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Formalize the informal: market segmentation and integration in the formal and informal credit markets in Wenzhou

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ABSTRACT

In 2012, the Chinese government designated Wenzhou city as a testbed for policy experimentation aimed at institutionalizing informal lending practices. This study investigates how interest rates in the formal and informal credit markets interacted before and after this policy experimentation. Hence, we use the vector autoregression models and ordinary multiple regression method, which is based on the financial repression theory. We document large yield spreads between the formal and informal credit markets in Wenzhou before (2003–2011) and after (2013–2018) the reforms. We find an increase in the responsiveness of the informal sector to the formal sector, after the reforms. We argue that the informal financial system serves as a one-way substitute for the formal financial sector in Wenzhou. An analysis of the transaction-level data suggests that maturity, availability of collateralization, loan purpose, and the amount of loans determine informal lending rates. Thus, this study provides important policy implications for reforming China's financial system.

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1. Introduction

Several emerging economies are saliently characterized by the coexistence of formal and informal credit markets. For example, China's mainstream financial systems comprise large state-owned banks and government-regulated formal financial markets. Generally, formal finance allocates funds to large enterprises at low interest rates. Regarding informal finance, it is widespread in environments characterized by financial repression and rapid economic growth. Small and medium-sized enterprises use informal financing to obtain funds for development. Informal finance refers to the non-bank financing activities involving individuals and enterprises and to the financing activities of various private financial organizations (World Bank, 1997). It

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comprises small, unsecured, and short-term loans to individuals or small businesses that are not served by formal finance and that are unregulated by monetary and banking authorities (Ayyagari et al., 2010).

Informal finance has played an important role in China's economy for several years. As per the report of the governor of the central bank of China, in 2018, small and medium-sized enterprises (SMEs) and sole proprietorship accounted for over 90% of businesses in mainland China and contributed to 80% of the total employment. However, most private SMEs in China encounter financing difficulties. The financial repression has made it difficult and expensive for these firms to obtain funds from formal financing organizations. Therefore, China is active in informal financing. According to available statistics, China's informal finance market reached approximately 10.1 trillion RMB in 2020, accounting for 5.7% of the RMB loan balance and 23.7% of the loan balance of SMEs in the same period (https://new.qq.com/omn/20220307/20220307A06PPH00.html). Given this scale, informal finance has become an important agenda of financial reforms.

It is worth noting that there has been limited research on the relationship between these two credit markets. On the one hand, the lack of authoritative, large-scale informal financial data has led most studies to consider theoretical models in emerging economies and has prompted little empirical analyses (Jain, 1999; Qin et al., 2014). These studies have adopted vector autoregression (VAR) models. However, VAR models require large sample data to produce accurate empirical results. On the other hand, despite its significance, there has been no examination of whether the financial environment, especially the financial system reform, influences the relationship between formal and informal credit markets (Karaivanov & Kessler, 2018).

Concerning this relationship in Wenzhou, the city fell into a debt crisis in 2011 due to financial lending in the same period. Subsequently, in March 2012, the Chinese government established the first pilot zone for comprehensive financial reforms in Wenzhou. Given this, it is worthwhile to compare the impact of the financial environment before and after the establishment of the comprehensive financial reforms. There are policy and academic implications of using these data to examine the impact of formal finance on informal finance in relation to interest rates.

This study considers Wenzhou as the research object for several reasons. The city has a vibrant private economy, with 95% of its output produced by privately owned enterprises (POEs) (http://finance.sina.com.cn/roll/2018-12-31/doc-ihmhafir4532558.shtml). Wenzhou has also been extraordinarily active in the informal lending market. Wenzhou Branch of the People's Bank of China (2012) reported that, in 2012, 89% and 59% of the individuals or households and enterprises, respectively, participated in the private lending market. As stated earlier, in 2011, the city experienced an unprecedented debt crisis triggered by the tightening of the central bank's monetary policy and the burst of the Wenzhou real estate bubble. In response to the severity of the crisis, the central government attempted to legalize private lending through a policy experiment. Specifically, the government selected Wenzhou as a pilot area for experimenting with new regulations aimed at recognizing and monitoring informal lending activities. This led to the emergence of several loan agencies from the underground economy. Based on local lending rates tracked to 2013, Wenzhou's municipal

government publishes an informal interest rate index in private lending daily. These aspects demonstrate the significance of Wenzhou as the research object.

In the context of Wenzhou, the findings present strong policy implications; hence, this study's conclusion is not one-sided. The reasons are as follows. First, the private debt crisis in the second half of 2011 severely stagnated Wenzhou's economy. Therefore, in March 2012, the Chinese government approved Wenzhou as the first pilot zone in the state for the comprehensive financial reforms. Hence, there is considerable policy significance in examining the effects of financial reforms. Second, Wenzhou is the only city in mainland China with complete data on informal financial lending rate indicators. Guangzhou provides data until 2012, and thus leads to an incomplete dataset. Hence, this study considers data from Wenzhou.

In this study, we examine the relationship between interest rates in the formal and informal credit markets before and after the policy experiment. We use two datasets on formal and informal interest rates. The first dataset comprises monthly time series of informal lending rates and local bank lending rates from 2003 to 2011, published by the People's Bank of China, Wenzhou Branch, in 2012. The second dataset comprises daily and monthly time series of informal lending rates and local bank lending rates, respectively, from 2013 to 2018, published by the Wenzhou Municipal Government Finance Office. The second dataset also provides transaction-level information, from which we create a monthly time series of the informal credit supply.

We perform vector autoregressions (VAR) on the formal and informal interest rates and on the formal interest rate and informal credit supply. In the 2003–2011 period, the two interest rates do not respond to each other. In the 2013–2018 period, while the informal rates and informal credit supply respond positively to shocks to the formal rates, the formal rate does not respond to formal credit supply. The one-way responses are not surprising because the banking rates in China are heavily regulated by the central bank, rather than being freely set by the market. These one-way responses are evidence that informal credit is a substitute for formal credit. We document large yield spreads across the formal and informal sectors before and after the reforms. The informal credit supply decreased over time, after the reforms, possibly because of the end of the debt crisis and the easing of the formal lending market. To confirm these results, we conduct a robustness test using ordinary multiple regression.

