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# Article

# Internet technology and regional financial fraud: Evidence from Broadband expansion in China

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# Internet technology and regional financial fraud: evidence from Broadband expansion in China

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#### ABSTRACT

Combined with data from the Broadband China pilots, panel data on financial fraud in prefecture-level cities from China Judgments Online are used to examine the impact of internet technology on financial fraud. We find that internet technology has significantly increased city financial fraud. The causal effect still exists after the model validity test, excluding the selection bias of Broadband China pilot cities and the reporting effect of the internet. Furthermore, the trust effect is an important mechanism, and heterogeneity analysis shows that internet technology has a more significant impact on the financial fraud committed by highly educated and young fraudsters and on high-tech-dependent financial fraud.

#### **ARTICLE HISTORY**

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#### **KEYWORDS**

Internet technology: financial fraud; Broadband China; trust effect

### 1. Introduction

In recent years, as the financial landscape has become more complex and financial risk products have become more diverse, financial fraud crimes have continued to grow (Burke et al., 2022; Wei et al., 2021). According to statistics from the Financial Conduct Authority (FCA), the total amount of financial fraud in the UK in 2021 exceeded 1.3 billion pounds. The 2022 IBM Global Financial Fraud Impact Report shows that each adult in Germany loses an average of 3519.99 euros due to financial fraud every year. The situation in China is also not optimistic. According to the China Household Finance Survey (CHFS), approximately 58% of Chinese residents have suffered from various types of financial fraud, such as telephone fraud, face-to-face fraud, and internet fraud. Rampant financial fraud has brought serious harm, which not only has a significant negative impact on regional business activities (Fe & Sanfelice, 2022) but also reduces the consumption desire of victims (Mejia & Restrepo, 2016) and reduces their financial confidence (Brenner et al., 2020). In addition, people who suffer from financial fraud

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are more likely to have psychological problems (Dustmann & Fasani, 2016), such as anger, frustration and even depression (DeLiema et al., 2020).

Moreover, the rapid development of internet technology has completely changed people's lifestyles (Diegmann, 2019) and has had a major impact on the financial structure (Niu et al., 2022). However, what is the net impact of internet technology on financial fraud? It depends on the strength of several theoretical mechanisms. On the one hand, internet technology can facilitate financial fraud to a certain extent. The use of the internet has expanded people's social scope, which virtually increases the probability of contact between internet users and fraudsters (Pratt et al., 2010), providing convenience for fraudsters to carry out fraud. Moreover, internet technology has made fraud crimes more easily concealed, faster to carry out, and more diverse, which makes them difficult for individuals to identify (Wei et al., 2021). The social trust between people is improved by using the internet (Bouchillon, 2014), which can also increase the chance of fraud.

On the other hand, internet technology may reduce financial fraud. The popularization of the internet makes information transmission cheaper and easier to obtain (Diegmann, 2019). People can use network information and communication technology to learn financial knowledge and improve financial literacy more conveniently, while a lack of financial knowledge is an important reason for financial fraud (DeLiema et al., 2020; Engels et al., 2020). Relevant departments also use internet technology to improve anti-fraud capabilities. For example, law enforcement agencies use information technology to track fraud, launching the National Anti-Fraud Center APP to improve the public's ability to identify fraud.

Given the ambiguity and controversy of the above theoretical explorations, the impact of internet technology on financial fraud has become an important empirical issue. To address this issue, we choose a quasi-natural experiment: the Broadband China pilot policy launched by the Chinese government in 2014. We use financial fraud data at the prefecture-level city level to provide empirical evidence for solving the puzzle between internet technology and financial fraud.

The regression results of the DID model show that the policy impact of improving internet technology leads to higher financial fraud in demonstration cities than in nondemonstration cities. The relationship still holds after a series of causal identifications, including the validity of the DID model, the exogeneity of the pilot cities, and the reporting bias of fraud cases. Further analysis shows that the use of internet technology has significantly increased people's trust in strangers, which is an important mechanism by which internet technology increases the financial fraud rate. Moreover, the effect of internet technology is more significant for young or highly educated fraudsters, as well as in high-tech-dependent financial fraud.

This study makes two possible contributions to the literature. First, our study provides new insights and ideas for research on the factors influencing financial fraud. Most of the literature focuses on the micro-factors that affect financial fraud. For example, studies have found that elderly individuals (DeLiema et al., 2020) and those who are overconfident (Xiao et al., 2022), impulsive (McAlvanah et al., 2015), or depressed (Lichtenberg et al., 2013) are more likely to be victims of financial

fraud. People with rich financial knowledge or high financial literacy are less likely to be defrauded (Wei et al., 2021) because they can identify fraudulent behavior (Engels et al., 2020) and choose financial products that suit them by accurately evaluating the risks and returns of financial products (Agarwal et al., 2015). However, few studies focus on the impact of changes in macro-factors on financial fraud. Our study supplements this gap from the perspective of internet technology, confirming that the development of city internet technology can significantly increase local financial fraud. And as far as we know, our study is also among the first to estimate the causal effects of internet expansion on financial fraud at the country level.

Second, our study contributes to the diverse effects of technological progress on social development (Acemoglu, 2002; Bresnahan et al., 2002), especially the literature on the impact of internet technology on illegal behavior (Moore et al., 2009; van de Weijer & Moneva, 2022). Internet technology not only breeds new types of crimes, such as hacker attacks (Holt & Bossler, 2014), but also brings new methods and influences to some traditional crimes (Moore et al., 2009). Bhuller et al. (2013) find that internet use significantly increases sexual crimes, such as rape, which may be a result of increased pornography consumption. Diegmann (2019) uses data from prefecture-level cities in Germany to find that the use of the internet can reduce the overall sexual crime rate, which he believes is caused by the substitution effect of the internet. Martin et al. (2020) point out that the invisibility of the internet has brought drug transactions online, reducing criminal exposure from street transactions. Further research by Zambiasi (2022) shows that the closure of the dark net led to a substantial increase in the street drug trade. In addition, Baker (2002) theoretically clarifies that the use of the internet makes fraudulent behavior lower in cost and wider in scope and notes that e-commerce fraud and internet company fraud are key areas. Our study supplements this kind of literature on financial fraud crimes and provides a wealth of empirical evidence that the development of internet technology has greatly increased financial fraud.

