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Article

Empirical study of the impact of E-CNY on low-carbon economy from AI trust concerns

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Abstract: The low-carbon economy is the major objective of China's economy, and its goal is to achieve sustainable economic development. The study enriches the literature on the relationship between digital Chinese yuan (E-CNY), low-carbon economy, AI trust concerns, and security intrusion. The rapid growth of Artificial Intelligence (AI) offered more ways to achieve a low-carbon economy. The digital Chinese yuan (E-CNY), based on the AI technique, has shown its nature and valid low-carbon characteristics in pilot cities of China, it will assume important responsibilities and become the key link. However, trust concerns about AI techniques result in a limitation of the scope and extent of E-CNY usage. The study conducts in-depth research from the perspective of AI trust concerns, explores the influence of E-CNY on the low-carbon economy, and discusses the moderating and mediating mechanisms of AI trust concerns in this process. The empirical data results showed that E-CNY positively affects China's low-carbon economy, and AI trust concerns moderate the positive impact. When consumers with higher AI trust concerns use E-CNY, their feeling of security intrusion is also higher. It affects the growth of trading volume and scope of E-CNY usage. Still, it reduces the utility of China's low-carbon economy. This study provides valuable management inspiration for China's low-carbon economy.

Keywords: digital Chinese yuan (E-CNY); low-carbon economy; artificial intelligence (AI) trust concerns; security intrusion

1. Introduction

Low-carbon development is the common pursuit of direction for countries globally. It is also the major objective of China's economic development in recent years. Industrialization brings financial bonuses, but it also brings serious problems of higher energy consumption and emissions. How to coordinate economic development with environment protection becomes the key point to attract attention from the governments. It is also the primary goal of policymakers worldwide. According to the panel data from the World Bank, China's carbon dioxide emissions showed a rising trend in the past 60 years, the data from 1.17 per metric ton in 1960 to 7.41 per metric ton in 2018. On 13 November 2021, Chinese President Xi Jinping emphasized at the 28th APEC Economic Leaders' Meeting that "China must adopt the harmonious coexistence rules between people and nature, actively respond to climate change, promote green and low-carbon transformation, and strive to build a global community of life". According to Guo (2022), China will achieve a carbon peak before 2030 and carbon neutrality before 2060.

AI techniques expansion provides more ways for China's low-carbon economy, and the smart contracts of E-CNY fully reflect the application of AI technology (Huang and Li, 2022). According to Zhang (2023), E-CNY, with the advantages of

no electricity, no internet payment (offline payment), smart contracts, and credit endorsement from State-owned banks are highly recognized and promoted by the Chinese government. Li and Azman (2023) pointed out that the advantages of E-CNY have a positive impact on achieving a low-carbon economy and sustainable development in China. Compared with the traditional banknote, the E-CNY has five advantages: offline payment, regulated credit, accurate delivery, the whole process is traceable, and lower cost. The E-CNY simplifies the payment process, making it faster, cost-effective, and transparent while also reducing incidents in public and private events, such as fraud and corruption (Zhang et al., 2023). According to Caudevilla and Kim (2022), compared with Bitcoin, E-CNY has the superiority of effectiveness and low carbon due to over half the electricity coming from burning coal, and the Bitcoin mining ban is proof that E-CNY's carbon footprint is much less than Bitcoin's.

Although the AI technique is growing in maturity and is closer to people's lives, the issue of AI trust concerns is still widespread (Omrani et al., 2022). The study found that E-CNY based on AI technique was affected by AI trust concerns during the pilot process, and there is a risk that it will not achieve low-carbon effects due to its low usage scope (Li and Azman, 2023). Zhang (2023) believes that only when more consumers develop the habit of using the E-CNY, the benefit of low-carbon, environmental protection, and green will be magnified. However, on the background of strong input to the E-CNY by the Chinese government, there is a high risk that the development effect may be diametrically opposed. Suppose the large-scale investment of E-CNY is affected by AI trust concerns. In that case, the vast amount of resources the government consumes for investment will instead become the source of promoting and increasing carbon emissions. Therefore, this study adopts the quantitative method and focuses on analyzing the impact of AI trust concerns on E-CNY promotion, and then its impact on China's low-carbon economy. This study hopes to fill the gaps in the area among previous literature and add theoretical support for the E-CNY promotion and development of a low-carbon economy. At the same time, based on forward-looking theoretical research and empirical data analysis results, this study provides possible marginal contributions to the development of E-CNY and the transformation of China's urban economy to a low-carbon economy. This study examines the relationship between E-CNY and the low-carbon economy using AI trust concerns as mediating and moderating variables. The results show that AI trust concerns affect the scale of E-CNY usage. It also affects the development of the E-CNY and the degree of transformation of China's urban economy into a low-carbon economy. The results also clearly show that as E-CNY technology matures, the construction of technology and systems is no longer the most urgent problem to solve. Easing AI trust concerns will likely become a critical bottleneck in developing E-CNY and transforming China's urban economy to low-carbon development.