This study contributes to three streams of literature. First, it adds to the literature on the relationship between the formal and informal credit markets and joins the debate on the effects of the interest rates. Some studies explore the relationship between formal and informal credit markets. The substitutive view argues that the informal sector competes with the formal sector as a credit supplier (Hou et al., 2020; Jain, 1999). However, the complement view states that informal lenders' monitoring ability allows formal lenders to channel credit through the former, and thereby reduce agency costs (Bose, 1998; Karaivanov & Kessler, 2018). Madestam's (2014) model of formal and informal finance, in undeveloped credit markets, argues that formal and informal credit can be either complements or substitutes. This role depends on banks' market power, with informal lenders substituting and complementing competitive and monopolistic banks, respectively. Unlike these studies, we analyse and test the relationship using reliable data, instead of theoretical models.

Second, this study contributes to the literature on the determinants of interest rates in informal finance, in a financial reform setting. Ayyagari et al. (2010) argue that the informal sector holds a comparative advantage in social enforcement and sanctions at the lower end of the market. Given this, it cannot scale up and service the higher end of the broad market. The Wenzhou experiment sheds light on this issue by examining the level of market segmentation and integration before and after the experiment.

Third, after the 2013 reforms, the transaction-level data from Wenzhou permit the investigation of the determinants of interest rates in informal finance. This can enrich the literature, as data scarcity poses a challenge to informal finance research. The availability of informal interest rates enables us to examine the relationship between informal and formal finance, specifically whether they are substitutes or complements.

Therefore, theoretically, studying the impact of gradual regional financial reforms on informal finance can expand the literature on financial repression and credit discrimination from the perspective of informal finance, in the context of China's typical dual financial structure. In practice, this study presents policy implications on how to summarize and evaluate the effectiveness of China's regional financial reforms and the next steps.

The remainder of this paper is organized as follows. Section 2 reviews related literature and presents a theoretical analysis. Section 3 describes the data on informal interest rates and variables and explains the sample selection. Section 4 presents the empirical results and robustness checks. Section 5 offers concluding remarks.

2. Literature review and theoretical development

2.1. Literature review

While some studies have qualitatively analysed informal finance, there is not much quantitative analysis of the interaction between informal and formal finance.

The literature on informal finance focuses mainly on the existence and influence of informal finance. The financial repression theory (McKinnion, 1973) argues that excessive government intervention lowers the efficiency of financial systems, causes market fragmentation, and leads funds into the informal financing sectors in underdeveloped economies. The literature finds that formal and informal finance coexists in developing economies with weak legal institutions and low income (Aryeetey & Nissanke, 1998; Mertzanis, 2019). The contribution of informal finance to economic growth has garnered much research interest. Some studies argue that informal lenders monitor and enforce loan repayments through social ties and sanctions and provide financing to businesses, whereas formal lenders lack these unique capacities (Cull & Xu, 2003; Hou et al., 2020). Informal finance provides valuable financial intermediation and ushers economic growth in underdeveloped economies (Giné, 2011; Xu et al., 2021). The China Banking Industry Operation Report 2011, issued by the China Banking Regulatory Commission in 2012, documents that only 20% of the loans from formal financial institutions serve SMEs, as of the end of 2011.

At the micro level, many studies document that China's small businesses resort to informal finance when their credit needs are not met by formal finance. Most private small and micro businesses in China encounter financing difficulties. On the one

hand, small and micro businesses, and sole proprietorships account for over 90% of the mainland businesses and contribute to 80% of the total employment. On the other hand, financial repression makes it difficult and expensive for these firms to obtain funds from formal financing organizations. These factors make mainland China to be a hotspot for informal financing activities. According to available statistics from the Chinese Academy of Social Sciences, in 2008, the size of informal finance in mainland China was over 9 trillion yuan. Approximately, 62% of the households and firms in mainland China participate in informal financing (http://finance.sina.com.cn/hy/20131123/ 172317414839.shtml).

To a large extent, this segment of the lending market has not been officially recognized by the regulatory authorities, though private lending has been a traditional practice in many parts of China before the introduction of formal banking (Chen et al., 2013; Hsu, 2012). Allen et al. (2005) find that the fastest-growing Chinese firms rely more on informal than formal credit. Households are one of the sources of capital for private lending. Conducted by the Southwestern University of Finance and Economics among 28,000 families, the 2013 China Household Finance Survey indicates that the proportion of families participating in private lending account for about 49%, 46%, and 38% in western, central, and eastern China, respectively (http://www.chfsdata.org/). Lu et al. (2015) document that the size of China's private lending market is estimated at approximately 4 trillion yuan. They also show that private loan, especially petty loan, represents the most prominent form of financing in the Yangtze River Delta region (covering the Shanghai, Zhejiang, and Jiangsu provinces)—the Chinese region with the most vibrant economic output and growth. Lu et al. (2015) also note that entrepreneurs and wealthy individuals contribute to the informal credit market, which relies on personal networks and resources to acquire funds.

At the macro level, empirical research on the factors influencing informal finance has mainly focused on monetary policy. Monetary policy affects the informal finance market by changing banks' credit supply and liquidity in the financial market. Hence, in the short-term, monetary policy can affect two types of private lending by the interest rate transmission channel (Buchak et al., 2018). Qin et al. (2014) also find that Wenzhou's informal credit lending rates are receptive to monetary policies.

A significant part of the literature examines the causes of informal finance and the impact mechanism of monetary policy. Owing to data availability, most of the literature studies informal finance as a black box and less systematically analyses the impact of formal institutional arrangements (e.g., regional financial reforms) on informal financial markets. Therefore, it is impossible to deepen the research on the theory of financial repression from the perspective of institutional arrangements.

2.2. Theoretical analysis

The financial repression theory reveals the main sources of informal finance in developing countries. McKinnion (1973) argues that the government's excessive regulation of the finance sector has repressed and reduced the efficiency of the financial system. This has reduced the operational efficiency of the formal financial systems. In this regard, it must be noted that while the interest rate ceiling stimulates the demand of

market players for funds, it also hinders funding allocation through market mechanisms. Informal finance responds to business requirements, and thereby compensates for the deficiencies of the formal financial systems.