The rest of this paper is structured as follows: Section 2 introduces the institutional background and research hypotheses; Section 3 presents the data sources and empirical strategies; Section 4 presents the empirical results, including causal inferences and robustness tests; Section 5 provides further analysis, including mechanism analysis and heterogeneity analysis; and Section 6 presents the conclusions and policy implications.

# 2. Institutional background and research hypotheses

# 2.1. Institutional background

At the beginning of the 21st century, there is still a large gap between China's infrastructure construction and the world's advanced level (Li et al., 2022). In this context, the State Council issued the Broadband China Strategy and Implementation Plan in August 2013, which aims to "solve key issues such as broadband network access speed,

VARIABLES	(1) BandContact	(2) BandContact	(3) BCRatio	(4) BCRatio
Treat×Post	30.6400*** (11.5885)	24.3822** (10.9255)	0.0379*** (0.0125)	0.0244** (0.0124)
Control Variables	NO	YES	NO	YES
Constant	79.1994***	-238.9094	0.1792***	0.5231**
	(1.7871)	(176.3095)	(0.0019)	(0.2416)
Observations	4,215	4,215	4,215	4,215
R-squared	0.6460	0.6513	0.7471	0.7597
Year FE	YES	YES	YES	YES
City FE	YES	YES	YES	YES

Table 1. Impact of Broadband China on internet penetration.

(1) \*, \*\* and \*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the city level.

coverage, and application popularization". Notably, the Ministry of Industry and Information Technology of China and the National Development and Reform Commission jointly issued the "Management Measures for Creating Broadband China Demonstration Cities (City Agglomeration)" to implement the Broadband China strategy. Through the creation of pilots, the development mode of demonstration cities can play a greater demonstration and leading role in similar cities across the country (Zhou et al., 2022). The project selected a total of 117 pilot cities (Appendix A) in three batches between 2014 and 2016 and achieved qualitative improvement in the construction of broadband internet in these cities (Li et al., 2022).

The method of piloting in batches has a great positive impact on the improvement in broadband infrastructure in the pilot cities, greatly increasing their internet penetration rate and making their broadband infrastructure construction much higher than that of cities that did not participate in the pilot projects (Luo et al., 2022). It can also be seen from the correlation analysis between Broadband China pilots and city internet development (Table 1). Demonstration cities have significantly promoted the increase in the number of internet broadband access users (*BandContact*) and have a significant effect on internet penetration (*BCRatio*). That is, the Broadband China strategy can improve broadband infrastructure construction and internet usage in demonstration cities.

Figure 1 clearly shows the sequential treatment of the cities. We find that the selection of the demonstration cities has a certain randomness since they are widely distributed, have different economic conditions, and differ greatly in their regional characteristics. Therefore, the policy is also a suitable quasi-natural experiment to identify the impact of internet development on various issues in China (Li et al., 2022), which provides us with an opportunity to explore the impact of internet technology on financial fraud.

# 2.2. Theoretical analysis and research hypotheses

What is the impact of internet technology on financial fraud? The answer depends on the mechanical strength of the following two aspects.

On the one hand, internet technology provides convenience for financial fraud, making it easier for people to be defrauded. The popularity of the internet and the development of technology have promoted the use of a series of social software, such as WeChat and QQ, which has expanded people's social scope. This has significant implications for increasing



Figure 1. The sequential treatment of the cities.

people's social trust (Bouchillon, 2013), making it easier for them to trust information delivered by strangers and subsequently increasing the probability of being defrauded.

At the same time, internet technology has diversified financial fraud methods, increasing the probability of people becoming targets of fraud, especially those who easily trust others. For example, fraud gangs use fake financial or lending apps to counterfeit well-known financial institutions or internet companies, making people easily trust their fraudulent products. Using digital technology makes financial fraud more targeted and accurate, especially fraud schemes tailor-made for certain types of people or a certain situation, which improve the fraud success rate (DeLiema et al., 2020).

In addition, while online social networking based on internet technology brings convenience to daily communication, it also exposes people to fraudsters to a greater extent (Pratt et al., 2010), especially for groups of people who are more likely to trust strangers.

On the other hand, internet technology also has the potential to reduce financial fraud. First, the development of internet technology improves people's financial literacy and anti-fraud capabilities. It enriches the channels and ways for people to obtain information (Luo et al., 2022), which brings a "learning effect" that can enable them to more quickly acquire new skills, accumulate new knowledge, and improve financial literacy and fraud detection capabilities (DeLiema et al., 2020; Engels et al., 2020).

Second, internet development improves relevant departments' anti-fraud technology. When internet technology is widely used by fraudsters to carry out financial fraud, it can also motivate law enforcement to actively explore ways to prevent financial fraud. For example, the Ministry of Public Security of China has launched the National Anti-Fraud Center APP, which plays a key role in anti-fraud measures. The APP was officially launched on 15 March 2021, and has been promoted and popularized nationwide. In that year, it urgently stopped the payment of more than 320 billion yuan of funds involved in fraud and intercepted 1.55 billion fraudulent calls. As of June 2023, the APP has accepted a total of 23.23 million reporting clues and issued 310 million early warnings to the public.

Based on the above analysis, the causal relationship between internet technology and financial fraud is uncertain. In theory, there are two diametrically opposed and relatively reasonable relationships. Therefore, how internet technology affects financial fraud has become an important empirical issue whose examination requires rigorous data and empirical methods. This is the starting point and the issue to be solved in this study.