2. Background of the study

2.1. E-CNY development issues and AI trust concerns

According to CNN, China is vigorously promoting the E-CNY and is about to

enter a cashless society. Although the E-CNY has developed rapidly under the big push from the Chinese government, Wang and Hu (2024) have pointed out that the E-CNY still faces five major problems: weak user demand, mismatched expansion mechanisms, operational costs transfer, basic techniques, and poor initial issue processes. Simply put, Chinese consumers' habit of banknote-holding structure and the use of traditional paper money in an aging society causes the problem of weak user demand for E-CNY. Next, promotion from the government leads to negative effects, such as mismatched expansion mechanisms like misappropriation of conception, unclear costs, and others. Then, the higher costs combined with promotion, advertising, and application were ignored by higher desired effects, and there is a widespread belief wrong to think that the higher cost of paper money has been transferred due to E-CNY. Finally, this article focuses on the underlying technical issues that consumers are concerned about or even afraid of using AI, as well as the problems of imperfect initial processes due to the lack of strict steps in implementing the scheme. In summary, the E-CNY faces many practical problems, among which the most inexperienced and difficult to overcome the problem is the concern about trust in artificial intelligence technology.

Boden (2016) argued that China's internet and digital economy are world leaders. Still, consumers are concerned about AI's "intimate services: push service" such as push ads, the risks that AI may bring, and the impending "singularity" of super AI. Meanwhile, some internationally renowned figures, such as legendary physicist Stephen Hawking. According to An and Wang (2016), For E-CNY, if consumers feel monitored based on concerns about trust in AI, counterproductive work behavior (CWB) may occur. The main application scenario of the E-CNY is smart contracts. By using AI programming to restrict the functions of funds, such as deposits in the contracts, it is possible to accurately achieve goals like special funds for special purposes and recovery of illegal funds. However, according to Li and Azman (2023), there is a high probability of failure due to system errors in AI programming and criminal intrusion. Therefore, consumers are concerned or even afraid of E-CNY smart contracts based on AI technology.

2.2. E-CNY and China low-carbon economy

The issuance method and operation mechanism of E-CNY have natural low-carbon attributes and an important part of green and low-carbon finance. According to Li and Azman (2023), E-CNY has a huge impact on China's low-carbon economy, as shown in **Figure 1**. Traditional banknotes with the advantages of anonymity, cultural identity, and no device support for Chinese consumers. According to Wand and Hu (2024), during the COVID-19 epidemic, the M_0 with risk of contact infection, instead of decreasing, has doubled, which reflects the superiority of paper money usage. However, the higher carbon consumption of paper money is the fundamental reason why it is replaced by E-CNY. Kenneth S. Rogoff's book "The Curse of Cash" discusses that the manufacturing cost of paper money is very high, and it is often used for money laundering and the underground economy (Rogoff, 2017). China's paper money includes production costs, transportation, storage, destruction, and management. Ma (2009) pointed out that the primary way to control the cost of

paper money is to maintain the total amount of cash and optimize the denomination. Based on this, the Chinese government is vigorously promoting the use of E-CNY to achieve the goal of low-carbon and sustainable economic development.

The retail consumption sector of China is adopting inclusive low-carbon practices, which will become a major driving force to facilitate green and low-carbon behavior (Huang, 2021). In June 2021, China's first carbon-friendly platform, the "low-carbon travel" application E-CNY, was officially launched. The platform is a green finance platform linked to the Chinese governments, banks, enterprises, and individuals. Enterprises and individuals could obtain "carbon reduction value" rewards on the application through low-carbon activities. In September 2021, the Meituan application with the Postal Savings Bank, Agriculture Bank, and Construction Bank of China jointly conducted a Carbon charity pilot activity, "Enjoy a low-carbon riding season with E-CNY." Users of the Meituan application obtain the E-CNY vouchers through the application. In a short three months, the pilot activity attracted approximately 8 million people to join it, including 2 million people who opened the E-CNY e-wallet. Huang (2021) pointed out that the function of E-CNY is to empower the low-carbon economy, which will continue to grow and will undoubtedly become an important boost for China to achieve its "double carbon" goals. According to Zhang (2023), the consumers and usage scope of E-CNY continue to grow, expanding the low-carbon, environment-friendly, and green effects of the E-CNY.