In the context of Wenzhou, Wenzhou's financial reforms intended to standardize and legalize informal finance. For example, the reforms have led to the registration of seven service centres; they provide information registration and advisory services in informal finance. Several institutions have also been established (e.g., small loan companies, rural mutual cooperatives, and private capital management companies) to improve the financial service system of informal finance. Therefore, the essence of financial reforms is to reform the financial management system and effectively allocate resources in the financial market.

The literature has carefully analysed the impact of the economic environment on formal and informal borrowing (Qin et al., 2014). In this context, it must be noted that financial system reforms can relax financial regulations and promote competition between formal and informal finance. Competition between the two credit markets can promote the development of interest rates toward marketization. The interest rate in formal lending can affect change in the private lending rate through two channels. One channel represents the supply and demand side. When there is an increase in the scale of formal credit, there is a decline in the interest rate of formal lending and a subsequent decline in the transaction volume of private lending. Eventually, the oversupply of private lending leads to a corresponding reduction in lending rates. Another channel is based on the signalling theory. For the private lending market, a decline in the formal lending rate signals a loose monetary policy. The private lending market follows the direction of the central bank to reduce the lending rate and increase the scale of credit. Therefore, it is not surprising that, after the financial reforms, Wenzhou's private loan interest rate changed in the same direction as the loan interest rate of the formal credit market.

3. Informal finance sample and data overview

3.1. Informal finance sample

In this section, we describe the data on informal interest rates and variables and explain the sample selection. Subsequently, we provide an overview of the data and perform vector autoregressions.

Given the availability and reliability of private lending data, we extract private lending interest rate data from the monthly data on the private financial index website of the Wenzhou Municipal Government Finance Office. Private lending data comprise six categories—small loan companies, private capital management companies, private lending service centres, rural mutual cooperatives, social direct lending institutions, and others. This dataset makes up of 417 data points and weighted calculation. Publicly released private lending data include daily, monthly, and annual indices. The data have been generated based on spontaneous private lending activities, and the interest rate follows a market with a high degree of marketization. These data have been recognized at the government level and by authoritative databases. For example, they have been accepted by the Wind database and have become the wind

vane of the private lending market. These data also appear in papers studying private financial institutions (Pan et al., 2018). We also obtain formal financial interest rate data and loan amounts from monthly data generated by the People's Bank of China, Wenzhou Branch.

To examine the differences between the formal and informal credit markets before and after the financial reforms, in the benchmark analysis, we set two sample intervals of informal finance. Specifically, we take the years 2003–2018 and 2013 to represent the periods before and after the reforms, respectively.

We also conduct a robustness test using multiple regression analyses. Based on data availability, we set the sample from 2011 to 2018 for the robustness test. We collect data on monetary policy variables from the Flush iFinD database. The rest of the data come from the Wenzhou Statistics Bureau, Wenzhou Municipal Government Finance Office, and the People's Bank of China. Specifically, for the period January 2013–July 2018, we obtain daily transaction data of informal lending from the Wenzhou Municipal Government Finance Office, with loan maturities of 1, 3, 6, and 12 months and over 1 year.

The sample covers 258,114 transactions, with a total value of 177 billion yuan, averaging 3,852 transactions and 2.64 billion yuan per month. The average loan size is 686,000 yuan. The percentage of the total informal lending volume to the GDP of Wenzhou averages at 8.28%, over the entire period. This percentage most likely represents the lower bound estimate of the informal lending market size, given that the Wenzhou Municipal Government Finance Office tracks transactions reported by formalized lending institutions.

3.2. Data overview

Table 1 lists all the transactions by maturities. The loans with maturities equal to or less than 12 months account for 96.2% and 98.2% of the transactions and loan values, respectively. The table does not present the exact terms for loans with maturities of over 1 year, and they account for only 3.8% and 1.8% of the transactions and loan values, respectively. The most frequent loans have a 6-month maturity and account for 36.3% and 32.3% of the transactions and loan values, respectively. Loans with a 12-month maturity rank second in transactions (29.8%), and loans with a 3-month maturity rank second in loan values (26.2%). Of the loans, 78.75% had no collateralisation. These small, short-term, and unsecured loans are prevalent and similar to the informal loans, as documented in other studies.

Table 1. Summaries on informal loans by maturities.

	Transactions		Values		Interest Rate		Loan Size	
	Count	Freq.	Total	Pct.	Mean	Std. Dev.	Mean	Std. Dev.
Maturity								
1 month	27,048	10.5%	38.30	21.6%	18.08%	4.15%	1,414	3,894
3-month	50,569	19.6%	46.80	26.4%	17.07%	3.75%	925	1,935
6-month	93,726	36.3%	57.20	32.3%	16.71%	3.55%	610	1,103
12-month	76,892	29.8%	31.70	17.9%	15.29%	3.90%	412	1,037
> 1 Year	9,879	3.8%	3.25	1.8%	15.42%	4.31%	329	1,886
Total	258,114	100.0%	177.00	100.0%	16.37%	3.87%	686	1,821

Total loan values and loan sizes are reported in billion yuan and thousands of yuan, respectively.
Source: Authors.

Across the five maturities, the 1-month loans have the highest average interest rate of 18.08%. This is followed by the average interest rates of 17.07%, 16.71%, 15.29%, and 15.42% for loans with maturities of 3, 6, and 12 months and above 1 year, respectively. Overall, this result suggests a negatively sloped term structure. This finding is consistent with the results of other studies. Zhu et al. (2012) consider a survey by Morgan Stanley on 64 informal lenders, including microcredit, pawnshops, and guarantee companies. They report that the average lending rate for a 1-month maturity is the highest, at an annualized rate of about 40%, followed by 38% and 35% for loans with 3- and 6-month maturities. Our results are in line with those of Zhu et al. (2012), though our overall rates are lower than their reported averages.

Table 1 also shows that the longer the maturity, the smaller the average loan size. The 1-month loans average at 1.414 million yuan per transaction, followed by 3-month, 6-month, 12-month, and 1-year-above loans, respectively.

