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The impact of digital finance on women's bargaining power: Evidence from China

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ABSTRACT

This paper explores the effect of digital finance adoption on women's bargaining power within the family. Empirical analysis finds that higher digital finance adoption significantly improves women's bargaining power and thus alleviates intra-household inequality. We explain the underlying mechanism in terms of women's participation in both labor and financial market. The subsample regression results show that the impact differs among families with distinct characteristics in terms of regions, family living patterns and women's fertility status. This paper provides a new perspective for understanding the inclusive contribution of digital finance and forms a timely complement to the literature in related fields.

1. Introduction

As the basic economic unit in society, the family comprises individuals with rational preferences (Cherchye, Rock, & Vermeulen, 2009). In a marital relationship, the bargaining power between husband and wife is not only the major determinant of resource distribution within the family and the ownership of the discourse rights, but a crucial cause of inequality within the family as well (Manser & Brown, 1980). This kind of imparity embodies several aspects, including the family status of husband and wife, work division, and decision-making power on household affairs, reflecting the gender inequality embedded through all of society to some extent. Moreover, skewed sex ratios and women's inferior family status have long been themes that have been continuously investigated by scholars (Sen, 1990).

Going as far back as the Paleolithic period, women enjoyed a relatively high social position because of their contributions to population growth and economic development. However, the evolution of production forces and the means of production decrease women's participation in socially productive activities, whereas men gradually capture more social values. Meanwhile, what makes the situation worse is that some internal and external barriers, such as physiological characteristics, cultural conventions, and political institutions, also limit women's bargaining power, as well as the opportunity to improve their positions in the family (Ebenstein & Leung, 2010). Today, in the wake of the third Internet-based technological revolution, high-speed developments in the digital economy have a profound impact on social effectiveness and impartiality (Kapoor, 2014). Digital finance can provide more financial services to vulnerable groups because of its huge advantage of inclusiveness. Therefore, it is reasonable to consider questions such as whether the

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Table 1
Summary of reasons for existing the labor market.

Variables	Wife's proportion %	Husband's proportion %
No need to work/not willing to work	2.72	3.97
Taking care of the family	65.9	12.55
Unable to work (aging)	2.96	6.90
Inability to work (disabilities or illness)	8.10	21.13
No suitable jobs	7.80	32.85
Retired	7.19	7.11
Schooling/Training	0.00	0.42
Others	5.32	15.06

The data comes from the 2014 China Family Panel Studies (CFPS).

development of digital finance will influence women's bargaining power and intra-household inequalities, and whether such a digital environment can help change the conventional work division concept of "men outside and women inside" in China. This study focuses on the answers to such questions.

Inequality within the family is particularly prevalent in developing countries (Cherchye et al., 2009). As a representative developing country, China provides an appropriate research environment. The idea of preferring sons to daughters was unwaveringly rooted in old China. Confined to concepts of "men outside, women inside," "passing on the generations," and "raising children against aging," women were economically dependent on men, and thus enjoyed significantly less bargaining power, nor a relatively equal household position. The good news is that after the founding of the People's Republic of China, the women's liberation movement gradually diluted identities based on traditional gender roles. As a result of this ideological emancipation that the rights and interests of the female community in China are guaranteed, learning opportunities, economic participation, and political involvement have all increased, and the labor force participation rate is much higher than that of other major economies in the world as well. Nevertheless, invisible social mechanisms of gender inequality still exist, based on the facts noted in the 2020 Global Gender Gap Report, which states that the Chinese gender equality index ranks 106th out of the 153 countries and regions covered by the report.

In addition, although the groundswell of support for women's empowerment has become much stronger and women's sense of self-independence has gradually increased, the internal inequalities in many regions, especially in rural areas, have not fundamentally changed, primarily because of the physical advantages women have in taking care of families and traditional gender identities are difficult to reverse in the short term. Table 1 shows that accounting for nearly 70%, the proportion of wives quitting the labor market is higher than that of husbands due to the responsibilities of conceiving offspring, raising children, and dealing with housework, which are tasks traditionally entrusted to women. A decline in women's labor force participation will make them lack economic autonomy and weaken their bargaining power within the family (Anderson & Eswaran, 2009). Moreover, policies encouraging the birth of three children and extending maternity leave will bring about so-called "maternity punishment," also known as the cost of childbirth. More specifically, the term refers to the negative effects of childbirth on women's career advancements. In China, the broad sense of "birth" covers the process of conception, childbirth, postpartum breastfeeding, and so on. As previously illustrated, under the influence of the entire social and cultural tradition, women are given the responsibility of raising offspring for the vast majority of the population. As a person's time and energy are limited, an increase in the time and energy invested in the family will reduce their corresponding devotion to work, thus reducing economic value. Consequently, a series of such chain reactions may further place women in a passive family position.

Existing literature has proposed several factors that affecting women's intra-household bargaining power, such as sex ratio in the marriage market (Angrist, 2002; Porter, 2014), gender of the first child (Li & Wu, 2015), and pension adjustment (Ambler, 2015). In addition, Grossbard-Schechtman and Mincer (2003) find that fertility rate is negatively related to women's bargaining power within the family, and Baldwin (1980) proves that low fertility rates give women opportunities to master more advanced knowledge and productive technologies, thus to improve their income and labor participation rate. Based on the conclusion drawn from previous studies, it is reasonable to consider the question of whether an increase in financial income can help improve women's bargaining power. More interestingly, Browning, Chiappori, and Weiss (2014) suggest that more properties an individual can obtain after divorce, the stronger the bargaining power he or she will possess during the marriage, which further supports that financial condition can be a crucial factor that affect the distribution of bargaining power the gender inequality within the family.

Addressing gender inequality has always been an ongoing concern for both Chinese society and the Chinese government, which is essential to improve family welfare and social vitality. In recent years, China has entered a stage of high-quality development in the field of digital finance. As noted in previous studies, Cull, Ehrbeck, and Holle (2014) show that increasing inclusiveness of financial sectors will spur savings, investment, and personal income. In addition, some informal financial services will also improve living conditions and economic situations for vulnerable groups such as the poor and female (Karlan, Savonitto, Thuysbaert, & Udry, 2017; Kosoll, Lilleor, Lonborg, & Rasmussen, 2016). Besides the empirical evidence given by academic research, the foundation of the Grameen Bank (meaning "bank for the poor") can also be considered as an example of inclusive finance, which closely integrated with rural women and improve their family life. Moreover, in 2015, UN-Women's Fund for Gender Equality (FGE) has supported 53 projects in 48 countries, reaching 218,800 people directly affected. For example, an FGE-supported project mentored and trained 25 women entrepreneurs to establish mutual fund cooperatives. Therefore, based on the inspiring evidence, we can see that as a typical form of inclusive finance, digital finance is inseparable from the field of women empowerment. Using data from the China Family Panel Studies (CFPS) and the Peking University Digital Financial Inclusion Index of China (PKU-DFIIC), our study investigates whether the

development of digital finance in China will have an impact on women's bargaining power within families and, if so, the mechanisms of this effect.