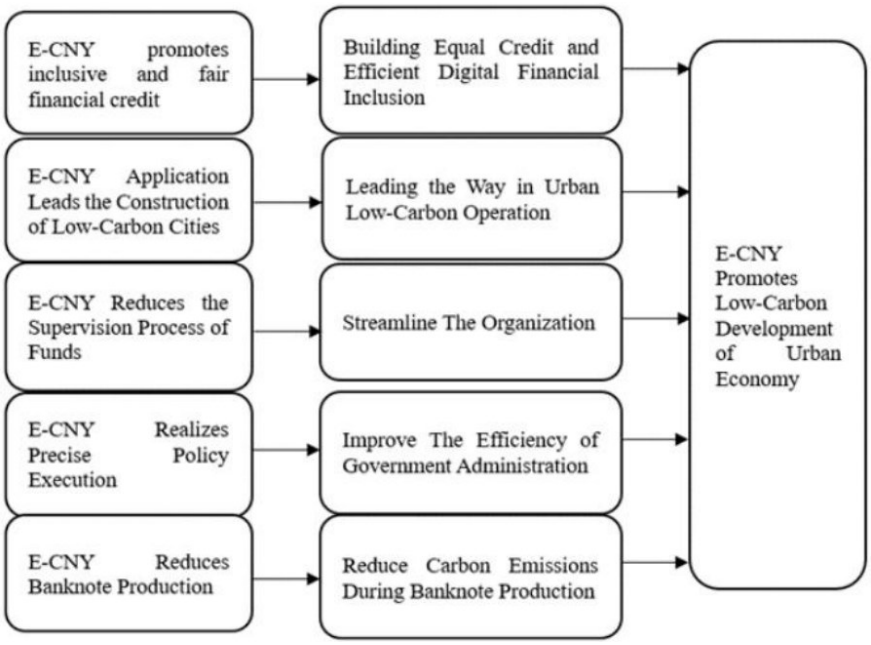

Figure 1. E-CNY promotes low-carbon economy roadmap.
Data source: Li and Azman (2023).

2.3. Modeling framework and research methods

2.3.1. Modeling framework

This study uses SPSS progress model 7 to conduct moderated mediation effect analysis, as shown in **Figure 2** below.

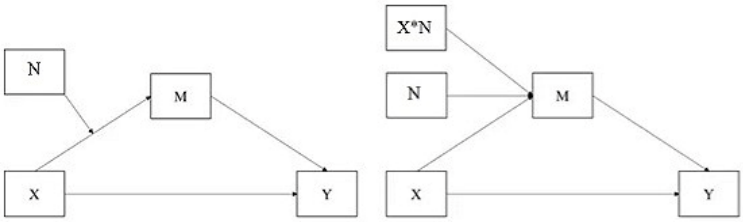

Figure 2. SPSS progress model 7 concept and statistics.

Data source: SPSS Software.

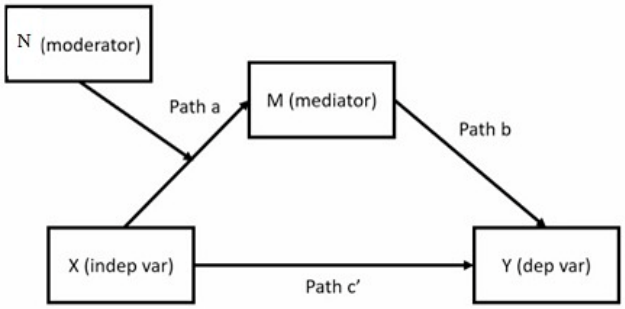

Figure 3. SPSS progress model 7 operation.

Data source: SPSS Software.

This model (see **Figure 3**) involves testing for the indirect effect of *X* (the independent variable) on *Y* (the dependent variable) by the proposed mediator *M*, with the indirect impact being moderated by *N*. In this model, there is first-stage moderation as *N* is moderating Path *a*. In a second-stage model, the moderation would be on Path *b*. This study examines the relationship between the independent variable, E-CNY, and the dependent variable, low-carbon economy. The mediating variable, AI trust concerns, influences the results, moderated by the moderating variable, security intrusion.

2.3.2. Research methods and validation

After using SPSS and other software to verify the model's reliability, data, and correlation, this study used path analysis to confirm the hypothesis proposed in this study. The main research methods are as follows.

a) Cronbach's alpha

$$\alpha = \frac{N \times \bar{c}}{\bar{v} + (N-1) \times \bar{c}}$$

in which N is the number of items. $\bar{c}$ is the average covariance. $\bar{v}$ is the average variance.

b) HTMT

HTMT is the Heterotrait-Monotrait ratio calculated by comparing the average heterotrait correlation and monotrait correlation between latent variables.

$$\text{HTMT}ij = \frac{\text{mean}(\text{cor}(X_h, Y_k))}{\sqrt{\text{mean}\big(\text{cor}(X_h, X_i)\big) \times \text{mean}(\text{cor}\big(Y_j, Y_k\big))}}$$

in which X_h and X_i are the indicators of latent variable i, and Y_j and Y_k are the indicators of latent variable j. cor(X_h, Y_k) is the correlation between indicators X_h and Y_k. mean (cor(X_h, X_i)) is the average of the correlations between all indicators of

latent variable i. mean (cro (Y_j, Y_k)) is the average of the correlations between all indicators of latent variable j.

c) Mediation effect test

The following regression equation usually estimates the mediation effect:

Equation (1): The effect of independent variable X on mediating variable M.

$$M = aX + \epsilon M \quad (1)$$

Equation (2): The effect of independent variable X and mediating variable M on dependent variable Y.

$$Y = c'X + bM + \epsilon Y \quad (2)$$

d) Path coefficient analysis

Determining path coefficients, a, b, and c is usually estimated through regression analysis.

Estimate a:

$$a = \frac{\mathrm{cov}(X, Y)}{\mathrm{Var}(X)}$$

Estimate b and c: Use multiple regression analysis to obtain regression coefficients b and c.