Concerning the interest rates after the policy experiment, we obtain monthly value-weighted 1-year loan interest rates from the Statistics Department of the People's Bank of China, Wenzhou Branch. We compute the value-weighted monthly informal interest rates in the informal credit market using loan sizes as weights.

Figure 1 plots the formal and informal rates for the periods January 2003–December 2011 and January 2013–December 2018. The informal rates have been consistently higher than the formal rates by an average spread of 7.51% and 10.42% in 2003–2011 and 2013–2018, respectively. Notably, the yield spread spikes in 2011 before the reforms. In 2011, the average yield spread rises to 14.35% and peaks in December at 17.84%.

After the crisis and ensuing reforms, both the formal and informal rates report a gradual decline. The average yield spread decreases from 11.30% in 2013 to 9.68% in 2017. Based on the behaviour of the time series, it seems reasonable to assume that the gap between the two rates will continue to exist. The persistence in yield spreads after the reforms indicates that the two markets are still segmented.

In addition, we aggregate the value of each loan into a monthly aggregate time series of new loan supply in the informal credit market. The informal loan supply (in millions of yuan) declines from 2013 to 2018. While the formalization of informal lending practices likely lifted restrictions on the informal loan supply, we note a decline in the overall informal loan supply. The decline in the informal loan supply might be related to the end of the debt crisis and the easing of the formal lending conditions. We also plot the formal loan supply (in trillion yuan) for comparison.

The persistence of large yield spreads and the decline in the informal loan supply support the view that informal finance, even when granted formal status, cannot fully compete against formal finance (i.e., gain market shares) and fully substitute formal finance.

4. Empirical results

4.1. Vector autoregression (VAR) analysis

To test the time-series relationship between the formal and informal rates, we run several vector autoregression analyses for the periods 2003–2011 and 2013–2018. We also employ the following standard Gaussian VAR model:

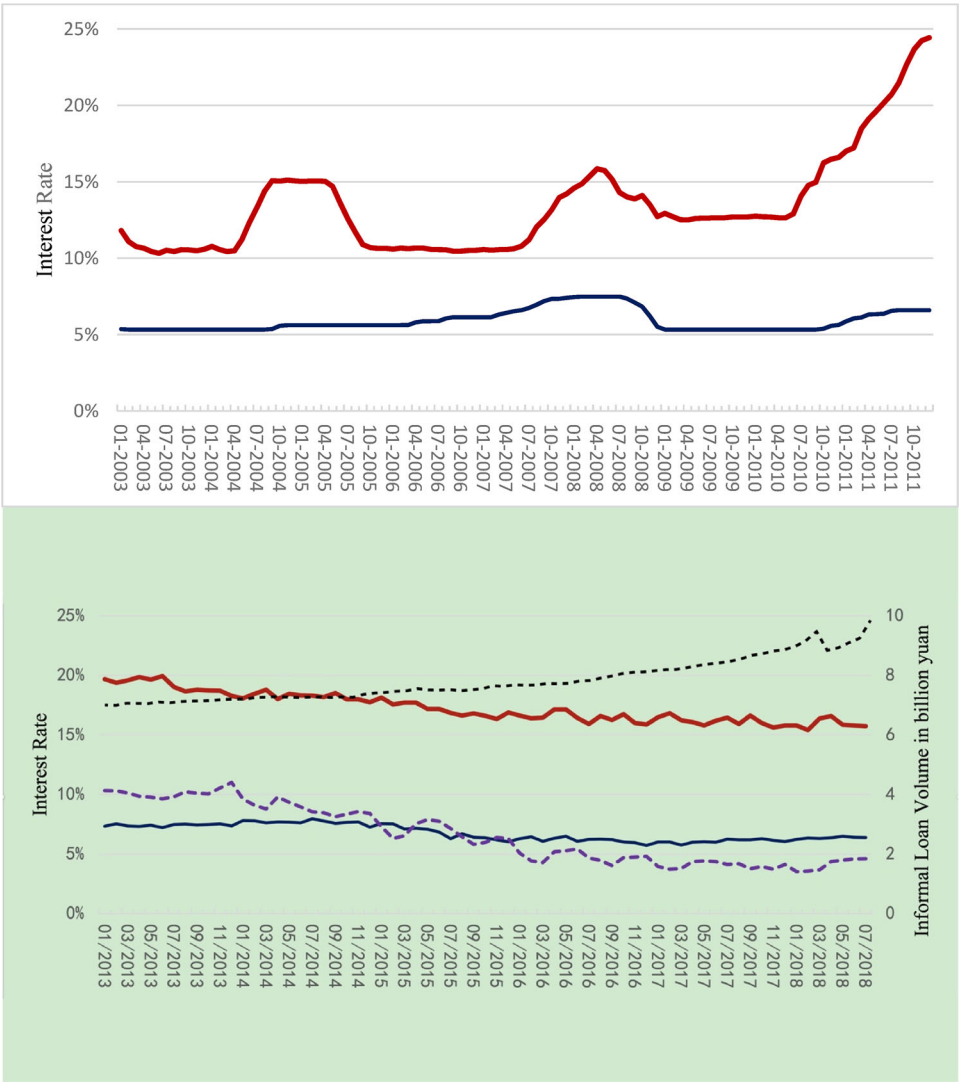

Figure 1. Formal and informal rates in the Wenzhou credit market (before and after the pilot experiment) and formal and informal loan supplies (after the pilot experiment).
Panel A plots the formal and informal lending rates from January 2012 to December 2011.
Panel B plots the formal and informal lending rates, formal loan supply (in trillion yuan), and informal loan supply (in billion yuan) from January 2013 to July 2018. The formal and informal loan supplies are plotted on the right y-axis.
Source: Authors.

$$y_t = \alpha + B_1 y_{t-1} + \ldots + B_p y_{t-p} + \varepsilon_t, \;\; \varepsilon_t \sim \mathcal{N}(0, \Sigma);$$

where $y_t = (y_{1t}, \ldots, y_{nt})'$ denotes that there are n variables in the VAR model; α is an $n \times 1$ vector of intercepts; $B_1, \ldots, B_p$ are coefficient matrices; and Σ is the covariance matrix of the error terms.