First, we ask whether the development of digital finance has improved women's bargaining power and family equity. Traditional financial institutions are considered inefficient in terms of their distribution of financial resources across customers of different sizes, locations, and demographics. The availability and convenience of digital finance provides opportunities for groups that previously did not have enough access to the financial market. According to the principle of exchange of equal values, women still bear the brunt of housework because of their low income and inferior professional status, which put them at a disadvantage when negotiating with their husbands. We believe that by acquiring financial resources from digital finance platforms, women can improve their financial situation to increase their bargaining power. In the empirical test, we used two proxies to characterize the bargaining power of women in the household: the wife's decision-making power in the decision-making process of family affairs and the wife's relative income to her husband. The former is the core proxy variable. To establish the causal impact of digital finance on women's bargaining power, we use the distance to Hangzhou as an instrument variable to capture the exogenous variation in digital finance. Through baseline regressions and a series of endogeneity and robustness tests, we find that digital finance helps improve women's decision-making power, thereby further enhancing their bargaining power and reducing intra-household inequality.

We then analyze the impact mechanisms of digital finance to demonstrate the channels by which it influences women's bargaining power. To begin, we explore whether digital finance helps improve women's bargaining power by encouraging their entrepreneurial behaviors. To test this mechanism, the total score on five major household affairs is adopted as the dependent variable due to the limitations on data availability for the variable of relative income ratio. We discuss the possible mechanism from the perspective of women's participation in different types of work and find that entrepreneurship plays a more significant role than any other form of labor participation. We construct the interactive term of *Digital Finance* × *Women Entrepreneurship* and conduct regression analysis based on baseline model. The empirical results suggest that women entrepreneurship enhances the effect of digital finance on women's bargaining power. Meanwhile, we find digital finance has not only promoted women entrepreneurship and working time, but also have no negative impact on the time women spend on household responsibilities, indicating that digital finance can help women balance work and family.

Furthermore, we investigate whether financial market participation by utilizing digital finance also help enhance women's bargaining power. It is common sense that the degree of inclusiveness in traditional finance is relatively restricted for women. The frequency of women's participation in financial market and their financial literacy are usually lower than men (Lusardi & Mitchell, 2011; Woodyard & Robb, 2012). Digital finance enables women to be involved in financial markets and to get more financial resources at a lower cost. According to the literature and regression results, we assume that digital finance enhances women's bargaining power by promoting their financial market participation.

Finally, we ask whether the impact of digital finance on women within the family is discrepant among individuals. The degree of influence may be inconsistent owing to some unique characteristics. We categorize the sample in terms of region, family living pattern, and fertility status. By conducting the heterogeneity analysis, we find that the impact will be larger for women within the family in rural areas than in urban districts and for women living with parents-in-law. From an individual perspective, the impact will also be larger for women who have their first child as a girl. Our results further shed light on the inclusive effect of digital finance on women.

This study makes several contributions to the literature in this field. Using convincing micro-databases and constructing representative variables, we quantify the causal relationship between the development of digital finance in China and women's bargaining power within the family through empirical regressions. In terms of research ideas, this study expands the research scope of gender inequality and provides a new perspective on family economics in the digital environment. Existing studies have discussed the welfare effect of digital finance on households, enterprises, and traditional financial institutions, while few have focused on its impact on inequality within households. For instance, how does digital finance affect the division of labor, decision-making processes, and resource allocation within the family? Most studies investigating factors that influence women's bargaining power and family inequalities are primarily from the perspective of women themselves and their offspring, as well as some social aspects, including cultural background, social regime, policy constraints, and gender concepts. In the wake of the changes in China's economic environment and the gradual prevalence of digital financial services, it is urgent to explore the impact of innovative financial tools on micro-entities. The empirical evidence from China in our study will form a timely complement to research in related fields.

2. Literature review and hypothesis development

According to the game theory, when buyers and sellers conduct transactions, a party with strong bargaining power can win prices and services that are favorable to them. This concept is commonly applied to cooperation between labor and capital, upstream and downstream enterprises, insurance agents and insured individuals, and even between couples (Alenezi & Walden, 2004; Hutchinson & Persyn, 2012; Itzkowitz, 2013; Wang, 2014). Furthermore, bargaining power seems to be particularly applicable to sexual relationships. Manser and Brown (1980), Mcelroy and Horney (1981) introduce the Nash bargaining theory into the intra-family decision-making process, arguing that the utility functions of husband and wife are distinct, and they can decide the allocation of utility and distribution of resources through bargaining. The stronger the bargaining power of the family members, the greater their ability to decide how family resources are allocated.

Several studies have provided different explanations for defining and measuring bargaining power of couples. If one spouse can influence or change the thoughts and behaviors of the other spouse by following his or her own preferences for things, he or she is considered to have stronger bargaining power in marital relationship. The existing literature defines women's bargaining power as their ability to control income and other non-material resources, such as time. In the classic labor economics literature, the relative

income of the husband and wife is a common indicator of bargaining power (Aizer, 2010; Bertrand, Kamenica, & Pan, 2015). Some scholars divide all households into two groups based on couples' wage ratios. If the ratio is less than a certain value, it means that women in such a family possess more bargaining power. In addition, several studies have closely linked bargaining power to family status, believing that bargaining power determines the ownership of family decision-making rights. Scholars have evaluated relative power from various perspectives. Blood & Wolfe (1960) use eight indicators, including husband's occupation, whether the wife goes out to work, and the purchase of cars and a house, to measure the relative power within the family. In this study, we measure the wife's decision-making power by adding up the logical variables of five family affairs. However, some scholars have pointed out the lack of effectiveness in using family affair indicators to represent the bargaining power of husbands and wives, believing that those sub-indicators are susceptible to gender differences, and proposing that the measurement of women's family status should focus on women's subjective satisfaction with marriage, division of labor, and other aspects. Similarly, Zuo and Bian (2001) point out that autonomy reflects individuals' independent will and may be a suitable indicator of the bargaining power of couples.

The degree of inclusiveness in traditional finance is relatively restricted for women. Digital finance takes advantage of technology to provide innovative financial services that can be beneficial to families, particularly by increasing the financial availability of vulnerable groups and reducing the cost of access to financial services for women. For female investors who are typically risk averse, FinTech incurs lower verification costs, allowing them to obtain professional financial advice at lower prices (Goldfarb & Tucker, 2019). Digital financial services are believed to offer women a more efficient and effective financial life by overcoming gender barriers associated with traditional finance. In addition, Burke, Rabinovich, and Schaner (2020) state that the rapid expansion of digital currency improves not only women's economic elasticity, but also their right to speak in the family decision-making process. However, this influence does not work for men. Digital finance expands women's social networks and credit resources, making them more influential in household affairs by weighing up the resources acquired from digital financial services. Based on the proposed viewpoints that women's bargaining power may be improved by the development of the digital economy because of its inclusiveness, we develop the following hypothesis:

Hypothesis 1. The development of digital finance can alleviate gender inequality within families by improving women's bargaining power.

In marital relationship, women devote more time and energy to housework and childcare, while men participate more in the labor market, depending on the physiological differences between men and women (Becker, 1976). The classic economic literature argues that women's comparative advantages in engaging in basic household affairs justify the current pattern of intra-household work divisions (Killingsworth & Heckman, 1987). Although awareness of gender equality has become increasingly non-negligible due to the diversification of economic modes and changes in labor patterns, the labor participation rate of women, especially women in rural areas, has been insufficient for a long time. The elasticity of women's labor supply is significantly greater than that of men (Heim, 2007).