# 3. Data sources and empirical strategies

# 3.1. Data sources

The data come from the "China City Statistical Yearbook" and the China Judgments Online (https://wenshu.court.gov.cn/). As an open online platform for judicial judgment documents, China Judgments Online uniformly publishes the effective judgment documents of the people's courts at all levels, which can provide the most objective, accurate and complete research data to identify financial fraud crimes. Appendix B reports the specific data cleaning process.

For some cities and years missing statistical data, the statistical yearbook of the province (municipality or autonomous region) is used to complete the data as much as possible. We consider all cities in the "China City Statistical Yearbook", where treated units are Broadband China demonstration cities, and control cities are the remaining cities in the yearbook. We also exclude some cities since there are too many missing data points in the sample period, and it is difficult to complete them by consulting the data. Finally, we construct panel data covering 281 cities from 2006 to 2020, including 108 treated units and 173 control units.

# 3.2. Characteristic facts

Figure 2a and Figure 2b show the change in the total number of financial fraud cases, the total number of defendants, and the average referee time between 2006 and 2020 for the treated and control groups. Overall, the two groups show a consistent trend of financial fraud first increasing and then decreasing. Specifically, the number of financial fraud cases and the number of defendants increased significantly after 2014, which basically coincides with the implementation of the Broadband China strategy. The year 2016 is the peak period of financial fraud cases, but the number of cases and the number of defendants in the following years decreases significantly, indicating that financial fraud crimes show a decreasing trend. In addition, we find that the average referee time has an upward trend, indicating that the difficulty of solving financial fraud cases is increasing.



Figure 2a. Trend of financial fraud changes (Treat).





Figure 3a and Figure 3b show the changes in the characteristics of financial fraud defendants for the treated and control groups. Overall, there are significant differences between the two groups. For the treated group, the proportion of financial fraudsters with a bachelor's degree or above and younger than 35 has fluctuated and increased, indicating that financial fraudsters are developing toward a higher education level and younger trends. For the control group, the proportion of financial fraudsters with

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Figure 3a. Trend of defendants with a bachelor's degree or above and under 35 years old (Treat).



Figure 3b. Trend of defendants with a bachelor's degree or above and under 35 years old (Control).

a bachelor's degree or above and younger than 35 is relatively stable, indicating that financial fraudsters in control cities do not show significant changes in characteristics.

The types of financial fraud, whether internet-based fraud or traditional-form fraud, can be significantly affected by the development of internet technology. The following classic examples of fundraising fraud can provide some qualitative evidence.

**Example 1:** In 2019, Guo from city  $S^1$  established an online investment platform "Yuehui Fortune", publicly promoted it to unspecified groups, and promised annual returns of up to 50%. His fraudulent activity mainly included using this online platform to publish false targets to attract investments from the public. He then used the proceeds from his fraudulent activity to pay for high interest loans and his personal consumption by borrowing and repaying old loans.

**Example 2:** In 2017, Li from city N promoted high rebates that could be obtained by investing in nursing home projects. He made phone calls and distributed promotional materials, enabling him to illegally absorb more than 10 million yuan in funds raised from more than 80 fundraising participants. In the process, Li established a fake company webpage to gain victims' trust.

In summary, example 1 is of a new fraud method based on internet technology. Its trading platform, fundraising means and subject matter are all online. In example 2, traditional methods were used, such as making phone calls and distributing promotional materials to defraud people, and the use of internet technology improved the success rate of the fraudulent activity.

# 3.3. Model setup

To effectively identify the impact of internet technology on financial fraud, referring to the literature (Li et al., 2022; Luo et al., 2022), we construct a quasi-natural experiment using the Broadband China pilot cities and use DID to perform empirical analysis. The DID model is as follows:

$$FinFraud_{i,t} = \mathbf{a}_0 + \mathbf{a}_1 Treat_i \times Post_t + \mathbf{a}_2 X_{i,t} + \mathbf{\delta}_i + \mathbf{\theta}_t + \mathbf{\varepsilon}_{i,t}$$
(1)

where *i* represents the city, *t* represents the year; the explained variable *FinFraud* is the financial fraud in prefecture-level city level; *Treat* is a dummy variable of the Broadband China pilot cities, where if the city is a demonstration city, the value is 1, otherwise 0; *Post* is a dummy variable that divides whether a city becomes a pilot city according to the time dimension, where after a city becomes a pilot city, the value is 1, otherwise 0;  $X_{i,t}$  represents control variables;  $\delta_i$  is the city-fixed effect;  $\theta_t$  is the time-fixed effect;  $\theta_t$  is the random error term. The coefficient  $\alpha_1$  of *Treat*<sub>i</sub> × *Post*<sub>t</sub> represents the causal effect of internet technology on financial fraud.

# 3.4. Variables

# 3.4.1. Explained variable: financial fraud

We aggregate all types of financial fraud to measure financial fraud and construct prefecture-level city panel data to obtain the ratio of the number of first-instance criminal cases of financial fraud to the registered population of the city at the end of the year. According to the "Criminal Procedure Law", financial fraud refers to the act of

<sup>&</sup>lt;sup>1</sup>To protect privacy, we have not identified the specific city, and the following cases are treated similarly.

defrauding public or private property or the credit of financial institutions for the purpose of illegal possession by fabricating facts or concealing the truth and disrupting the order of financial management. Financial fraud specifically includes eight types of securities fraud: letter of credit fraud, credit card fraud, bill fraud, financial certificate fraud, fundraising fraud, loan fraud, and insurance fraud. The explained variable used in this study covers eight types of financial fraud, which is a comprehensive measure of all financial fraud crimes.