We perform augmented Dickey–Fuller (ADF) tests to verify whether the variables are stationary. Table 2 shows the test results with varying time-series models by choosing whether to include a constant term, trend term, drift term, and the number of lags. In 2003–2011, the formal rate exhibits a stochastic trend, and the informal

Table 2. Augmented Dicker Fuller test.

	Model (C, T, D, L)	Test Statistics	1% Critical Value	5% Critical Value	p-value	Stationary
Variable				2003-2011		
formal	(1,1,0,1)	−2.369	−4.038	−3.449	0.396	Non-stationary
formal	(1,0,1,1)	−2.286	−2.363	−1.660	0.012	Stochastic Trend
informal	(1,1,0,1)	−1.162	−4.038	−3.449	0.918	Non-stationary
informal	(1,0,1,1)	−0.308	−2.363	−1.660	0.379	Non-stationary
Δ*formal*	(1,0,0,0)	−4.266	−3.508	−2.890	0.001	Stationary
Δ*informal*	(1,0,0,1)	−3.831	−3.508	−2.890	0.003	Stationary
				2013-2018		
formal	(1,1,0,1)	−1.073	−4.132	−3.492	0.933	Non-stationary
formal	(1,0,1,1)	−1.162	−2.396	−1.673	0.125	Non-stationary
informal	(1,1,0,1)	−3.626	−4.132	−3.492	0.028	Deterministic Trend
informal	(1,0,1,1)	−1.536	−2.396	−1.673	0.065	Non-stationary
Δ*formal*	(1,0,0,0)	−10.607	−3.569	−2.924	0.000	Stationary
DT_formal	(1,0,0,0)	−4.600	−3.567	−2.923	0.000	Stationary
g_infloan	(1,0,0,0)	−11.848	−3.569	−2.924	0.000	Stationary

C, T, D, and L stand for the constant term, trend, drift, and lags. A score of 0 indicates no, and 1 indicates yes.
Source: Authors.

Table 3. Vector autoregression on formal rates and informal rates and loan growth rate. Δ*formal* is the first differential in the monthly formal interest rates. Δ*informal* is the first differential in the monthly informal rates. *DT_formal* represents the detrended monthly informal interest rates. *g_infloan* is the growth rate in informal credit supply. VAR (3) is used in all three panels. Regression coefficients and standard errors (in parentheses) are reported.

Panel A: VAR (3) on Formal Rate and Informal Rate in 01/2003-12/2011						
	*L1.*Δ*formal*	*L2.*Δ*formal*	*L3.*Δ*formal*	*L1.*Δ*informal*	*L2.*Δ*informal*	*L3.*Δ*informal*
Δ*formal*	0.839	−0.248	0.088	0.042	−0.083	0.080
	(0.094***)	(0.118**)	(0.093)	(0.055)	(0.080)	(0.065)
Δ*informal*	−0.139	0.435	0.074	0.689	−0.029	0.037
	(0.376)	(0.475)	(0.374)	(0.099***)	(0.120)	(0.100)
Panel B: VAR (3) on Formal Rate and Informal Rate in 01/2013-12/2018						
	*L1.*Δ*formal*	*L2.*Δ*formal*	*L3.*Δ*formal*	*L1.DT_informal*	*L2.DT_informal*	*L3.DT_informal*
Δ*formal*	−0.395	−0.267	0.223	0.060	−0.033	−0.035
	(0.136***)	(0.142)	(0.140)	(0.073)	(0.074)	(0.069)
DT_informal	0.494	0.720	0.447	0.291	−0.086	0.226
	(0.244**)	(0.254***)	(0.251)	(0.131**)	(0.133)	(0.123)
Panel C: VAR (3) on Formal Rate and Informal Loan Growth Rate in 01/2013-12/2018						
	*L1.*Δ*formal*	*L2.*Δ*formal*	*L3.*Δ*formal*	*L1.g_infloan*	*L2.g_infloan*	*L3.g_infloan*
Δ*formal*	−0.382	−0.237	0.285	−0.001	0.001	0.004
	(0.121***)	(0.127)	(0.121**)	(0.003)	(0.003)	(0.003)
g_infloan	7.930	16.223	13.051	0.032	0.018	−0.685
	(3.674**)	(3.847***)	(3.660***)	(0.081)	(0.081)	(0.081***)

The standard errors are shown in parentheses. *** and ** denote significance at the 1% and 5% levels, respectively.
Source: Authors.

rate remains non-stationary. After their conversion into first differentials, both Δ*formal* and Δ*informal* become stationary. In 2013–2018, the formal rate remains non-stationary, and the informal rate exhibits a deterministic trend. We use the first differential of the formal rates to obtain Δ*formal* and the detrended informal rate *DT_formal*[1]. For 2013–2018, we use the growth rate in informal credit supply, *g_infloan*, as an additional measure in the informal market. As our selected variables are stationary, they all meet the requirements for vector autoregression (VAR) analysis.

We use the VAR (3) model[2] for 2003–2011 and 2013–2018. Table 3 presents the results of the VAR regression. Panel A regresses the formal and informal rates on their lagged

values for the 2003–2011 period. There seems to be no interaction between the formal and informal rates, in either direction. Panel B regresses the formal and informal rates on their lagged values for the 2013-–2018 period. The lagged values of formal rates have a positive and significant effect on informal rates. Panel C regresses the formal rates and informal credit supply growth rates in the 2013–2018 period. The lagged formal rates have a positive and significant effect on the growth rate of informal credit supply. Panels B and C indicate that the formal rates have an impact on the informal market, in terms of the interest rates and credit supply growth rates, though the latter does not affect the former. The one-way dependence of informal credit on the condition of formal credit reveals a one-way substitute relationship between the formal and informal credit markets. In both periods, the formal rates do not respond to the informal rates. This can be attributed to the fact that the formal rates are highly regulated by China's banking authorities and not set freely by market forces.