On the one hand, in light of labor demand, a high entry threshold for women in some job positions exemplifies the fact that gender discrimination still exists in the labor market. On the other hand, on the supply side, women themselves are prone to take care of the whole family and protect their marriage with insufficient willingness to participate in social activities. Bertrand et al. (2015) have found that the notion of "husbands should earn more than wives" affects wives' labor participation rate, income level, and marital satisfaction. Pierce, Dahl, and Nielsen (2013) also argue that gender identity has created distortions in married women's performance in the labor market, including either quitting the labor market or choosing positions with income far below their potential. Women usually lag behind men in terms of employment quality and income level (Fortin, 2015), which directly leads to women's inferior family status and weak bargaining power for family resource allocation. Based on the background discussed above, we believe that digital finance will improve women's participation in the labor market. Thereby improving their own economic independence and family bargaining power.

How does digital finance help improve labor participation for women? We propose that women's entrepreneurship may be the crucial form of labor participation encouraged by digital finance. As we all know, innovation in financial products has lowered the financial threshold for customers, making financial services such as payment, credit, and investment more convenient. Lack of financial support is a major factor restricting entrepreneurial behaviors (Karaivanov, 2012), digital finance provides more inclusive services to alleviate financial constraints by harnessing its advantages of expanding financial capacity and reaching to wider audience. Existing literature has already proved that digital finance can encourage firms' innovative and entrepreneurial behaviors. Duarte, Siegel, and Young (2012) show that digital finance can utilize information technologies to build a crediting system at a lower cost, which helps borrowers acquiring capitals and thus to promote firms' innovation and entrepreneurship. Xie, Shen, Zhang, and Guo (2018) have also find that digital finance has a stronger role in encouraging the entrepreneurial behavior of micro-enterprises that with less registered capital and that locate in provinces with lower urbanization rate, reflecting the inclusiveness of digital finance and exemplifying the fact that "long tail effects" brought by traditional finance institutions can be alleviated by the digital finance. When comes to the individual level, Beck, Pamuk, Ramrattan, and Uras (2018) take M-Pesa mobile payment in Kenya as an example to exemplify that the mobile payment can improve individuals' entrepreneurial performance by strengthening their abilities of execution, reducing information asymmetry and the probability of capital appropriation. In terms of the gender difference, some scholars hold that as women possess less physical strength, lower risk affordability, and more inferior human and social capital, they will encounter more discrimination in the process of starting a business (Miri, Candida, & Robert, 1997; Neider, 1987). Since the emergence of digital finance services, the public considered it as an effective tool to solve such financial discrimination and partiality. Zeng and Ma (2022) find that female entrepreneurs are more likely to receive online loans with lower interest rates than male entrepreneurs, while the gender difference does not exist in the situation of offline loans. Suri and Jack (2016) suggest that mobile payments can improve

Table 2
Index structure and specification of digital financial inclusion.

Level I	Level II indicators
Breadth of coverage	Account coverage rate: number of Alipay accounts owned per 10,000; proportion of Alipay users who have bank cards bound to their Alipay accounts; average number of bank cards bound to each Alipay account
Depth of usage	Payment: frequency and amount of digital payment per capita Monetary fund: Yu'ebao purchases Credit: personal online consumption loans and small business loans Insurance: number and the amount of insurance transaction Investment: internet investment and money management Credit investigation: access to credit-based livelihood services
Degree of digitalization	Mobility, affordability, credit, convenience

women's contribution to household budgets by boosting their involvement in income-generating activities. Therefore, it is reasonable to propose that digital financial services can effectively alleviate such discrimination on women in the traditional finance market in terms of social capital aspects, and thus to improve their economic conditions and family status. Meanwhile, working through digital financial platforms helps reduce time conflicts between women's social work and domestic work. Additionally, women can benefit from their advantages in information gathering and empathetic communication, boosting their entrepreneurial success rates on digital platforms. To sum up, we propose the following hypothesis:

Hypothesis 2. Digital finance increases women's bargaining power within the family by encouraging their entrepreneurship.

Last but not the least, it is not surprising that the frequency of women's participation in financial market and their financial literacy are usually lower than men (Lusardi & Mitchell, 2011; Woodyard & Robb, 2012). Ke (2021) finds that the threshold for engaging in the financial industry is also higher for women. Hsu (2016) proposes that the primary reason for the gap between men and women in terms of the level of financial control is that men usually take charge of financial issues within the family. As a result, it is common for women to neglect the necessity of getting access to financial resources, which gives rise to an imbalance between husband and wife in bargaining power. Digital finance is an innovative financial tool that increases the possibilities for women to benefit from financial services, assists women in comprehending and participating financial markets, and refines their financial control about personal and family financial issues. The Women's World Banking report noted that women will fully benefit and acquire economic empowerment once they can access digital financial services and utilize resources appropriately. Brainard (2016) points out that real-time control can be efficiently achieved using digital finance technologies. Elijah and Sulaiman (2021) also find that compared to men, women can benefit more from mobile payments in terms of the control of personal financial assets. If one party focuses on managing the family's financial issues, he or she is inclined to make decisions and conduct negotiations based on his or her own preferences. Therefore, we propose the following hypothesis:

Hypothesis 3. Digital finance influences women's bargaining power within the family by promoting their financial market participation.

3. Data and summary statistics

3.1. Data source and sample selection

The data utilized in this paper are derived from three major sources. First, we use the personal and family level data of the CFPS, officially launched by the Institute of Science Survey of Peking University in 2010, covering a wide range of domains for families and individuals from 162 counties in 25 provinces of China, including the statistics of individuals' basic characteristic, work status, work type, wage income, family relationship, and other information. Based on our research question, we only retain information on individuals who are married and have a spouse. We match the data of husband and wife in CFPS adult database based on the spouse code in CFPS family relationship database. As the retirement policy in China will affect not only individuals' decisions on optimal behavior but also the relative income between the husband and wife, retirement will undoubtedly make a difference to the discourse power within the family (Addoum, 2017). Therefore, according to the regulations of legal working age and marriage age in China, the sample is limited to men aged 22–60 years old and women aged 20–55 years old.

Second, we use the Peking University Digital Financial Inclusion Index of China, jointly compiled by the Peking University Institute of Digital Finance and the Ant Financial Group. Based on the user data of the Ant Financial Group, the index depicts the current development and evolution trends of China's digital finance from 2011 to 2020 (Guo et al., 2020). Table 2 summarizes the whole index system of digital financial inclusion in Guo et al. (2020). The general index comprises three indices, including breadth of coverage, depth of use, and degree of digitalization. Breadth of coverage is reflected by the number of Alipay accounts owned and the number of bank cards bound per capita. Depth of use measures the actual use of internet financial services such as payment, monetary fund, credit, insurance, investment, and credit investigation services. Degree of digitalization focuses on the higher mobility and lower interest rates of digital financial services. Since its release, it has been widely used to study the impact of digital finance on household income, consumption and employ (Yang & Zhang, 2022; Xie et al., 2018). The whole index system comprises province, city, and county

Table 3
Summary statistics of dependent variable: women's bargaining power.

Variables	Mean	sd	Min.	Max.	Observations
Relative income	0.301	0.434	0	0.999	8288
Women's decision-making power	1.405	1.892	0	5	8288
Male-led decision	0.543	0.498	0	1	8288
Female-led decision	0.153	0.360	0	1	8288
Couple-led decision	0.304	0.460	0	1	8288
Five household affairs:					
Family basic expense	0.288	0.450	0	1	8288
Child raising	0.376	0.484	0	1	8288
Purchase of luxury	0.283	0.453	0	1	8288
Family finance issues	0.258	0.437	0	1	8288
Purchase of houses	0.200	0.400	0	1	8288

This table shows summary statistics of dependent variables in our sample. For women's bargaining power, we use two measures: (1) the "women's decision-making power" means wife's total score in the decision-making process of major family affairs, including allocation of household expenditures, financial management of insurance and investment, purchase of a house, children's education issues and purchase of high-end consumer goods. This indicator is the primary proxy variable in our paper. (2) the ratio of couple's personal income, we use it in baseline regression and robustness tests.

three levels, limited by the availability of CFPS county-level codes and referring to Yang and Zhang (2022), we match the city-level PKU-DFIIC with CFPS household data. Finally, the region-level variables are taken from the city statistical yearbook and the National Bureau of Statistics yearbook.