3. Study hypothesis

The nature of E-CNY is electronic money (E-money). The paperless transaction began in the era of bank card payment. Electronic payment platforms have emerged and are recognized by consumers, such as PayPal, Alipay, Paytm, and others. However, E-money is not the E-CNY. It is the unit of account for paper money in online transactions. Xiong and Qiu (2018) believed that E-CNY is based on AI technology to record the relationship between claims and liabilities, which accurately reflects the nature of currency as a debt. In addition, from a national review, many countries cannot accept institution-based digital currency as mainstream currency because the right to issue currency and policy is considered fundamental sovereignty. In China, E-CNY has become a major trend in the financial market with its national sovereignty endorsement and legal status.

From the macro perspective, E-CNY has the advantages of no electricity, no internet payment (offline payment), smart contracts, and credit endorsement by state-owned banks (Zhang, 2023). Traditional currency difficulties in meeting low-carbon development. With the expansion of AI technology, Huang (2021) believed that E-CNY has strategic value for the national low-carbon economy. E-CNY has been recognized and promoted by the Chinese government due to its low-carbon feature. At the same time, previous literature has virtually unanimous opinions of the characteristics of E-CNY in China. From the micro level, E-CNY has gradually accumulated the concept of low-carbon development in the minds of consumers. Combined with the AI technique, it is a bridge between the low-carbon target and consumers (Qi et al., 2018). E-CNY, an emerging currency, is affecting the lives of consumers. The functions of convenient payment and smart application scenarios reduce transaction processes. Traceability and smart contracts gradually promote financial inclusion in China. Based on this, the study proposed the following hypothesis.

H1: E-CNY positive impacts the low-carbon economy in China.

AI trust concerns are divided into perception, control, and reliability risks, which may cause counterproductive work behavior (CWB). The concept of perceived risk was introduced into marketing from psychology by Bauer of Harvard University, and he defined it as the consequences of consumer behavior he could not predict (Feng et al., 2006). There are two types of consequences: One is uncertainty in product performance attributes, and the other is the adverse consequences of purchasing a product, such as loss of time and money. AI is both a product and an environment. Its dual attributes allow consumers to perceive both and will reduce their trust in E-CNY due to perceived risks.

Control risk. The main manifestation of consumers being controlled by AI algorithms is that their privacy is recorded, and their consciousness is induced, which means people who understand you hurt you the most (Zhai, 2018). Herali (2017) argued that, suppose the problem of the opacity of AI algorithms is only partially solved in the future. In this case, the control risk may rise to the point where the consumer class is shackled, resulting in unprecedented social and political inequality. In the future, it may even evolve into a situation where the consumer group is controlled, so consumers generally express concerns or even fear about the risk of being controlled (Jamie, 2024).

Reliability risks. E-CNY faces the issue of how to pursue legal responsibility when smart contract editing errors occur. Even if we attribute errors or misbehavior in AI to designers and programmers, the development of a program may be done by many people, and its creation may not be traceable to a specific person or organization (Wang, 2018). Higher reliability risks for consumers lead to lower trust.

Counterproductive work behavior (CWB) represented behaviors that would have the opposite impact. The use of CWB here means that if the E-CNY is promoted without addressing the trust concerns, it may cause consumers to feel perceived, control, and reliability risk. In this case, AI trust concerns affect the scope of usage of E-CNY, and it may limit achieving large-scale usage and fail to promote the low-carbon economy of China. Based on this, the study proposed the following hypothesis.

H2: AI trust concerns moderating the positive impact of E-CNY on the low-carbon economy.

Issues such as trust concerns in AI and security intrusion all concern the feelings of E-CNY users. However, there are significant differences between the two concepts from a theoretical perspective. Security intrusion is the cost factor of the model, which describes and quantifies the sensitive degree of consumers when they feel security intrusion. Wen (2009) believes AI trust concerns to be a potential behavior worried about individual security. Therefore, security intrusion is the actual violation felt by consumers, while AI trust concerns are preventive emotions against potential violations. When using E-CNY or other AI products, consumers who have higher concerns about AI trust show a defensive attitude and higher levels of loss aversion, while consumers who have lower concerns about AI trust show a positive attitude and higher expectations for using E-CNY. Suppose consumers with high AI trust concerns encounter security intrusions when using E-CNY, thus developing resistance. In that case, it will limit the growth of E-CNY users and the use of E-

CNY, affecting the low-carbon economy. Based on this, this study proposes the following hypothesis.

H3: Security intrusion mediates the relationship between AI trust concerns and E-CNY, affecting the low-carbon economy.

4. Empirical analysis

4.1. Basic overview of the questionnaire

The data collection of this study uses online self-administered questionnaires. This study issued 200 questionnaires as a pilot and then modified and issued the formal questionnaire. Finally, 450 questionnaires were delivered. Among them, there were 413 valid, and the invalid sample was 37. Demographic information shows that females account for 60.78%, and 99.51% of respondents' educational levels are in high school or above. The annual income of respondents is mainly between 10,000 and 30,000 Chinese Yuan, which is about 1388 to 4166 US dollars, accounting for 51.81%. The study adopted the SmartPLS4.0 software for data analysis. Meanwhile, this study uses *X*-represented E-CNY and *Y*-represented the low-carbon economy, uses *M*-represented AI trust concerns, and uses *N*-represented security intrusion. The value of Cronbach's alpha and composite reliability (CR) are shown in **Table 1**.