However, it should be noted that measurement errors are inevitable based on the number of cases (Freeman, 1999; Levitt, 1998). To prevent measurement errors to the greatest extent, we take criminal cases of first instance as the research object. For criminal offences, although there are measurement errors, cases such as undiscovered, unreported, and unregistered cases are relatively few, and the negative impact on society and the impact on the empirical analysis conclusions are relatively small (Levitt, 1998). Thus, it is still relatively reliable to use the official records of China Judgments Online to measure financial fraud. In addition, we use a series of methods to prevent the possible impact of case reporting bias.

#### 3.4.2. Core explanatory variable: internet technology

The core explanatory variable, internet technology, is mainly measured through the quasi-natural experiment constructed by the Broadband China pilot cities. The treated group and the control group are set according to the list of Broadband China demonstration cities and their approval time. If the city becomes a demonstration city of Broadband China in that year, then it belongs to the treated group in that year and the subsequent years, and the value is 1; otherwise, it is included in the control group, and the value is 0.

Variables	Definition	Measurement
Fraud	City financial fraud cases	The total number of financial fraud cases
FraudRate	City financial fraud incidence	The ratio of the number of financial fraud cases to the city's population
GDP	City's GDP	The logarithm of GDP
Adv	City's industrial structure	The proportion of employees in the tertiary industry to all employees
Open	The ability of a city to attract foreign investment	The logarithm of the amount of foreign capital actually used
Gov	City's public budget expenditure	The proportion of general public budget expenditure to GDP
Fin	The development of a city's traditional finance	The proportion of year-end balance of RMB deposits and loans of financial institutions to GDP
Wage	City's average wage level	The logarithm of the average salary of employees on the job
Retail	City's social consumption level	The proportion of total retail sales of social consumer goods to GDP
PhoneUser	City's mobile phone users	The proportion of mobile phone users to the year- end registered population
FixPhoneUser	City's fixed-line telephone users	The proportion of fixed-line telephone users to the year-end registered population
IntExp	The expenditure of a city's government on science and technology	The proportion of the expenditure on science and technology to GDP

Table 2. Variable definition.

		Tre	ated	Cor	ntrol
Variables	Obs.	Mean	Std.Dev	Mean	Std.Dev
Fraud	4,215	25.103	96.535	9.515	22.086
FraudRate	4,215	0.045	0.102	0.024	0.049
GDP	4,215	7.509	1.100	6.878	0.849
Adv	4,215	50.429	12.852	55.692	12.788
Open	4,215	10.452	2.005	9.355	1.782
Gov	4,215	0.165	0.139	0.198	0.105
Fin	4,215	2.544	1.454	2.143	1.007
Wage	4,215	10.691	0.508	10.571	0.504
Retail	4,215	0.370	0.107	0.369	0.106
PhoneUser	4,215	1.172	1.138	0.760	0.443
FixPhoneUser	4,215	0.282	0.267	0.173	0.116
IntExp	4,215	0.003	0.003	0.002	0.002

#### Table 3. Descriptive statistics.

# 3.4.3. Other control variables

To control other characteristics that affect financial fraud, a series of control variables related to the city's economic development, financial development, and residents' lives are also introduced, such as the city's GDP, industrial structure, and public budget expenditure. Table 2 reports the specific definition and measurement of each variable.

#### **3.5.** Descriptive statistics

Table 3 shows the descriptive statistics of the explained variable, core explanatory variable, and control variables of the treated group and the control group. The data range covers 281 cities from 2006 to 2020, with a total of 4,215 samples, including 1,620 samples of the treated group and 2,595 samples of the control group. According to the descriptive statistics, the mean of the total number of financial fraud cases in the treated group is 25.10. In contrast, the mean in the control group is 9.52, indicating that there are obvious differences in financial fraud between the Broadband China pilot cities and nonpilot cities. Moreover, the control variables, such as the regional GDP and the proportion of the tertiary industry, do not show significant differences between the treated group and the control group, indicating that the selection of pilot cities has a certain exogeneity.

# 4. Analysis of empirical results: internet technology and regional financial fraud

#### 4.1. Analysis of baseline regression results

Table 4 reports the baseline regression results of internet technology on financial fraud. Each column controls the city- and year-fixed effects and clusters the standard errors to the city level. Columns (1)–(2) show the impact of Broadband China on the number of financial fraud cases; columns (3)–(4) show the impact of Broadband China on the incidence of financial fraud.

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	5	57		
	(1)	(2)	(3)	(4)
Variables	Fraud	Fraud	FraudRate	FraudRate
Treat×Post	19.2324***	16.0299***	0.0291***	0.0246***
	(5.2979)	(4.5210)	(0.0072)	(0.0069)
GDP	,	-13.4189		-0.0246**
		(11.6893)		(0.0111)
Adv		0.1116		0.0003
		(0.1310)		(0.0003)
Gov		-20.1130		-0.0249*
		(13.1247)		(0.0131)
Fin		0.7527		0.0015
		(1.4530)		(0.0018)
Open		1.3678**		-0.0009
		(0.5534)		(0.0018)
Retail		-6.8496		-0.0172
		(11.6656)		(0.0180)
Wage		-13.3453*		-0.0357**
		(7.8767)		(0.0150)
PhoneUser		19.5180***		0.0307***
		(7.1224)		(0.0103)
FixPhoneUser		-42.3769**		-0.0363
		(18.0464)		(0.0435)
IntExp		1,120.6675		2.0159**
		(952.6757)		(0.8629)
Constant	12.5404***	223.9837	0.0275***	0.5550***
	(0.8170)	(153.0316)	(0.0011)	(0.1799)
Observations	4,215	4,215	4,215	4,215
R-squared	0.6007	0.6081	0.4930	0.5086
City FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

	Table 4.	Baseline	regression:	internet	technology	and	financial	fraud.
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(1) \*, \*\* and \*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are clustered standard errors at the city level.