Our study aims to examine the impact of digital finance on women's bargaining power within households. We mainly use data from CFPS 2014, as the questionnaire for this year alone clearly addresses issues related to the household decision-making process. To alleviate the endogeneity problem, we adopted a first-order lagged digital finance index at the city level. In fact, the launch of Alipay marked China's digital finance entering a new era in 2004, and then the technology of QR-code scan payment was introduced to further facilitate the development of mobile payment. In 2013, Alipay launched Yu'ebao that allowed customers to invest with their pocket money inside the ecosystem. Beginning in 2014 Ant further offered mutual fund distribution service, which increase Alipay's user engagement and expanded the market for mobile payment segments. Therefore, our use of the digital finance index to investigate its impact on households is reliable in terms of both data quality and relevance.

After excluding samples with missing values for the main variables, we retain the data of 127 cities across the country, 8288 observations are included. In the robustness test, using other representative dependent variable, we also construct panel data for 2014–2018 to further inspect the empirical results.

3.2. Variables

The main dependent variable is bargaining power within the family. We utilize two proxies to characterize the bargaining power of women in the family. The first one is the wife's total score in the decision-making process of family affairs. Relevant questions in the CFPS questionnaire are the most essential measure of the dependent variable in our study. There are five major questions related to the decision-making process of family affairs, asking who has the final say in five matters: allocation of household expenditures, financial management of insurance and investment, purchase of a house, children's education issues, and purchase of high-end consumer goods. The answers to these questions shown on the survey are represented by individual's personal code. After handling the identification problem, the value of "the husband has the final say" is set to 0 while the value of "the wife has the final say" is set to 1. By simply adding up the values of answers to these five questions, we can obtain a total score of the wife's bargaining power in the decision-making process of family affairs. A high score indicates that the wife has higher bargaining power in family and can play a leading role in more family events, and vice versa. Besides, in order to clarify the difference in the decision-making power of husband and wife, we continue to define three dummy variables, which are named "male-led decision," "female-led decision," and "couple-led decision." Specifically, "male-led decision" means that the five matters are all decided by the husband, so "female-led decision" is the opposite and "couple-led decision" means that husband and wife participate together in the afore-mentioned five household affairs.

Table 3 tabulates the summary statistics of the dependent variables. The results show that although modern gender-role attitudes advocate for gender equality and the promotion of women's social status, wives' discourse rights are still weaker than those of husbands. According to the statistics in Table 3, the wife's income accounts for only 30% of the family income, and the average of the total score on the decision-making process of family affairs is minute. It is noticeable that more than half of households' decisions are led by husbands, with a mean greater than the other two situations. Among the decision-making processes of the five specific family affairs, women have a relatively larger discourse right on children's education issues and the distribution of family expenditure. Research has shown that women pay more attention to the overall welfare level of the family, preferring to allocate resources to various trivial household matters (Pahl, 1990). However, this disposition of the wife is primarily applied to the daily management of several insignificant household affairs, while the husband has a greater discourse right on "one-time" family affairs, such as purchases of houses.

Another proxy variable is the relative income of wife and husband by constructing the formula below. In the formula, the wife's income and husband's income are both total personal income from work. To avoid the impact of extreme values, their incomes are

Table 4
Summary statistics of independent variables and control variables.

Variables	Interpretation	Mean	Sd.	Min.	Max.	Observ
Independent variables:						
Digital finance index	One-year lagged index	1.274	0.217	0.932	1.893	8288
Breadth of Coverage	Coverage of accounts	1.133	0.275	0.683	1.839	8288
Depth of Usage	Actual use of digital finance	1.287	0.287	0.704	2.153	8288
Level of Digitalization	Convenience and low costs	1.715	0.209	1.115	2.471	8288
Wife Characteristics variables:						
Age	Age of the wife	40.28	8.966	20	55	8288
Education level	Years of education	7.249	4.439	0	22	8288
Status of health	Healthy = 1, unhealthy = 0	0.699	0.459	0	1	8288
Gender attitude	Male career-oriented while female family-oriented	4.006	1.134	1	5	8288
Surfing online	Surfing = 1 , not surfing = 0	0.252	0.434	0	1	8288
Children	Num. of children in family	1.596	0.845	0	7	8288
Husband Characteristics variables:						
Age	Age of the husband	42.19	9.084	22	60	8288
Education level	Years of education	8.616	3.791	0	19	8288
Status of health	Healthy = 1, unhealthy = 0	0.780	0.414	0	1	8288
Gender attitude	Male career-oriented while female family-oriented	4.054	1.026	1	5	8288
Surfing online	Surfing = 1 , not surfing = 0	0.321	0.436	0	1	8288
Family-level and regional-level variables:						
Family size	number of family members	4.605	1.913	1	17	8288
Total family income	Logarithm	8.959	1.566	0	13.70	8288
Family net assets	Logarithm	10.25	3.628	−13.01	15.76	8288
Clan cuture	Logarithm of ancestral temples	0.452	0.782	0	3.258	8288
GDP per capita of region where family is located	Logarithm	10.490	0.591	9.192	11.877	8288
Size of traditional finance	Year-end balance of loans divided by GDP for financial institutions	1.016	0.539	0.215	3.139	8288
Industry structure	Proportion of service sector	0.404	0.0960	0.184	0.780	8288
Government fiscal policy	Proportion of fiscal expenditures	0.221	0.145	0.044	1.397	8288

This table shows summary statistics of independent variables and control variables, we control for the relevant variables at the individual, household, and regional levels. The digital finance index is divided by 100 for empirical tests.

winsorized at the 1% level. According to the CFPS calculation method, the personal income from agricultural production and operation, private business activities, and other self-employed work are valued at zero, in other words, we adopt the ratio of wage earnings for a couple.

$$Wife\_RelativeIncome = \frac{Wife\_Income}{Husband\_Income + Wife\_Income} \tag{1}$$

Although relative income is commonly used, endogeneity may exist when directly using it to measure bargaining power (Mcelroy & Horney, 1981), as bargaining power is not only multidimensional but also complex and dynamic. In contrast, family decision-making power can more intuitively represent the bargaining power of family members. Hence, we believe that the questions related to decision-making process of family affairs in CFPS are the most essential measures of women's bargaining power in our paper.

The independent variable is the degree of digital finance development in each city, as measured by the PKU-DFIIC. The index is detailed in section 3.1. To alleviate the endogeneity problem, we adopted a lagged digital finance index at the city level. We also control for the relevant variables at the individual, household, and regional levels. Personal characteristic variables included the age of the couple, years of education, health status, and gender attitudes. Gender attitude refers to the attitude toward the view that "men are career-oriented while women are family-oriented," ranging from 1 to 5. The higher the value, the more the person is inclined toward this opinion. Household characteristic variables include household size, total net income and net assets (logarithm of the difference between total assets and total liabilities). The presence of children can significantly affect patterns of resource allocation within the family. Therefore, to eliminate the influence of this consideration, we controlled for the number of children in the regression. Since Internet use may also directly affect the income or decision-making power of family members, we set a logical variable that takes the value of 1 if a woman uses the Internet and 0 otherwise.