Table 1. The value of Cronbach's alpha and composite reliability (CR).

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
M	0.802	0.870	0.626
N	0.751	0.858	0.668
X	0.760	0.847	0.582
Y	0.786	0.861	0.609

Sources: Author's made.

From the above table, the value of Cronbach's alpha of the four variables is all above 0.7, and composite reliability (CR) is all above 0.8. Combined with the AVE indicator, which is all above 0.5, shows a good reliability of the model.

4.2. Measure of sampling adequacy

This study uses factor loading and the average variance extracted (AVE) for the factor test. The results of factor loadings are above 0.708, the data report is shown in **Table 2**. In **Table 1**, we can see AVE is higher than 0.5. Combining the two results, this study chose the proper factors, and no one needs to be deleted. Nest, the study adopted the SmartPLS 4.0 software to analyze the discriminant validity, and the results of the Heterotrait-Monotrait ratio (HTMT) are reported in **Table 3**. According to the results of HTMT, the test values are all between −1 and 1 and do not include 1, which means the model has good discriminant validity. Meanwhile, the test values of HTMT inference in **Table 4** are all behind 1, which means this model has perfect validity. This study also uses SPSS26 software to conduct the exploratory factor analysis (EFA), and the results of the EFA extracted four variables, namely E-CNY, low-carbon economy, AI trust concerns, and security intrusion. The kaiser-meyer-olkin (KMO) test value was 0.816. Bartlett's sphericity test was significant ($P <$

0.001), and the percent of variance was 62.630%. The explained variance of the first common factor is 16.973%, which has not exceeded 30%. The goodness-of-fit texts include SRMR, whose value is 0.068 (< 0.08). d_ULS value is 0.21 (< 0.95). d_G value is 0.071 (< 0.95). NFI value is 0.829 (> 0.8). indicating a perfect goodness-of-fit of the model (Henseler et al., 2016; Japutra et al., 2021).

Table 2. The value of factor loading.

	M	***N***	***X***	***Y***	***M* × *X***
*M*1	0.779				
*M*2	0.834				
*M*3	0.787				
*M*4	0.765				
*N*1		0.809			
*N*3		0.794			
*N*4		0.848			
*X*1			0.790		
*X*2			0.744		
*X*3			0.801		
*X*4			0.713		
*Y*1				0.738	
*Y*2				0.762	
*Y*3				0.797	
*Y*4				0.822	
M*X					1.000

Sources: Author's made/SmartPLS4.0

Table 3. The value of Heterotrait-Monotrait ratio (HTMT).

	M	***N***	***X***	***Y***	***M*X***
M					
N	0.531				
X	0.090	0.396			
Y	0.290	0.168	0.518		
M × *X*	0.045	0.135	0.033	0.181	

Sources: Author's made/SmartPLS4.

Table 4. The value of HTMT inference.

	Original sample (*O*)	**Sample mean (*M*)**	**2.50%**	**97.50%**	**Bias**	**2.50%**	**97.50%**
N ↔ *M*	0.531	0.532	0.426	0.630	0.001	0.421	0.628
X ↔ *M*	0.090	0.122	0.074	0.188	0.033	0.048	0.110
X ↔ *N*	0.396	0.395	0.279	0.506	−0.001	0.279	0.505
Y ↔ *M*	0.290	0.290	0.183	0.399	0.001	0.182	0.399
Y ↔ *N*	0.168	0.176	0.083	0.288	0.009	0.077	0.278
Y ↔ *X*	0.518	0.517	0.406	0.619	0.001	0.401	0.616

Sources: Author's made/SmartPLS4.0

4.3. Correlation analysis

The study adopted correlation analysis to test whether there is a significant correlation between variables. Since the non-normal distributions of data, the Charles Spearman (*S*) coefficient was selected to conduct correlation analysis. The result of the analysis shows that E-CNY has a significant positive impact on the low-carbon economy ($P < 0.001$). AI trust concerns have a significant negative impact on the low-carbon economy ($P < 0.001$). Meanwhile, AI trust concerns have a significant negative impact on the relationship between security intrusion and the low-carbon economy ($P < 0.001$) (**Figure 4**). At the same time, this study multiplies E-CNY and AI trust concerns to form an interaction and then uses the interaction as the variables to conduct a correlation analysis on the low-carbon economy and security intrusion. The result of the test shows the interaction has a significant negative relationship with the low-carbon economy ($P < 0.001$) and has a significant positive relationship with security intrusion ($P < 0.001$).