Figure 2 plots the impulse and response functions (IRFs) for the three VAR analyses above. For simplicity, we only include two IRFs across the two credit markets and drop the two IRFs within each market. Panel A plots mutual IRFs for the formal and informal interest rates in 2003–2011. Panel B plots mutual IRFs for formal and informal interest rates in 2013–2018. Panel C plots mutual IRFs for formal rates and growth rates in informal credit supply in 2013–2018. In Panel A, the two rates are not responsive to each other for 2003–2011. In Panel B and C, it is shown that informal credit responds positively both in terms of rates and credit supply to shocks in the informal rates for 2013–2018. The change in responsiveness to the reforms signals some level of integration and convergence between the two markets.

The regression results strongly support that informal finance substitutes formal finance in the 2013–2018 period. Another piece of supporting evidence is that the informal credit supply increases substantially in response to a freezing of formal finance triggered by a debt crisis; it declines after the crisis and stabilization of the formal financial section. Our conclusions are drawn at the aggregate level. We do not rule out the possibility that the complementary role of informal finance also exists at the micro levels. The 2012 report and the 2013 whitepaper, respectively, by the Wenzhou Branch of PBC the Wenzhou People's Court document the anecdotes of financial intermediations by informal players who channelled funds from formal banks to borrowers, often in the form of co-signing loans as credit guarantors.

Panel A plots the IRFs between the formal and informal lending rates from January 2003 to December. 2011. Panel B plots the IRFs between the formal and informal lending rates, and Panel C plots the IRFs between the formal rate and the informal credit supply from January 2013 to December 2018.

4.2. Fama-McBeth regression on the determinants of informal rates

All the transctions permit the exploration of the determinants of informal interest rates. Table 4 lists the summary statistics of the variables of interest. *Size*[3] is the logarithm of the dollar value of a transaction (expressed in thousand yuan). *Term* is the logarithm of 1 plus the maturities in months. *Liquidity* is a dummy variable indicating whether the loan is for short-term liquidity needs, as opposed to other purposes ranging from investment to production purchases. *Collateral* is a dummy variable

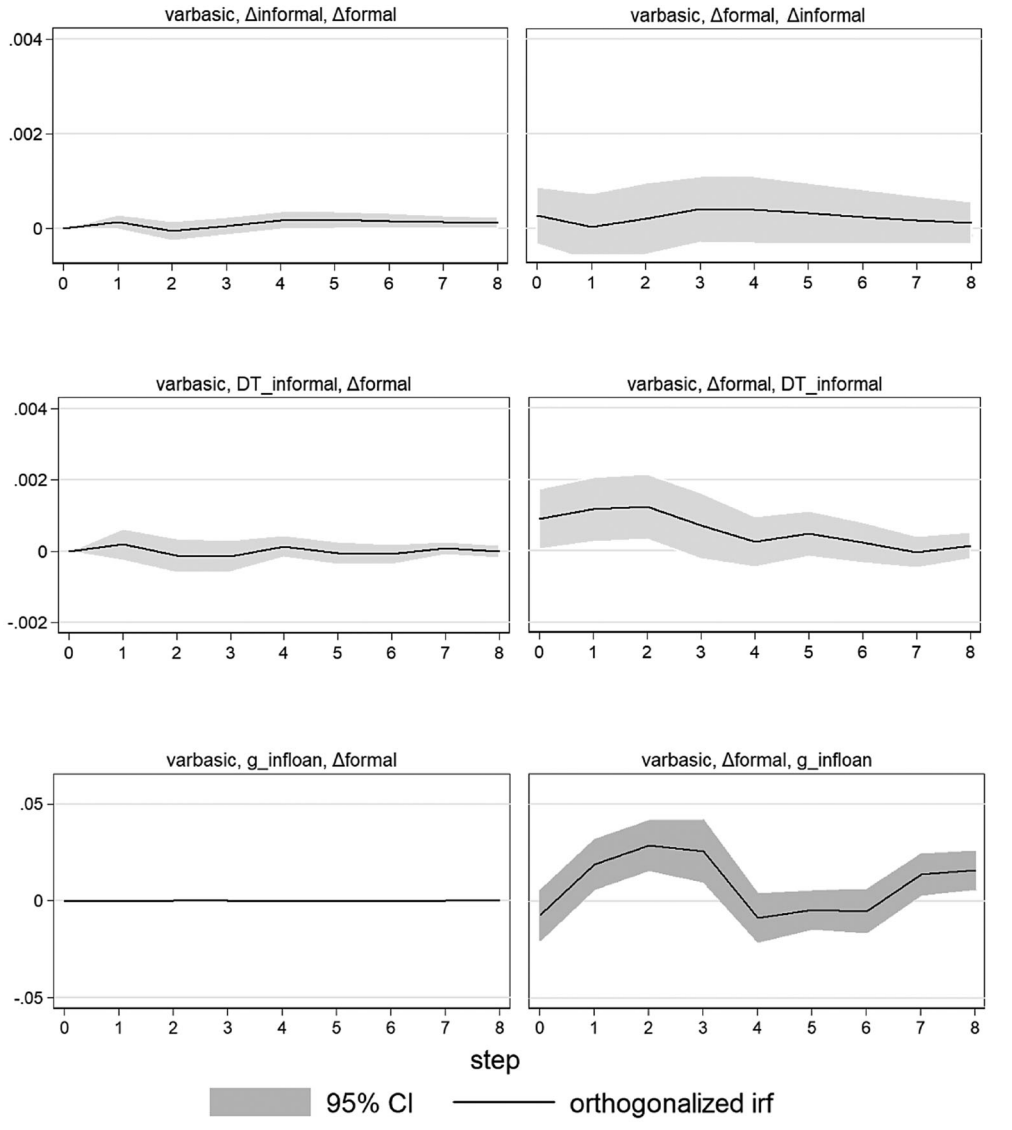

Figure 2. Impulse and response functions between the formal and informal credit markets.
Source: Authors.

indicating that the loan is backed by collaterals. The dataset also categorizes the reporting agencies into six categories—small loan companies (46.0%), private asset management companies (0.3%), private lending service centres (17.2%), rural mutual cooperatives (3.6%), social direct lending institutions (32.6%), and others (0.3%). We create dummy variables for the first five categories.