In terms of regional control variables, we include the per capita GDP, representing the degree of economic development of the city where the family is located, the ratio of the year-end loans of financial institutions to GDP showing the scale of the regional finance market, the ratio of the growth of tertiary industry to GDP explaining the regional industry structure, and the ratio of government fiscal expenditures to GDP. It should be mentioned that culture plays an important role in socioeconomic development as an informal institution, as well as in women's bargaining power and intra-household inequality (Guiso, Sapienza, & Zingales, 2006; Ebenstein & Leung, 2010). Chinese traditional culture is rooted in Confucian culture and maintains strict patriarchal family cultural characteristics. Even in modern times, the concept of carrying on the family line is still common in Chinese families. Existing literatures show that the strength of clan culture is significantly correlated with regional boy preference and female development, which brings about gender imbalance. We add control variable of clan culture, clan ancestral temples are important feature of clan culture prevalence. According to CFPS questions "whether the community has clan ancestral temples and the number of clan ancestral temples", we calculate the

Table 5
Baseline results.

Variables	Women's decision-making Ologit		Relative income OLS	
	(1)	(2)	(3)	(4)
Digital finance	0.983***	1.057**	0.339***	0.093**
	(0.354)	(0.452)	(0.066)	(0.047)
Variables of wife:				
Age		0.038***		0.005***
		(0.007)		(0.002)
Education		0.065***		0.014***
		(0.008)		(0.002)
Health status		−0.221***		0.020
		(0.067)		(0.013)
Gender attitude		−0.014		−0.022***
		(0.019)		(0.005)
Surfing online		0.484***		0.058***
		(0.068)		(0.012)
Children		0.379***		0.026***
		(0.062)		(0.006)
Variables of husb.:				
Age		0.005		−0.005***
		(0.008)		(0.002)
Education		−0.047***		−0.003**
		(0.005)		(0.001)
Health status		0.039		−0.033**
		(0.051)		(0.013)
Gender attitude		−0.004		−0.021***
		(0.021)		(0.005)
Surfing online		−0.158**		−0.036**
		(0.077)		(0.018)
Family-level:				
Family size		−0.257***		−0.003
		(0.028)		(0.003)
Total income		0.008		0.046***
		(0.011)		(0.003)
Net asset		−0.006		−0.004***
		(0.008)		(0.001)
Regional-level:				
Clan culture		−0.154*		−0.014
		(0.080)		(0.013)
Traditional finance		0.084		−0.007
		(0.057)		(0.015)
Fiscal policy		0.083		−0.071
		(0.293)		(0.051)
Industry structure		−0.275		0.095
		(0.831)		(0.170)
GDP per capita		−0.278		0.054
		(0.256)		(0.082)
Provincial fixed effect	Yes	Yes	Yes	Yes
Observations	8288	8288	8288	8288
R-squared	0.022	0.062	0.069	0.175

Table 5 shows the baseline results, controlling for regional fixed effects. We use two proxies to characterize the bargaining power of women in the family. The dependent variables in column (1) and (2) are the total score of wife's family decision-making power on five household affairs, while the dependent variables of column (3) and (4) are the wife's relative income to the husband. Digital finance index is one-year lagged. Standard errors are clustered at the provincial level to avoid serially correlated error terms across households. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

number of ancestral temples in each city, and define clan culture as the logarithm of "clan ancestral temples +1". The descriptive statistical results of the variables after excluding the extreme values and invalid samples are shown in Table 4. We note that the average number of years of education and Internet use are both lower for wives. Both wives' and husbands' gender attitudes are mostly biased toward the traditional concept of "male outside, female inside," reflecting that Confucian patrilineal and husband-oriented ideas still have a far-reaching impact on Chinese families. The proportion of our sample families with relatively open and equal notions of gender accounted for only 30%. Additionally, the situation is worse in families located in rural areas than in urban areas.

4. Digital finance and women's bargaining power

4.1. Baseline regression: digital finance and women's bargaining power

Based on the data characteristics, we consider the model of ordered choice and linear regression model for empirical analysis. The baseline model is constructed as follows:

$$Female\_decision_i = \alpha_0 + \alpha_1 Digital\_finance_i + \alpha_2 X_i + \lambda_i + \varepsilon_i \quad i = 1, 2, \ldots, N \tag{2}$$

The dependent variable represents the wife's bargaining power within the family and is measured in terms of the wife's decision-making power on household affairs and relative income. $Digital\_finance_i$ is the main independent variable representing the degree of development of digital finance. First-order lagged digital finance index is adopted in all regressions. We also control for the provincial fixed effect λ_i, which avoids the problem of omitted variables to a certain extent. X_i controls a series of variables at individual and regional levels. $\varepsilon_i$is a random error term.

Table 5 presents the regression results for the baseline model. The first two columns examine the impact of digital finance on wives' family decision-making power over household affairs. Column (1) only considers main explanatory variable. In column (2), we add the control variables at the individual, household, and regional levels. The results show that the coefficient of digital finance is positive and significant at the 1% confidence level, indicating that digital finance helps to improve the wife's right to speak within the family, thereby further enhancing the wife's bargaining power and reducing the inequalities formed under traditional conceptions of gender roles. We can see that for every unit of standard deviation added to the digital finance index, the probability of women's gaining decision-making power in the family increases accordingly. In addition, we cluster standard errors at the provincial level to avoid serially correlated error terms across households. Using the relative income of wife and husband as another dependent variable, the results in columns (3)–(4) further confirm this conclusion. Therefore, our regression results are consistent with the Hypothesis 1 that women who have high digital finance adoption are more likely to realize their bargaining power's improvement.

Next, we examine the coefficients of the controlled variables. First, the wife's education level has a positive effect on her decision-making power within the family, while reducing husband-led decisions. Education is often considered one of the most important channels for empowering women (Zhou, Li, & Su, 2021). In general, the higher the number of years of education for the wife, the higher the learning ability and level of knowledge reserves, and the more possible wives to overturn conventional wisdom and accept gender equality. Financial knowledge mastered through education will increase the wife's economic and social resources and assist her in dealing with more family affairs. Similarly, as the husband's years of education increase, the wife's decision-making power is also affected. The degree of influence is exactly the opposite of the impact of the wife's educational level, which further confirms the importance of education as a personal resource in the family bargaining game. Second, we notice that the number of children in households is positively correlated with the wife's bargaining power. When the number of children increases, women need to put in more effort in taking care of their children. Moreover, children's emotional dependence on their mothers also enforces women's decision-making power over issues related to their children's education. Third, Internet usage positively influences the bargaining power of both wives and husbands. Fourth, the more the wife or husband stick to conventional gender attitudes, the more detrimental it is for the wife's bargaining power in the family. It is worth noting that most of the regional economic variables in the regression results have less influence on the interpreted variables, possibly because these variables change less in a short period for most cities and are therefore absorbed by the regional fixed effect.

4.2. Endogeneity analysis: distance-to-Hangzhou as an instrument

To further nail down the causal impact of digital finance on women's bargaining power, we employ an instrument variable approach. The estimates of baseline model may be biased on account of reverse causality and omitted variables. For instance, if a wife's bargaining power increases and her decision-making power over family affairs increases, her demand for online shopping and Internet financial management will also promote the development of digital finance. Indeed, there is still a small probability that owing to extreme risk aversion, women will refuse to use new forms of financial products, which may impede the development of digital finance. In addition, because of the limited availability of data in CFPS, we use cross-sectional data for the baseline regression in our study. Although the results remain consistent after controlling for the regional fixed effect and replacing the dependent variable with panel data in following robustness test, the problem of omitted variables may still exist. Therefore, the instrumental variable method is used for endogeneity analysis.