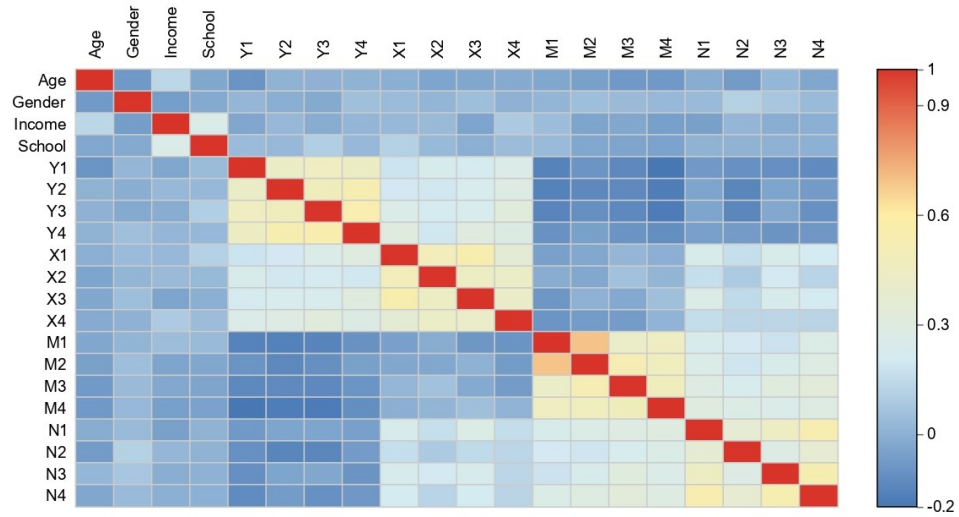

Figure 4. Correlation heat map.

Data source: The author made it with Cnsknowall software.

4.4. Mediating effect

The mediating effect adopts Process Model 7 to conduct analysis. As shown in **Table 5**, the mediated indirect effect indicated that the standard deviation is within the normal range, and the 95% confidence interval does not contain 0 ($P < 0.001$), which means a mediating effect is established. After the mediated indirect effect is established, the next step is to analyze the mediated direct effect. As shown in **Table 6**, mediated direct effect results indicated that the standard deviation is within the normal range, and the 95% confidence interval does not contain 0 ($P < 0.001$), which means a mediating effect is established (**Figure 5**). The test results that the mediation effect is significantly established, combined with the path analysis, prove hypothesis H3.

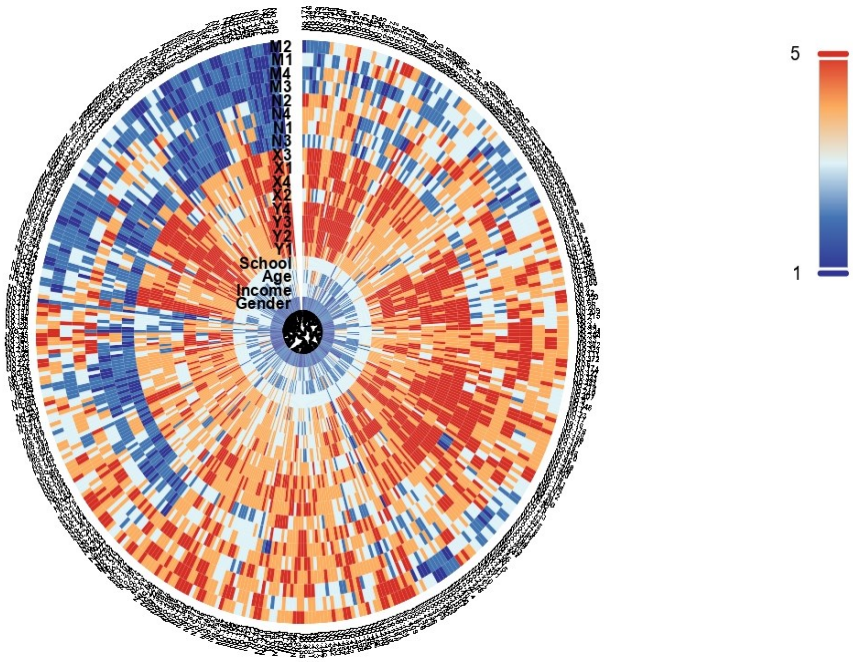

Figure 5. Circular cluster heat map.

Data source: The author made it with Cnsknowall software.

Table 5. Conditional indirect effect.

Mediating variable	Level	Level value	Effect	BootSE	BootLLCI	BootULCI
	Low-level (−1SD)	2.356	−0.039	0.018	−0.079	−0.008
N	Mean	3.265	−0.069	0.018	−0.107	−0.036
	High-level (+1SD)	4.173	−0.099	0.025	−0.151	−0.053

Sources: Author's made.

Remark: BootLLCI refers to the lower limit of the 95% interval of Bootstrap sampling, and BootULCI refers to the upper limit of the 95% interval of Bootstrap sampling.

Table 6. Conditional direct effect.

Level	Level value	Effect	SE	*t*-Value	*P*-Value	LLCI	ULCI
Low-level (−1SD)	2.356	0.597	0.060	9.902	0.000	0.479	0.715
Mean	3.265	0.449	0.044	10.156	0.000	0.362	0.535
High-level (+1SD)	4.173	0.300	0.062	4.808	0.000	0.178	0.422

Sources: Author's made

Remark: LLCI refers to the lower limit of the 95% interval of the estimate, and ULCI refers to the upper limit of the 95% interval of the estimate.

4.5. Model path analysis

The results of path analysis are shown in **Table 7**. There are five steps to test the path coefficient.

The first step is to test the path coefficient between the control variable and the low-carbon economy. It was found that the path coefficient of gender and the low-carbon economy is 0.010, age and the low-carbon economy is 0.012, education and the low-carbon economy is 0.037, and income and the low-carbon economy is 0.039. The corresponding significance is no statistical significance ($P > 0.05$).