Loans aimed at alleviating liquidity shortages account for 39.59% of all the loans. This finding suggests that borrowers resort to informal credit markets to finance their short-term liquidity needs when they fail to obtain funds from formal banks. Only 21.25% of the loans have collateralized assets, and the majority are purely based on credit.

Table 4. Summary statistics.

Variables	Description	N	Mean	SD
Rate	Informal Rate	248,235	0.1638	0.0385
Size	Log (Loan Size)	248,235	5.5473	1.4506
Term	Log (1 + month)	248,235	1.8872	0.5917
Liquidity	1, if liquidity driven; 0, otherwise	248,235	0.3959	0.4890
Collateral	1, backed by collateral; 0, otherwise	248,235	0.2125	0.4091
Small Loan	1, agency type = small loan; 0, otherwise	248,235	0.4599	0.4984
Private Asset Management	1, agency type = private asset management; 0, otherwise	248,235	0.0028	0.0532
Service Center	1, agency type = service center; 0, otherwise	248,235	0.1722	0.3775
Rural Mutual	1, agency type = rural mutual; 0, otherwise	248,235	0.0358	0.1858
Social Direct	1, agency type = social direct; 0, otherwise	248,235	0.3255	0.4686

Source: Authors.

To formally test the above mediating factors, we run daily Fama-MacBeth regressions (Fama & MacBeth, 1973), using informal rates as the dependent variable. We estimate a series of cross-sectional regressions separately for each of the 2,071 days from 2 January 2013 to 31 December 2018. Subsequently, we compute the average, standard errors, and t statistics of the regression coefficients across time.

Table 5 presents the regression results using the four models, by selecting different groups of independent variables. As shown, the size factor is not significant. This does not support the argument in Madestam (2014). The terms of loans have a significantly negative effect on the informal lending rates, confirming a downward-sloping term structure in the informal lending market. The loans issued for liquidity needs are charged at higher rates than those for production and investment purposes. The *Collateral* dummy has a significant positive coefficient. This is surprising because uncollateralized loans pose a higher risk and are charged at higher rates. One possible explanation for this paradoxical finding is that borrowers who borrow on credit may have higher creditworthiness and thus receive lower rates. The statistical significance of most of the dummy variables on the reporting agency type suggests the presence of heterogeneity across loans issued by different agencies. The R-squared value also increases after the inclusion of these dummy variables.

4.3. Robustness tests

In this section, we conduct a sensitivity test to determine the robustness of the positive relationship between the rate $*$ reforms and informal interest rates.

4.3.1. Model design

We use the following regression models to verify the relationship between Wenzhou's informal interest rates, money supply, and lending rates, before and after the pilot financial reforms.

$$IFR = \alpha + \beta_1 rate{*}reform + \beta_2 rate + \beta_3 M2 + \beta_i Controls_i + \varepsilon;$$

where IFR is the informal financial interest rate of Wenzhou. We use daily data on Wenzhou's private lending transaction rate as the proxy variable for Wenzhou's informal financial market maturity. We obtain this comprehensive interest rate by an equal weighting of the six reporting institution categories mentioned above. The

Table 5. Daily Fama-MacBeth regression on determinants of informal interest rates.

	[1]	[2]	[3]	[4]
Independent Variables				
Size	0.0005		−0.0003	−0.0012
	(0.0004)		(0.0004)	(0.0009)
Term	−0.0085	−0.0052		−0.0061
	(0.0008***)	(0.0005***)		(0.0008***)
Liquidity	0.0097	0.0076	0.0095	0.0098
	(0.0007***)	(0.0006***)	(0.0006***)	(0.0008***)
Collateral	0.0064	0.0076	0.0067	0.0063
	(0.0009***)	(0.0007***)	(0.0008***)	(0.0008***)
Small Loan		0.0028	0.0002	0.0016
		(0.0009***)	(0.0009)	(0.0011)
Private Capital Management		−0.0023	−0.0021	−0.0023
		(0.0006***)	(0.0006***)	(0.0006***)
Service Center		−0.0096	−0.0100	−0.0106
		(0.0010***)	(0.0013***)	(0.0013***)
Rural Mutual		−0.0178	−0.0198	−0.0182
		(0.0011***)	(0.0011***)	(0.0011***)
Social Direct		−0.0164	−0.0219	−0.0189
		(0.0011***)	(0.0014***)	(0.0014***)
Constant	0.1677	0.1745	0.1691	0.1842
	(0.0030***)	(0.0016***)	(0.0030***)	(0.0035***)
	n = 248,235	n = 248,235	n = 248,235	n = 248,235
	# days =1,945	# days =1,945	# days =1,945	# days =1,945
	R-squared = 0.0368	R-squared = 0.1141	R-squared = 0.1054	R-squared = 0.1100

Standard errors are reported in parentheses. *** indicates 1% significance level.
Source: Authors.

impact of the financial reforms on Wenzhou's informal finance is mainly reflected in the change in Wenzhou's private lending rate. Therefore, the use of the private lending rate to represent the degree of change in the financial system after the reforms is relatively representative. For instance, a declined borrowing rate indicates an improvement in the financial institutional environment, whereas an increased borrowing rate reveals deterioration in the financial institutional environment.

The variable *rate* is a loan interest rate. The private loans at Wenzhou are neither single short-term nor single long-term loans. The terms of each loan transaction differ, and the corresponding loan interest rates are not the same. Therefore, quarterly data on the weighted interest rate of general loans are used to represent the lending rate of the formal financial sector.

The variable *reform* is a dummy variable for the pilot financial reforms at Wenzhou. When the sample starts in 2013 or later, the value of *reform* is assigned as 1; otherwise, it is 0. The regression coefficients for the interaction term of the rate and reforms are expected to be significantly positive.