Geographical locations and terrain characteristics are frequently-used exogenous variables separated from the economic system, and the stationary nature of physical characteristics is not affected by external factors. In general, if the distance between a specific region and the first-tier city or coastal port is close enough, the "radiation effect" of developed cities will also drive the economic transformation and upgrading of industrial structure of that region. Referring to Yang and Zhang (2022) and setting Google Maps as a reference standard, we calculate the spherical distance from each city to Hangzhou based on longitude and latitude. We use distance to Hangzhou as an instrument to predict the intensity of digital finance across different cities.

The main reason we choose Hangzhou as the benchmark is that the compilation of the Digital Financial Inclusion Index utilizes data from Alipay, and Hangzhou, the headquarters of Ant Group, is in a leading position in the digital finance field. As mentioned in Hong, Lu, & Pan (2021), Ant Group initially partnered with the Hangzhou municipal government to implement QR code-based digital payments, local merchants accepted QR-Scan as a payment method through marketing and ground promotion, and the scale gradually

Table 6
Distance to Hangzhou as IV for digital finance usage: first and second stage.

	Digital finance	Women's decision-making	Digital finance	Relative income
	(1)	(2)	(3)	(4)
Digital finance		2.656**		1.317**
		(1.027)		(0.519)
Dist. to Hangzhou	−0.136***		−0.073***	
	(0.005)		(0.006)	
Provincial fixed effect	Yes	Yes	Yes	Yes
observations	8288	8288	8288	8288
R-squared	0.929	0.090	0.928	0.143
Wald test		7.54		
P-value		0.006		
F-stats of first stage				122.98
Wald-F				176.46

This table reports the estimation results using the distance to Hangzhou as an instrument variable for digital finance usage in each city. The dependent variable in columns (1) and (2) is women's decision-making power, and the dependent variable in columns (3) and (4) is the couple's relative income ratio. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

Table 7
Digital finance and intra-household decision-making process on household sub-affairs.

Panel A	Wife-led	Husband-led	Couple-led
	(1)	(2)	(3)
Digital finance	0.522**	−0.714***	0.630***
	(0.288)	(0.307)	(0.358)
Control variables	Yes	Yes	Yes
Provincial fixed	Yes	Yes	Yes
Observations	8288	8288	8288
R-squared	0.092	0.110	0.060

Panel B	Expense allocation	Financial issues	House purchase	Kids' education	Luxury purchase
	(1)	(2)	(3)	(4)	(5)
Digital finance	0.472	0.409**	0.329	0.892***	0.367
	(0.325)	(0.189)	(0.368)	(0.248)	(0.317)
Control variables	Yes	Yes	Yes	Yes	Yes
Provincial fixed	Yes	Yes	Yes	Yes	Yes
Observations	8288	8288	8288	8288	8288
R-squared	0.113	0.114	0.097	0.087	0.093

This table shows the impacts of digital finance on specific intra-household decision-making process. The dependent variables in Panel A are three patterns of decision-making process, and the dependent variables in Panel B are five family matters. We employ Probit model regression, and the control variables are the same as the baseline regression. Standard errors are clustered at the provincial level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

expanded. As a result, cities closer to Hangzhou tend to have higher levels of digital finance penetration. Yang and Zhang (2022) also explain the feasibility of this instrument variable from the perspective of word-of-mouth spread and population inflows. Therefore, we argue that the smaller the geographical distance from Hangzhou for a given region, the more rapidly digital financing will develop in that region.

Table 6 presents the results of the instrumental variable tests. Consistent with baseline regression, we still adopt two proxies here to measure women's bargaining power, and use instrument variable method to make endogeneity analysis respectively. The dependent variable in columns (1)–(2) is women's decision-making power, and the dependent variable in columns (3)–(4) is the couple's income ratio. As shown in Table 6, columns (1) and (3) present the results of the first-stage regressions. The coefficients clearly indicate that the instrument variable is negatively correlated with the development of digital finance at a significance 1% level, which means that the farther from Hangzhou a region is, the slower the development of digital finance in that area. Columns (2) and (4) show the results of the second-stage IV test, we find that the weak instrument variable test is greater than the bias value for 10% level, so the distance to Hangzhou satisfies identifiable condition. After adopting the instrumental variable, the coefficients of digital finance become larger and remain positively significant. The endogeneity test further confirms our hypothesis that digital finance does casually improve women's bargaining power and alleviate intra-household gender inequality.

Table 8
Robustness tests: replace dependent variables.

Variables	Women's satisfaction with life	Men's satisfaction with wife's economic contribution
	(1)	(2)
Digital finance	0.535**	0.864*
	(0.224)	(0.483)
Controls	Yes	Yes
Provincial fixed effect	Yes	Yes
Observations	8288	8288
R-squared	0.021	0.016

We replace dependent variables with family members' subjective feelings and employ Ologit model. The control variables are the same as the baseline regression. Standard errors are clustered at the provincial level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 9
Robustness tests: other aspects.

Panel A	City deletion	Add variable
	(1)	(2)
Digital finance	1.048**	1.095**
	(0.451)	(0.452)
First child is a boy		0.037
		(0.036)
Control variables	Yes	Yes
Provincial fixed effect	Yes	Yes
Year fixed	No	No
Observations	7765	8022
R-squared	0.063	0.059

Panel B	City deletion	Add variable	Panel data
	(1)	(2)	(3)
Digital finance	0.093*	0.108**	0.134***
	(0.047)	(0.048)	(0.042)
First child is a boy		0.008	
		(0.008)	
Control variables	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes
Year fixed	No	No	Yes
Observations	7765	8022	10,266
R-squared	0.158	0.170	0.224

Panel A takes women's decision-making power which is the wife's total score in decisions-making process of family affairs as the dependent variable and adopts Ologit model, while Panel B takes relative income as the dependent variable and adopts OLS model. The number of samples in Columns (1) and (2) becomes smaller because of municipalities deletion and missing values of the newly added control variable. Column (3) is the result of panel fixed effect model regression by combining the data of 2014–2018. Standard errors are clustered at the provincial level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4.3. Digital finance and intra-household decision-making process on household affairs

In order to clarify the impact of digital finance on couples' bargaining power, we continue to use the binary choice model. The dependent variables in Table 3 are logical values that we develop to measure the specific pattern of decision-making processes within the family, which are wife-led, husband-led, and couple-led decision-making. Furthermore, we also explore the impact of digital finance adoption on women's decision-making power in specific family matters. Table 7 displays whole regression results. It is obvious that the evolution of digital finance has a positive effect on wife-led and couple-led decision-making in Panel A. Interestingly, digital finance significantly reduces husbands' discourse rights on family affairs. From the perspective of the decision-making process of household sub-affairs, columns (2) and (4) in Panel B show that digital finance improves the probability that women take charge of family financial issues and children's education issues. The results indicate that digital finance as an innovative financial service is expected to reconstruct the pattern of the decision-making process within households and alleviate inequality within the family caused by traditional gender cognition.