The second step added the impact of the independent and moderating variables

on the low-carbon economy. The path coefficient of E-CNY is 0.485, which has a statistical significance ($P < 0.05$), indicating that E-CNY has a positive impact on the low-carbon economy. Therefore, hypothesis H1 is confirmed. This step also shows the path coefficient of AI trust concerns on the low-carbon economy is -0.278, which has a statistical significance ($P < 0.05$), indicating that AI trust concerns have a negative impact on the low-carbon economy.

Table 7. The results of path analysis.

Model step	Explanatory variable	Path coefficient	Significance
The first step			
Control variable → the low-carbon economy	Age	0.012	$P > 0.05$
	Gender	0.010	$P > 0.05$
	Education	0.037	$P > 0.05$
	Income	0.039	$P > 0.05$
The second step			
Independent variable/ moderating variable → the low-carbon economy	E-CNY	0.485	$P > 0.05$
	AI trust concerns	−0.120	$P > 0.05$
The third step			
Independent variable plus moderating variable → the low-carbon economy	Interaction (decentralized)	−0.032	$P > 0.05$
	Interaction (non-decentralized)	−0.184	$P > 0.05$
The fourth step			
Independent variable plus moderating variable → security intrusion	Interaction (decentralized)	0.117	$P > 0.05$
	Interaction (non-decentralized)	0.215	$P > 0.05$
The fifth step			
Mediating variable → the low-carbon economy	Security intrusion	−0.278	$P > 0.05$

Sources: Author's made.

The third step added the impact of the interaction of independent and moderating variables on the low-carbon economy. It was found that the indirect path coefficient of the interaction under the influence of the non-decentralized mediation effect is −0.184, which has a statistical significance ($P < 0.05$), indicating that the interaction of E-CNY and AI trust concerns has a significant negative impact on the low-carbon economy. Moreover, the interaction of decentralized also has a significant negative impact on the low-carbon economy, which has a path coefficient of -0.032 and has a statistical significance ($P < 0.05$).

The fourth step includes the impact of independent and moderating variables on security intrusion. It was found that the impact coefficient of interaction with non-decentralized on security intrusion is 0.215 ($P < 0.05$), indicating that the interaction of independent and moderating variables has a significant positive impact on security intrusion, at the same time, the interaction with decentralized has a similar effect, which path coefficient is 0.117, has a statistical significance ($P < 0.05$), indicating that the interaction has a significant positive impact on security intrusion, when consumers with higher AI trust concerns, the positive impact of E-CNY on the low-carbon economy was weakened. Therefore, hypothesis H2 is confirmed.

The fifth step includes the impact of mediating variables on the low-carbon

economy. It was found that the path coefficient of security intrusion and the low-carbon economy is −0.278, which has a statistical significance ($P < 0.05$). Combined with the significant test result of mediating effect, indicating a significant moderated mediation effect. Therefore, security intrusion plays a mediating role in the impact of the interaction of E-CNY and AI trust concerns on the low-carbon economy. Thus, hypothesis H3 is confirmed.

5. Recommendation and strategy

5.1. The impact of E-CNY on low-carbon economy—Enterprise view

The relevant literature conducted an empirical analysis of the enterprise panel data in the E-CNY pilot areas and concluded that: using E-CNY can reduce transaction costs for businesses, improve transparency, and enhances traceability, thereby reducing the transaction, precautionary, and agency motivations for businesses to hoard excess cash. Further analysis shows that firms without financing privileges (private firms and firms lacking political connections), firms facing higher collection costs, firms with poor stock liquidity, and firms with more volatile stock returns benefit more from the launch of the E-CNY. Finally, the dynamic model shows that using E-CNY helps firms adjust their cash holdings more quickly to achieve their target cash holding levels. (Zhang et al., 2023). From this, we can see that from the perspective of enterprises using E-CNY in the pilot areas, E-CNY has improved enterprises' financing capabilities and operating efficiency and promoted low-carbon and sustainable development.

5.2. The impact of E-CNY on low-carbon economy under the background of AI trust concerns

This study focuses on the impact of E-CNY on the low-carbon economy and explores the moderating and mediating mechanisms of AI trust concerns and security intrusion in the process. The empirical results show that E-CNY is affecting the low-carbon economy, and AI trust concerns moderating the positive impact of it. When consumers with higher AI trust concerns use E-CNY, their feeling of security intrusion will be higher, thus reducing the scope and growth of consumers and decreasing the effects of the low carbon. Meanwhile, security intrusion mediates between AI trust concerns and E-CNY, affecting low-carbon efficiency.

5.3. Recommendation and strategy

This study puts forward the following suggestions and strategies:

Firstly, it should enhance the technology of AI trust concerns of E-CNY. Some scholars found that consumers are instinctively "sensitive" to errors in AI and will amplify the risk factors of AI with various "biases". Therefore, trust protection should be established through psychological explanations, algorithm transparency, and clear legal roles from the perspectives of consumers' perceived, control, and reliability risk. So that consumers can alleviate the AI trust concerns of E-CNY.