We select the control variables in line with the relevant literature (Pan et al., 2018; Qin et al., 2014). *M2* denotes the money supply; we select this variable to represent the

currency circulation. We construct the *MCI* macroeconomic control variable using several microscopic control variables—the subject of the loan, loan period, and use of loan funds. *SBD* is a dummy variable for direct social lending. When the borrowing subject is direct social lending, it is assigned a value of 1; otherwise, it is set to 0. *Long Bond* is a dummy variable for long-term lending, which is set to 1 when the loan period is 1 year or more and 0 otherwise. *Operation* is likewise a dummy variable for loan capital use, which is 1 when it is used for operation and 0 otherwise.

4.3.2. Regression results

Table 5 reports the regression results concerning the influence of Wenzhou's private lending rates on formal lending rates, after Wenzhou's financial reforms. The samples comprise daily transaction data of Wenzhou's private lending from 2011 to 2018. We delete the samples with wrong records, missing data, unknown loan purposes, and a loan period of 10 days. This filtration yields 4,553 day-based observations. We take the macro-level data from the Wind financial database and the People's Bank of China's database.

Columns (1)– (4) of Table 5 show that the control variables (i.e. macroeconomic climate index, subject, term structure, and use of funds) are successively added to the regressions such that column (5) is the final regression result. The coefficients of the interaction term (rate * reform) between Wenzhou's financial reforms and formal financial interest rates are significantly positive at the 1% level. This shows that the informal lending rate continues to decline when the formal lending rate falls, after the implementation of financial reforms in Wenzhou. On the one hand, the high-interest rate of private lending in Wenzhou continues to mature after the financial reforms, and the interest rate shows a downward trend. On the other hand, the financial reforms strengthen the interest rate relationship between informal and formal finance.

Among the control variables, the regression coefficient of M2 is significantly negative at the 1% level, indicating that the loose monetary policy has encouraged the decline of private interest rates in Wenzhou. The macroeconomic climate index is inversely proportional to the lending rate. Given this, the more prosperous the economy, the lower

Table 6. Influence effect of formal financial interest rate under financialization reform.

	(1) IFR	(2) IFR	(3) IFR	(4) IFR	(5) IFR
*Rate*reform*	0.5701***	0.1741***	0.1480***	0.2207***	0.4102***
	(14.492)	(4.793)	(4.010)	(5.661)	(11.432)
Rate	−0.023*	−0.079**	−0.082*	−0.924**	−0.027*
	(-1.785)	(-2.103)	(-1.861)	(-2.196)	(-1.763)
M2	−1.923***	−5.348***	−4.511***	−4.911***	−2.667***
	(-6.493)	(-19.632)	(-16.287)	(-16.795)	(-9.874)
MCI	−0.0941***				−0.0732***
	(-4.913)				(-8.223)
SBD		−2.579***			−1.963**
		(-16.771)			(-12.440)
Long Bond			−2.211***		−1.388***
			(-5.682)		(-6.028)
Operation				1.0236***	0.157**
				(9.007)	(2.159)
constant	46.681	88.623	76.987	80.424	57.262
R2	0.038	0.159	0.130	0.031	0.199

Note: (1) The t value is in parentheses; (2) ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively.
Source: Authors.

the private lending rate. Meanwhile, the demand for direct social lending, loans for 1 year or more, and business lending significantly reduce private lending rates and constantly promote the maturity of informal finance in Wenzhou (Table 6).

5. Discussion and conclusion

The coexistence of the formal and informal credit markets is an important feature of the emerging economies. In recent years, risks associated with private lending in emerging economies have drawn researchers to examine the relationship between the formal and informal credit markets in these regions. However, owing to the unavailability of private lending data, few studies have analysed this relationship. In March 2012, the Chinese government established the first pilot zone for implementing comprehensive financial reforms in Wenzhou. Thus, examining the impact of formal finance on informal finance through interest rates has both policy and academic value. It is also worth comparing the impacts before and after the establishment of the pilot zone's comprehensive financial reforms.

We investigate formal and informal credits in Wenzhou before and after the policy experiment. The city was designated a pilot zone in 2012, after the debt crisis in 2011. This policy is aimed at formalizing the informal lending institutions. We find that the informal and formal interest rates behave completely independently of each other before the experiment. After the experiment, both the interest rate and credit supply in the informal credit market respond to the formal interest rate. The positive responses are evidence that informal credit substitutes formal credit. In addition, the increase in responsiveness indicates that the two markets are moving towards integration, and the reform has positive effects.

Concerning the regional financial reform, this study examines the influence of formal finance on informal finance to enrich the theory of financial repression from the perspective of formal institutional arrangements. It also evaluates the actual effects of regional financial reform, from the perspective of informal finance. Therefore, unlike the existing research, this study does not simply regard the impact of policies on formal and informal financial markets as two separate or parallel systems, which could ignore the inherent relationship between the two financial systems. It does not summarize the relationship between formal and informal financial markets as alternative or complementary.

Based on the empirical results, the study proposes the following policy suggestions. First, further financial reforms can lead to adjustments in the credit structure of formal finance, expand the coverage of the formal financial system to include small and micro enterprises, and gradually lead to a decline in the private lending interest rate. Second, the reason for the abnormal term structure of private lending rates is that the short-term interest rates remain high. Given this, the study proposes the establishment of a private lending trading platform with abundant liquidity and a high degree of information exchange. It is also important to break down the trading barriers between markets with different terms and to establish market discipline to restore private lending rates to a reasonable level.

This study also has certain limitations. First, this study does not examine the transmission mechanism of the influence of formal finance on the informal finance interest rates, after the financial reforms. Second, the study mainly uses the VAR model and ordinary least squares method. It does not conduct a difference-in-difference estimation to analyse the relationship. Third, this study does not establish a strictly theoretical framework.

In the future, based on the theoretical framework of informal finance, subsequent research can focus on the mechanism of the impact of interest rate marketization on the interest rate. Future research can also analyse the factors affecting the scale of informal finance, including investigating the reasons for the term structure anomaly in the informal financial interest rates. It will also be worthwhile to examine the informal financial risk and its governance mechanisms.

Notes

1. We regress the monthly informal rates on the time variable month to obtain the residuals.
2. We choose three lags based on the Akaike information criterion, Hannan–Quin information criterion, and Final Prediction Error criterion.
3. Madestam (2014) presents a model that the informal interest rate is increasing in the size of loans.

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