It is necessary to pay attention to the result that digital finance improves women's decision-making power in family financial issues. In fact, it has long been widely believed that men possess gender advantages in terms of risk investment, social interactive, financial

services, and information acquisition. In societies with strong gender norms, even if the wife is proficient in the financial industry, her influence over intra-household financial decisions and her willingness to propose financial suggestions will both be restricted (Ke, 2021). Digital finance services have greatly increased the participation rate in financial markets by making transactions more convenient. The innovation of digital financial products has lowered the threshold of the financial market and enriched investment options, such as the emergence of Internet financial products with low risk and stable yields for vulnerable groups who used to be excluded from traditional financial institutions. Nonetheless, digital finance is also a double-edged sword, leading to new social problems, such as data privacy risks and online fraud. Compared with men, women have stronger risk awareness and insurance awareness, statistics from the China Academy of Information and Communication (CAICT) show that 69% of the deceived people involved in digital financial fraud were men, more than twice as many as women. The convenience and product diversification of digital finance make women have a higher awareness to allocate financial products for family. To sum up, women's risk aversion and prudent investment may further enhance their financial decision-making power in the family.

4.4. Robustness tests

In this section, we conduct a series of robustness tests for the baseline regression. To begin, some scholars are suspicious of the use of decision-making power in family matters to measure the bargaining power of couples. According to the existing research, different indicators are easily constrained by gender differences and weights. The improvement of women's status is not at the expense of the reduction of the male position but is committed to the establishment of an equal and harmonious interactive between husbands and wives, an enhancement of the autonomy and satisfaction of family life for both parties. Several studies suggest that the measurement of women's bargaining power should focus on their subjective satisfaction with marriage, division of labor, and other aspects. Therefore, based on the question on CFPS of "How happy are you," we construct a subjective indicator to measure wives' feelings toward family life. We choose the question of "husband's degree of satisfaction with the wife's economic contribution to the family" to reflect the economic value of the wife. These two variables are ordered variables. We return both indicators to the baseline model as dependent variables, and the control variables are the same as the baseline regression. The results in Table 8 show that the role of digital finance remains significant.

Next, we make robustness tests from other aspects. The regression results are displayed in Panel A and Panel B separately in Table 9. First, sample adjustment is conducted. Considering the distinctiveness of the administrative regulation and regional characteristics of the municipalities that are directly controlled by the central government, we remove Beijing, Tianjin, Shanghai, and Chongqing from our sample. Second, we add a control variable called "the gender of the first child is male." In some areas, the birth of a boy is an important factor that affects a woman's family status (Das Gupta et al., 2003). Families typically prefer sons to daughters, potentially giving women with their first child a boy greater decision-making power. Owing to the large number of missing values, we did not include this variable in the baseline model. The coefficients in columns (1)–(2) show the results remain significant, we confirm the reliability of the baseline regression results.

As mentioned before, the questionnaire in the CFPS mentions issues related to household decision-making power only in 2014, so the baseline regression uses cross-sectional data. In the robustness test, we combine the data from 2014, 2016, and 2018 CFPS. We use relative income as the dependent variable and make regression through the panel fixed effect model to test the baseline results. Column (3) in Panel B presents the result, which is still positive and significant.

5. Mechanism analysis

We have demonstrated the significant role of digital finance in improving women's bargaining power and alleviating inequalities within families from multiple perspectives. However, the channels for this impact need to be further investigated. In this section, from the perspective of labor and financial market participation, we consider two possible mechanisms in explaining the relationship between digital finance and women's bargaining power.

5.1. Women entrepreneurship and women's bargaining power

Hypothesis 2 proposes that digital finance can improve women's bargaining power in the family and reduce inequality within the family by promoting women's labor participation, especially by encouraging women entrepreneurship. Women have limited access to formal finance, which affect their ability to participate in entrepreneurship. Digital finance provides them new source of capital, so they can start a new business, which may give women greater bargaining power on major family affairs. This logic needs to be tested by focusing on women entrepreneurship as the core mechanism.

The labor market participation is complicated. In the CFPS questionnaire, interviewees are asked in detail about "what is the main type of work", including their own agricultural production and management, private enterprise/individual business/other self-employment, non-agricultural employment, and agricultural part-time work. We take the sample of women answering "private enterprise/individual business/other self-employment" as the sample of women entrepreneurship, and assign values of 0 and 1 to this variable. We construct the interactive term of *Digital Finance* × *Women Entrepreneurship* and conduct regression analysis based on baseline model. Column (1) of Table 10 shows that interactive term is positively and significantly related to digital finance and the economic significance remains large, suggesting that women entrepreneurship enhances the effect of digital finance on women's bargaining power. Existing studies have shown that digital finance can help alleviate women's credit and information constraints, and improve their financing availability. Our results have once again verified that the development of digital finance is friendly and helpful

Table 10
Mechanism analysis: women entrepreneurship and women's bargaining power.

	Women's bargaining power		
	(1)	(2)	(3)
Digital finance	0.800*	0.996**	1.230**
	(0.422)	(0.460)	(0.466)
Digital finance *	0.531*		
women entrepreneurship	(0.292)		
women entrepreneurship	−0.534		
	(0.391)		
Digital finance *		0.332	
women employment		(0.221)	
women employment		−0.600*	
		(0.322)	
Digital finance *			−0.413
women agricultural production			(0.309)
women agri. Production			0.586
			(0.434)
Control variables	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes
Observations	8288	8288	8288
R-squared	0.053	0.062	0.062

This table reports regression estimates of digital finance on women's bargaining power through different types of job. Columns (1) reports the results for the intersection terms of digital finance and women entrepreneurship, columns (2) and (3) report the estimations of the other two interactive terms. The dependent variable is the total score of wife's family decision-making power on five household affairs, the control variables are the same as the baseline regression. Standard errors are clustered at the provincial level. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

Table 11
Digital finance and women's working time.

	Women's bargaining power	Women's working time	Women's housework time
	(1)	(2)	(3)
Digital finance	0.623	8.281**	−0.248
	(0.588)	(3.156)	(0.457)
Digital finance *	0.010**		
women's working time	(0.005)		
women's working time	−0.018***		
	(0.006)		
Control variables	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes
Observations	6582	6582	8288
R-squared	0.057	0.062	0.111

This table reports regression estimates of digital finance on women's bargaining power through women's working time. Column (1) reports the results for the interactive term, columns (2) and (3) report the estimations of digital finance on women's working time and housework time. The dependent variable is the total score of wife's family decision-making power on five household affairs. If women have withdrawn from the labor market, the value of working time is excluded, after deleting missing values, we retained 6582 observations of women's working time. Standard errors are clustered at the provincial level. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

to women.

We also construct the interactive terms of digital finance and women employment , digital finance and women agricultural production respectively. We test whether digital finance could also have an impact on women's bargaining power through employment and agricultural production. In comparison, column (2) and column (3) show that the coefficients on these two interactive terms are statistically insignificant and have a much smaller magnitude. This contrast among women entrepreneurship, employment and agricultural production is consistent with our intuition, mobile payment, online lending, and other inclusive digital financial services alleviate financial constraints and discrimination, which provides women new sources of capital, so they can start a new business more easily. Table 10 proves the effective impact of women's entrepreneurship on improving women's bargaining power within the households.

In addition, we consider more deeply about labor participation. Changes in women's labor participation include whether they are involved in the labor market and their transformation of working hours (Heckman, 1993). The time distribution of family members can be categorized into leisure, working, and housework time. We continue to explore whether changes in women's working status brought about by digital finance will expand the depth of work participation. In other words, we wonder whether working time will replace housework time, and thus affect women's bargaining power.

Table 12
Mechanism analysis: financial market participation and women's bargaining power.