The results in columns (1)-(2) show that Broadband China leads to a significant increase in the number of financial fraud cases, and the significance level is 1% before and after adding control variables. On average, after the implementation of Broadband China, the number of financial fraud cases in the city increased by approximately 16.03. Compared with the mean of the treated group at the beginning of the pilot year, the increase is 26.47%. The ratio of financial fraud cases to the city's population is also used. According to the results in columns (3)-(4), the estimated coefficients of Broadband China on the incidence of financial fraud are still significantly positive at the 1% level, indicating that Broadband China has significantly promoted the incidence of city financial fraud.<sup>2</sup> It can also be found that the implementation of Broadband China leads to a 2.46% increase in the incidence of financial fraud, and the increase is 24.38% compared with the mean increase of the treated group at the beginning of the pilot year.

Worth noting is that the identified effects incorporate any type of financial fraud. As mentioned above, given the development of internet technology, not only has more internet-based financial fraud become increasingly rampant but also traditional financial fraud methods have been significantly affected by the technology upgrade, which has increased all types of financial fraud.

<sup>&</sup>lt;sup>2</sup>Since the policy not only increases access to the internet at the national level but also improves the quality of internet utilization (Løken et al., 2017), the observed effects potentially incorporate both the effects of increased access and the effects of improved quality.

In addition, compared to estimates from other studies (Anderson, 2013; Engels et al., 2020), our results have significant economic significance. For example, Engels et al. (2020) used data from the United States and found that the probability of fraud increased by only 3% for every one standard deviation increase in an individual's financial knowledge. However, such a comparison with the results in the literature suggests that not much has been done in the research to empirically document the causal effect of increased internet access on financial fraud at the national level. Thus, the conclusion driven by the interpretation of the above results also provides new evidence that the development of internet technology can facilitate financial fraud.

# 4.2. Identification of causal effects

To ensure the accuracy of the causal relationship, the causal effect identification is further carried out in combination with three aspects: the model validity test, the exogeneity of the Broadband China pilot cities selection, and the reporting effect of the internet.

#### 4.2.1. Model validity test and dynamic effect analysis

An important condition for using DID is to satisfy the parallel trend assumption between the treated group and the control group (Li et al., 2022). To test whether the parallel trend assumption is met, referring to the literature (Li et al., 2022; Niu et al., 2022), the interaction term of the Broadband China dummy variable and the year dummy variable is added to model (1):

$$FinFraud_{i,t} = \boldsymbol{\beta} + \sum_{\substack{k=-4 \ k=-4}}^{k=-1} \boldsymbol{\beta}_k Treat_i \times Post_t^{\ k} + \boldsymbol{\beta}_0 Treat_i \times Post_t^{\ 0} + \sum_{\substack{k=-5 \ k=-4}}^{k=-1} \boldsymbol{\beta}_k Treat_i \times Post_t^{\ k} + \boldsymbol{\gamma} X_{i,t} + \boldsymbol{\delta}_i + \boldsymbol{\theta}_t + \boldsymbol{\zeta}_{i,t}$$
(2)

where the initial period is taken as the base period, the core explanatory variable of model (1) is replaced with a group of dummy variables of  $Treat \times Post^k (k = -4, ..., 0, ..., 5)$ , and *k* represents the year relative to the start of the Broadband China pilot work.

Table 5 reports the results of dynamic treatment effects, and Figure 4a and Figure 4b directly illustrate the dynamic effect on financial fraud before and after the pilot by plotting coefficient estimates and 95% confidence intervals. It can be found that the estimated coefficients of *Treat*×*Post*<sup>-4</sup>, *Treat*×*Post*<sup>-3</sup>, *Treat*×*Post*<sup>-2</sup>, *Treat*×*Post*<sup>-1</sup> (i.e., d\_4, d\_3, d\_2, d\_1 in the figure, the same applies below) are not significant at the 5% level, which shows that there is no systematic difference in financial fraud among cities before Broadband China and that the parallel trend assumption is satisfied.

In terms of the dynamic effect of Broadband China, the pilots already presented a significant impact in the first year. In fact, the policy effect is the most significant in the first year of the pilots. Within four years after the pilot's implementation, the influence of Broadband China is still relatively significant but is gradually declining. That is, the facilitation effect of internet technology on financial fraud continues to decline over time, which may be related to the improvement in people's anti-fraud knowledge. The internet changes people's traditional ways of learning, communicating, and obtaining information (Luo et al., 2022) and promotes the low-cost cross-regional dissemination of knowledge, information, technology, etc., which can improve people's fraud detection capabilities with

	(1)	(2)
Variables	Fraud	FraudRate
Treat×Post <sup>-4</sup>	1.9338	-0.0005
	(4.5813)	(0.0053)
Treat×Post <sup>-3</sup>	-1.1289	-0.0039
	(4.7477)	(0.0049)
Treat×Post <sup>-2</sup>	8.2301	0.0150
	(12.0819)	(0.0129)
Treat×Post <sup>-1</sup>	4.1398	0.0131
	(6.9694)	(0.0113)
Treat×Post <sup>0</sup>	27.7651**	0.0500***
	(11.8865)	(0.0172)
Treat×Post <sup>1</sup>	30.4331**	0.0448***
	(12.6314)	(0.0151)
Treat×Post <sup>2</sup>	21.6062**	0.0276***
	(8.9076)	(0.0102)
Treat×Post <sup>3</sup>	15.6526**	0.0165**
	(6.0731)	(0.0068)
Treat×Post <sup>4</sup>	6.4366**	0.0133**
	(2.8625)	(0.0053)
Treat×Post <sup>5</sup>	-3.4776	0.0031
	(7.7532)	(0.0083)
Control Variables	YES	YES
Constant	223.7841	0.5601***
	(148.4336)	(0.1771)
Observations	4,215	4,215
R-squared	0.6123	0.5153
City FE	YES	YES
Year FE	YES	YES

Table 5. Dynamic treatment effects.