Secondly, optimizing the workflow of E-CNY. Consumers should be provided informed consent on AI work to explain the purpose, risks, and related uses, and then

work through AI technology with consumers' informed consent. Options for consumer informed consent should be made more visible, which can give consumers the impression of being "willing to protect my safety", thereby allowing consumers to put down their psychological alertness about AI trust concerns and, to a higher degree, accept and use E-CNY.

Thirdly, establish a true and good image for E-CNY. Reduce the security intrusion of consumers by actively promoting efforts that E-CNY made in the AI trust concerns area. This study shows that security intrusion will reduce The Low-carbon economy. Therefore, increasing consumers' reliability on E-CNY should be through assessment documents issued by experts or third-party institutions, reflecting the protective measures E-CNY took for AI security. By providing consumers with scientific knowledge about AI safety technology, consumer concerns about AI trust and security intrusions can be reduced.

5.4. Understudied and prospective

Although the E-CNY has developed rapidly under the strong promotion of the Chinese government, it has yet to be fully promoted in China. The E-CNY issuing agency stated that the relevant operating data is still being collected and cannot be released. At the same time, for objective reasons, all regions of China, including the E-CNY pilot areas, still mainly use traditional paper notes and electronic payment transactions. The few consumers with experience using E-CNY also have objective problems such as short usage time and scale. Therefore, this study should monitor the E-CNY's development through new data to verify and identify regularities and issues and propose valued advice.

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Reference

An, F., & Wang, B. (2016). Abusive supervision and counterproductive work behavior: Moderating effect of negative affectivity. Journal of Service Science and Management, 09(01), 66–73. https://doi.org/10.4236/jssm.2016.91009

Boden, M. A. (2016). AI: Its nature and future. Oxford University Press.

Caudevilla, O., & Kim, H. M. (2022). The Digital Yuan and Cross-Border Payments: China's Rollout of Its Central Bank Digital Currency. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4371414

Feng, J., Weisong, M., & Zetian, F. (2006). A Review of Consumers' Purchase Intention Research. Modern Management Science, (11), 7–9.

Guo, X. (2022). The Impact Mechanism and Empirical Test of Green Finance in Promoting Low-Carbon Economic Transformation. Southern Finance, 52–67.

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: updated guidelines. Industrial management & data systems, 116(1), 2–20.

Harari, Y. N. (2017). Homo Deus: A Brief History of Tomorrow. London: Vintage.

Huang, G., & Li, W. (2022). E-CNY promotes digital fiscal construction and fiscal digital transformation. Public Finance Research, 29–43.

Huang, J. (2021). The application status and development suggestions of E-CNY in low-carbon consumption scenarios. Western Finance, 90–93.

Jamie, B. (2024). Americans' top feeling about AI: caution. Available online: https://today.yougov.com/technology/articles/49099-americans-2024-poll-ai-top-feeling-caution (accessed on 2 June 2023).

Japutra, A., Roy, S. K., & Pham, T. A. N. (2021). Relating brand anxiety, brand hatred and obsess: Moderating role of age and brand affection. Journal of Retailing and Consumer Services, 60, 102465. https://doi.org/10.1016/j.jretconser.2021.102465

Li, D., & Azman, N. H. N. (2023). A review of the impact of artificial intelligence (AI) trust concerns on digital Chinese Yuan (E-CNY) to promote Chinese economic low-carbon sustainable development. Journal of Infrastructure, Policy and Development, 8(1).

Ma, G. (2009). Analysis of the operating cost of Chinese cash currency. Financial Theory & Practice, 49–52.

Omrani, N., Rivieccio, G., Fiore, U., et al. (2022). To trust or not to trust? An assessment of trust in AI-based systems: Concerns, ethics and contexts. Technological Forecasting and Social Change, 181, 121763. https://doi.org/10.1016/j.techfore.2022.121763

Qi. L., Jiang, Z., Zhao, H., et al. (2018). A brief analysis of news media supporting the development of a low-carbon economy: Taking the dissemination of the low-carbon concept in Zhenjiang as an example. Journal of Journalism Research.

Rogoff, K. (2017). The curse of cash: How large-denomination bills aid crime and tax evasion and constrain monetary policy. Princeton University Press. https://doi.org/10.1515/9781400888726

Wang, G., Hu, K. (2024). Five problems to be solved in the expansion of E-CNY. Fujian Forum (Humanities and Social Sciences Edition), 54–71.

Wang, L. (2018). The Challenge of Artificial Intelligence to Civil Law. China City Daily.

Wen, J. (2009). Crime prevention theory research. Journal of Guangzhou Police College, 19(04), 34–37.

Xiong, J., & Xun, Q. (2018). The nature, value and future development of virtual currency. Journal of Panzhihua University, 35(03).

Zhai, D. (2018). Big data kills familiarity: the person who knows you best hurts you the most. Science and Technology Daily, 28.

Zhang, C. (2023). What will the E-CNY change? Prosecutorial View, 32–33.

Zhang, G., Kam C., & Chan. (2023). Central bank digital currency and corporate cash holdings: Evidence from China's E-CNY pilot. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4584652 (accessed on 2 June 2023).

Zhang, P. (2023). E-CNY assists low-carbon economy under the dual-carbon background. Shanxi Science and Technology News, 03, B03.