there are many types of cryptocurrencies, so the scope of our research may not be highly representative. Future research needs to expand the scope of the research to other cryptocurrencies to provide comprehensive coverage. In addition, we used a unified concept to represent all cryptocurrencies, which may have caused the research results to ignore the peculiarities of certain currencies (such as Bitcoin and Dogecoin). Future research can classify and discuss the types and characteristics of currencies, making the research focus more prominent. Finally, our research results may not be universal, for the sample was limited to a specific period and a specific country. Therefore, the results of this study must be interpreted with caution. Considering the importance of time and country characteristics in cryptocurrency, future research needs to apply specific methods, such as longitudinal analysis, and collect more data to closely observe and investigate the investment in cryptocurrencies in different periods and countries around the world.

Data availability

The datasets analysed during the current study are available in the Dataverse repository: <https://doi.org/10.7910/DVN/MI0SUF>.

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Author contributions

The authors confirm their contribution to the paper as follows: YG: conception and design, acquisition of data, analysis and interpretation of data, drafting the manuscript. XT: conception and design, revising theoretical framework, revising the manuscript. E-CC: drafting the manuscript, revising the manuscript critically for important intellectual content. All authors reviewed the results and approved the final version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

There was no approval required. Firstly, the method used in this article is a questionnaire, which has a low risk. Secondly, all respondents were given informed consent, volunteered to take the survey and were paid accordingly. Lastly, the survey pledged to protect the privacy of the respondents by using their data only for scientific research and not for other purposes. Therefore, the rights of respondents are safeguarded in this study, in line with the Declaration of Helsinki.

Informed consent

Respondents obtained informed consent while undergoing the questionnaire in June 2021. At the beginning of the survey, respondents were informed that the purpose of the survey is to investigate users' attitudes towards cryptocurrencies and they can voluntarily choose to participate in the survey.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-023-01870-0>.

Correspondence and requests for materials should be addressed to En-Chung Chang.

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