(1) \*, \*\* and \*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the city level.



Figure 4a. Parallel trend test (number of financial fraud cases).



Figure 4b. Parallel trend test (incidence of financial fraud).

the increase in knowledge (Burke et al., 2022). Moreover, internet technology triggers the updating and upgrading of anti-fraud technology, such as the National Anti-Fraud Center App, which may be another important reason why the facilitation effect of internet technology on financial fraud continues to decline.

However, there may be some bias in the estimation of staggered DID. Callaway and Sant'anna (2021) point out that estimates using two-way fixed effects (TWFE) are biased if there is heterogeneity between groups or time points. Baker et al. (2022) also point out that since the treated and control groups are different at different time points, the treatment effect has strong heterogeneity, and the weighted average of multiple different treatment effects may produce estimation bias. Therefore, we use two approaches to ensure the validity of the results.

estimation.		
	(1)	(2)
	Fraud	FraudRate
policy effect	22.7326	0.0351
	(7.9294)	(0.0094)
LB CI	7.1910	0.0167
UB CI	38.2743	0.0534
placebo effect	-3.7387	-0.0020
	(7.2724)	(0.0098)
LB CI	-17.9926	-0.0213
UB CI	10.5151	0.0173
breps	100	100

Table	6.	Bias	test	for	staggered	DID	model
estimat	tion.						

(1) LB CI is the upper limit of the 95% confidence interval, UB CI is the lower limit of the 95% confidence interval, and breps is the sampling frequency. (2) The values in brackets are the standard errors at the city level.

	(1)	(2)
Variables	Fraud	FraudRate
ATT	11.9448*	0.0231**
	(7.0408)	(0.0116)
Control Variables	YES	YES
Observations	4,215	4,215
City FE	YES	YES
Year FE	YES	YES

Table	7.	Test	for	the	heterogeneity	of	treatment
effects.							

 \*, \*\* and \*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the city level.

On the one hand, we use the method proposed by De Chaisemartin and D'Haultfoeuille (2020) to test the robustness and validity of heterogeneous treatment effects. On this basis, they also propose a placebo Wald-TC estimator to test the common trend setting. The specific regression results are shown in Table 6. The effect of internet technology is 22.7326 and 0.03551, and the significance and value of the estimated results are slightly different from those of the baseline regression results, indicating that heterogeneity processing has little influence. In addition, the placebo effect estimates are -3.7387 and -0.0020, which do not reject the hypothesis that the placebo estimate is 0, indicating that the model meets the common trend setting.

On the other hand, Callaway and Sant'anna (2021) propose a new TWFE estimator that addresses the problem of treated vs. treated comparisons, and we include this method as a robustness check. It can allow for arbitrary treatment effect heterogeneity and dynamic effects, which helps prevent the problem of interpreting the results of the TWFE estimator as causal effects of DID. Therefore, we use this method to re-estimate model (1) to obtain a weighted average estimator of the time between groups. Table 7 reports the regression results. After considering the heterogeneity of treatment effects, the coefficients of the main explanatory variables are still significantly positive, which also verifies the robustness of the baseline estimation results.

#### 4.2.2. The exogeneity of Broadband China pilot cities

Another concern about the selection of a quasi-natural experiment is that the selection of Broadband China pilot cities may not be completely exogenous, and there are potential interfering factors that affect financial fraud. Both a certain level of basic network condition and adequate economic status are important for the pre-evaluation of provinces and the comprehensive evaluation of Broadband China experts (Li et al., 2022; Zhou et al., 2022), which may also lead to city selection bias.

Therefore, relevant factors affecting the exogeneity of the Broadband China pilot cities are controlled as much as possible to reduce the interference of selection bias. Since the selection of demonstration cities may be related to the city's preexisting broadband infrastructure and economic development, based on model (1), the average value of each city's GDP (*GDP3*), internet penetration rate (*BCRatio3*), technology investment (*IntExpense3*), and technological development (*IntWork3*) in the first three years is further controlled. Notably, the average value in the first three years is also dynamically

	(1)	(2)
Variables	Fraud	FraudRate
Treat×Post	12.3048***	0.0225***
	(4.2515)	(0.0069)
GDP3	-14.5297	-0.0034
	(9.8419)	(0.0195)
BCRatio3	87.6903*	0.1424***
	(52.3176)	(0.0369)
IntExpense3	-1.1632	-0.0093
	(8.7835)	(0.0127)
IntWork3	132.9056	-0.0887
	(135.4966)	(0.1741)
Control Variables	YES	YES
Constant	170.8359*	0.5102**
	(91.6929)	(0.1984)
Observations	3,372	3,372
R-squared	0.7151	0.5566
City FE	YES	YES
Year FE	YES	YES

 Table 8. Preventing the selection bias of Broadband

 China pilot cities.

(1) \*, \*\* and \*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the city level.

variable with a time trend. We calculate an average of the city's broadband infrastructure and economic development for the first three years.

The results are shown in Table 8. After controlling the city's preexisting broadband infrastructure and economic status, the estimated coefficients of Broadband China on *Fraud* (column (1)) and *FraudRate* (column (2)) are still significantly positive at the 1% level. Li et al. (2022) and Zhou et al. (2022) also confirm the validity of using Broadband China as a quasi-natural experiment.

#### 4.2.3. Reporting bias in financial fraud cases

In addition to measurement error in crime cases, case reporting bias needs attention. On the one hand, under China's vertical political management system, there is a fierce "political tournament" among local government officials (Li & Zhou, 2005). The promotion of officials is closely related to their performance, and the social governance environment is an important item in performance evaluation, so financial fraud can affect their political performance. In this context, to demonstrate a good regional legal environment and a low crime rate, local officials may underreport some criminal cases, which leads to reporting bias. This phenomenon may be more serious especially when officials change.

Therefore, the influence of local government officials is controlled in the baseline model; that is, a dummy variable is set according to whether there is a change in the mayor or the secretary of the municipal party committee during the sample period. If there is a change, it is 1; otherwise, it is 0. The results are shown in columns (1)-(2) of Table 9. After controlling for the impact of changes in local officials, the empirical results do not change significantly.

	Exclude changes in local government officials		Exclude cities with high internet penetration		Exclude the first cities to open internet courts	
Variables	(1) Fraud	(2) FraudRate	(3) Fraud	(4) FraudRate	(5) Fraud	(6) FraudRate
Treat×Post	16.0376***	0.0246***	13.0510***	0.0232***	11.7410***	0.0191***
	(4.5254)	(0.0069)	(3.9061)	(0.0068)	(4.0706)	(0.0059)
Political	-1.0686	0.0008				
	(1.2462)	(0.0018)				
Control Variables	YES	YES	YES	YES	YES	YES
Constant	226.2365	0.5533***	202.8712	0.5300***	38.2491	0.3068***
	(155.0978)	(0.1801)	(153.3713)	(0.1781)	(40.7292)	(0.1173)
Observations	4,215	4,215	4,170	4,170	4,065	4,065
R-squared	0.6082	0.5087	0.6168	0.5093	0.4702	0.4621
City FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Table 9. Reporting bias in financial fraud case
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(1) \*, \*\*\* and \*\*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the city level.

On the other hand, the internet's own reporting effect needs to be accounted for when examining the impact of the internet on fraud. Diegmann (2019) point out that the internet may change the way individuals report crimes. For example, victims may make anonymous reports directly through the platform, which increases the possibility of criminal exposure. In other words, the popularity of the internet may increase only the number of reported cases but not the actual crimes (Bhuller et al., 2013).

Following Diegmann (2019), we remove the top 10 cities in terms of China's internet penetration rate and the cities that first opened internet courts for re-estimation because these cities are most susceptible to the internet "reporting effect". The regression results are shown in columns (3)–(6) of Table 9. The positive impact of Broadband China on financial fraud is still significant, indicating that internet technology can still promote an increase in financial fraud.

#### 4.3. Other robustness tests

In addition, we carry out a series of other robustness tests to ensure the reliability of the baseline regression results, including replacing core variables, conducting subsample examination, correcting the differences between the treated and control groups, considering the time lag, controlling the influence of omitted variables and macro factors, and excluding relevant policy interference. After the robustness tests (Appendix C), the baseline results still hold.

#### 5. Further analysis

#### 5.1. Mechanism analysis: how does internet technology affect financial fraud?

Based on the above analysis, it can be concluded that internet technology can promote financial fraud. Then, how exactly does internet technology affect financial fraud? Next, we give possible reasons mainly from the trust mechanism.

(1) (2) (3) (4) (5)	(6)	(7)	(8)
variables interuse phoneuse iruststr iruststr iruststr	FrauaTar	FrauaTar	FrauaTar
Treat×Post 0.0245** 0.1138*** 0.0695**	0.0139		
(0.0113) (0.0116) (0.0330) (	(0.0241)		
InterUse 0.0687**		-0.0083	
(0.0290)		(0.0294)	
PhoneUse 0.2645***			0.0301
(0.0289)			(0.0204)
Treat×Post×TrustStr C	0.0205**		
(0	0.0102)		
InterUse×TrustStr		0.0270**	
		(0.0131)	
PhoneUse×TrustStr			0.0429***
			(0.0086)
TrustStr 0	0.0207***	0.0232***	-0.0006
(0	0.0050)	(0.0049)	(0.0028)
Control Variables YES YES YES YES YES YES	YES	YES	YES
Constant -0.0430 0.4230*** 2.1272*** 2.1876*** 2.0587***	0.0136	0.0599	0.0485
(0.0319) (0.0312) (0.1045) (0.1000) (0.0998) (	(0.0446)	(0.0431)	(0.0420)
Observations 10,022 10,013 5,378 5,378 5,375	5,377	5,377	5,374
<i>R-squared</i> 0.0361 0.2577 0.0586 0.0588 0.0728	0.1142	0.1142	0.1362
City FE YES YES YES YES YES	YES	YES	YES

#### Table 10. Trust mechanism.

(1) \*, \*\*\* and \*\*\*\* represent significance at the levels of 10%, 5% and 1%, respectively; (2) The values in brackets are the clustered standard errors at the family level. (3) IntUse indicates whether an individual uses the computer to go online and takes the value of 1 if yes and 0 if no. PhoneUse indicates whether an individual uses the smartphone to go online and takes the value of 1 if yes and 0 if no.

The use of the internet broadens people's social scope, especially by building a "bridge" of communication between strangers. Moreover, internet users are inclined to interact with people with similar views, which enhances social trust (Bouchillon, 2013). Both situations can increase the possibility of individuals becoming victims of fraud because too much trust in strangers can lead people to reduce their exercise of personal judgment and defense.

Given these facts, we use the micro-database of the China Household Finance Survey (CHFS) in 2015 for empirical testing. As mentioned by Wei et al. (2021), people who trust strangers more are more likely to become fraud targets. Therefore, "degree of trust in strangers" (*TrustStr*) is used as the proxy variable, and the related question is "How much do you trust people you don't know?" Individual characteristics (gender, household registration, work, health) and family characteristics (family size, number of children, family asset, family debt) are further controlled.

The regression results are shown in Table 10. First, we set two virtual variables of whether an individual uses the computer to go online (*InterUse*) and whether an individual uses a smart phone to go online (*PhoneUse*), which takes the value of 1 if using the Internet and 0 otherwise. The results in columns (1)-(2) show that the Broadband China policy indeed increases the personal use of the internet.

Then, according to the regression results in columns (3), Broadband China has promoted individuals' trust in strangers. That is, the promotion effect of internet technology on financial fraud is achieved by increasing trust in strangers. We also 20 😔 Q. XUE ET AL.

conduct a re-examination using only microlevel individual data (columns (4)-(5)). The results show that individuals who use the internet are more likely to increase their trust in strangers.

Further, we use interaction term models to examine whether people are more vulnerable to financial fraud in the context of internet development as social trust increases. The explained variable is whether an individual has suffered financial fraud, and the dummy variable for "encountered financial fraud" is used as a proxy variable. This variable takes the value of 1 if fraud is encountered and 0 otherwise. If the estimated coefficient of the interaction term is significantly positive, then as trust in strangers increases, internet technology makes individuals more vulnerable to financial fraud. The results in columns (6)-(8) show that the estimated coefficients of the interaction terms are all significantly positive, confirming the above expectation. Therefore, the above empirical results show that internet technology increases people's trust in strangers, making them more vulnerable to financial fraud.

# 5.2. The heterogeneous impacts of internet technology on financial fraud

We also explore which groups have been most affected by internet technology. Heterogeneity analysis is conducted from two aspects: the characteristics of the defendant and the technology dependence of financial fraud.

# 5.2.1. Heterogeneity of defendant characteristics

The impact of internet technology on financial fraud may be related to the defendant's own characteristics. For individuals with higher education and younger age, the ability to master and apply internet technology is stronger, and the likelihood of being exposed to the internet is greater. Thus, we perform subsample testing separately based on the



Figure 5. Heterogeneity by defendant's education.



Figure 6. Heterogeneity by defendant age.



Figure 7. Heterogeneity of financial fraud types.

education and age of the defendants. Education is divided into three subsamples: junior high school and below, junior high school and below undergraduate, and undergraduate and above. Age is divided into three subsamples: under 30, over 30 and under 50, and over 50. Figure 5 and Figure 6 report the results.

According to Figure 5, Broadband China has no significant impact on the financial fraud of defendants whose education level is undergraduate or below, but its impact is significantly positive for those with an undergraduate degree or higher, indicating that internet technology mainly promotes the increase in financial fraud among the highly educated.

According to Figure 6, Broadband China has a significantly positive effect on financial fraud for defendants aged 50 and younger but is not significant for those older than 50. Moreover, the coefficient of the group younger than 30 is more significant (5% significance) than that of the group older than 30 and younger than 50 (10% significance), indicating that internet technology mainly promotes financial fraud among young people. Overall, internet technology has a more significant facilitation effect on the financial fraud carried out by highly educated and young fraudsters.

#### 5.2.2. Technology-dependent heterogeneity of financial fraud

There are differences in the technological dependence of different financial fraud crimes, which may lead to differential effects of internet technology. For example, internet technology drives the development of digital payments, brings about the digitization of identity information and spawns online fundraising platforms that facilitate credit card fraud, loan fraud, fundraising fraud and other high-tech-dependent types of fraud. However, financial fraud, such as insurance fraud, which is mainly related to individuals defrauding insurance funds by fabricating insurance targets and creating insurance accidents, is relatively weakly connected to internet technology. Therefore, we classify credit card fraud, fundraising fraud, and loan fraud as high-tech-dependent financial fraud and securities fraud, letter of credit fraud, bill fraud, financial certificate fraud, and insurance fraud as low-tech-dependent financial fraud and then perform subsample testing.

The results are shown in Figure 7. The estimated coefficients of Broadband China in the two groups are both significantly positive, but the coefficient is more significant and larger in the high-tech dependent group than in the low-tech dependent group. That is, the impact of internet technology on high-tech-dependent financial fraud is even more significant.

In addition, differentiating between financial fraud crimes related to technology and those not related to technology represents a useful placebo test. According to the above regression results, internet technology plays a significant role in facilitating financial fraud of different technology-dependent types, while high-tech-dependent financial fraud is more strongly affected.

# 6. Conclusions and policy implications

Does the development of internet technology increase or decrease financial fraud? We use the Broadband China demonstration cities to construct a quasi-natural experiment and combine prefecture-level city panel data of financial fraud from 2006 to 2020 to test the causal relationship. The results show that Broadband China has a significant promotion effect on the number and incidence of city financial fraud; that is, internet technology has a facilitation effect on financial fraud. The mechanism analysis shows that the trust effect of the internet is an important path that can increase trust in strangers and then increase the possibility of individuals becoming victims of fraud. Furthermore, heterogeneity analysis shows that internet technology is more likely to increase financial fraud carried out by highly educated and young fraudsters, and it has a more obvious effect on high-tech-dependent financial fraud.

Based on the above conclusions, we also draw the following three policy implications. First, people's awareness of network security and a correct sense of trust must be cultivated to prevent more individuals from becoming targets of financial fraud. The development of internet technology has increased financial fraud, an important mechanism of which is increased trust in strangers. Therefore, the government should popularize internet safety education, enhance people's awareness of prevention with respect to strangers - especially online strangers, which is helpful for preventing individuals from becoming victims of financial fraud in the first place. Second, internet technology should be robustly used to improve anti-fraud technology. Internet technology also provides opportunities for the optimization of anti-fraud technology, such as the National Anti-Fraud Center app. Relevant departments should continuously upgrade anti-fraud technology to implement fraud warnings, fraudster reporting, anti-fraud publicity, etc., related to new types of financial fraud, which can also protect personal property. Third, the focus should be on preventing and controlling high-tech-dependent financial frauds, including credit card fraud, fundraising fraud, and loan fraud, which depend strongly on the internet for transactions. It is necessary to pay attention to protecting private information when sharing data. Credit card fraud, for example, is primarily about obtaining other people's credit card information to illegally take possession of their finances. Meanwhile, strengthening the real-time monitoring of transactions, which can provide early warning of financial fraud, is essential.

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