	Financial market participation	Women's bargaining power	Women's bargaining power
	(1)	(2)	(3)
Digital finance	1.253***		1.034**
	(0.465)		(0.446)
financial market part.		0.285**	0.278**
		(0.132)	(0.132)
Control variables	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes
Observations	8288	8288	8288
R-squared	0.332	0.062	0.062

Table 12 shows the regression results about digital finance and financial market participation, controlling for the relevant variables at the individual, household, and regional levels. The variable "financial market participation" is constructed based on the question "Does you currently own stocks, funds, bonds, trusts, foreign exchange and other financial products?", we adopt Probit model in column (1) because this variable is a binary variable. The dependent variables in columns (2) and (3) are both the total score of wife's family decision-making power on five household affairs. Standard errors are clustered at the provincial level. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

We continue to construct the interactive term of *Digital Finance* × *Women's Working Time* and perform regression analysis based on baseline model. According to the question "How many hours per week do you typically spend on work?" we construct variable of working time per week for wife. If a family member has quit the labor market, there will be no data on the working hours available. Column (2) in Table 11 shows that interactive term is positively and significantly related to digital finance, suggesting that women's working time enhances the effect of digital finance on women's bargaining power. The development of digital finance has also further enhanced the depth of women's labor participation, thus increasing their own economic value and the possibility of obtaining more family decision-making power for women.

Further to say, women are the main bearers of domestic work. Existing literature has shown that when wives enter the labor market, an increase in relative income leads to a decline in housework time, as women have the right to offset the reduction in housework time with their increased financial contribution to the family. Interestingly, Bertrand et al. (2015) has found that if the wife earns more than her husband, she will compensate for the violation of traditional gender norms by increasing the number of hours spent on housework. Based on the CFPS question regarding "daily housework time on weekdays or weekends," we obtain the average daily housework hours of the husbands and wives. In column (3), we notice that even though digital finance has promoted women entrepreneurship and working time, it does not have a negative impact on the time women spend on performing their household responsibilities, indicating that digital finance can help women balance work and family.

5.2. Financial market participation and women's bargaining power

This section analyses whether financial market participation by digital finance also help enhance women's bargaining power. As we mentioned before, the threshold for women's engaging in the financial industry is higher for women (Ke, 2021), which gives rise to an imbalance between husband and wife in bargaining power. Through the alleviation of information asymmetry and credit constraints, digital finance is an innovative financial tool that increases the possibilities for women to benefit from financial services, assists women in participating financial markets and accessing more financial resources at a lower cost, thus improve their attention to personal finance and the ability to manage family assets.

To test this mechanism, we select variable from family economic database in CFPS and combine it with our sample. The variable "financial market participation" is constructed based on the question "Does you currently own stocks, funds, bonds, trusts, foreign exchange and other financial products?", we define family members holding any of these financial products as participating in financial market, with a value of 1, otherwise 0. We can notice that the probability of families' participating in financial market is relatively at the bottom level. Table 12 shows that digital finance has significantly improved women's bargaining power by promoting the probability of financial market participation. The regression results in column (3) proves the rationality of this mechanism. Digital finance enables women to be involved in financial markets and to. With increasing participation in financial market, women can master more financial knowledge and improve financial management, thus possess stronger bargaining power within households (Elijah & Sulaiman, 2021). Women enhanced financial control will help them reduce their emphasis on their husbands' preferences, improve their own power and promote their labor market participation.

6. Heterogeneity analysis

In this section, we primarily discuss the question of whether the influence of digital finance on women's bargaining power will be discrepant for individuals with distinct traits. Taking the heterogeneity of groups into account, we conduct a heterogeneity analysis in terms of regions, family living patterns and fertility status.

Table 13
Heterogeneity analysis in terms of region and living pattern.

	Urban	Rural	All sample	With parents	Not with parents	All sample
	(1)	(2)	(3)	(4)	(5)	(6)
Digital Finance	1.464**	0.906**	1.154***	2.469***	0.533	0.880*
	(0.613)	(0.439)	(0.411)	(0.722)	(0.465)	(0.492)
Digital finance * Urban			−0.469*			
			(0.244)			
Urban			0.948***			
			(0.307)			
Digital finance * With parents						0.603**
						(0.299)
With parents						−1.579***
						(0.456)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3577	4651	8288	3247	5041	8288
R-squared	0.065	0.057	0.064	0.079	0.035	0.070

Table 13 tests the heterogeneity in terms of region and living pattern. Column (1) and column (2) are categorized in terms of regions, while column (4) and column (5) are grouped in terms of family living pattern. The dependent variable is the total score of wife's family decision-making power on five household affairs. Standard errors are clustered at the provincial level. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

Table 14
Heterogeneity analysis in terms of fertility status.

	No child	With child	First birth is girl	First birth is boy
	(1)	(2)	(3)	(4)
Digital finance	−0.860	0.863**	1.817**	0.426
	(3.303)	(0.405)	(0.728)	(0.396)
Control Variable	Yes	Yes	Yes	Yes
Provincial fixed effect	Yes	Yes	Yes	Yes
Observations	411	7877	3740	4282
R-squared	0.157	0.056	0.064	0.057

Table 14 tests the heterogeneity in terms of fertility status. Column (1)–(2) are categorized in terms of the question of whether the couple has conceived a child, while column (3)–(4) are grouped in terms of the first child's gender. The dependent variable is the total score of wife's family decision-making power on five household affairs. Standard errors are clustered at the provincial level. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively.

6.1. Regions and family living pattern

When examining the socioeconomic impact of traditional Chinese cultural concepts, the existing literature believes that the conventional culture of gender and family has a greater impact on rural areas than on urban areas. Women living in rural areas are more likely to be constrained by social norms, with more than half the families being husband-oriented. Women's financial performance and the proportion of families in which wives possess decision-making power is much lower than that of husbands. To test whether there are differences in the role of digital finance in women's bargaining power between urban and rural areas, we divide samples into two groups in terms of region and construct an urban variable taking the value of 1 when the family lives in urban area.

Furthermore, the influence of traditional social norms is mirrored in family compositions. Married men usually bear the responsibility of supporting their elderly parents. Elderly people in China generally live with their sons rather than with their daughters. The acceleration of modernization has altered this kind of social atmosphere: young couples are gradually building their own families and making decisions through effective communication. Living with in-laws still exists and is more common in rural areas. Under these circumstances, the distribution of power between generations may also affect the wife's (daughter-in-law's) bargaining power in the family, as elders usually table their advice to interfere with the younger generation's life (Lundberg & Pollak, 1994). The husband often tends to defend the interests and authority of his parents, which can easily lead to a compromise in the wife's discourse rights. Even so, some studies believe that living with parents-in-law means wives will also receive support in housework and childcare, which has a "spillover effect" on women's labor supply. In view of the different conclusions drawn from the existing literature, we examine whether the impact of digital finance on women's bargaining power differs for distinct family living patterns. We construct variable according to the question "whether to live with parents" in CFPS, and classify samples in terms of family living pattern with the value assigned as 1. Otherwise, it is equal to 0.

Column (1)–(3) in Table 13 report that the development of digital finance has a greater effect on alleviating inequalities within families in rural areas where traditional gender attitudes are deeply rooted. Conversely, urban areas with more mature economic and cultural developments will impair the role of digital finance acting in improving women's bargaining power. From the perspective of the country, the inclusiveness of digital finance is conducive to rural revitalization. Column (4)–(6) show that living with parents will

reduce the wife's decision-making power within the family, while the coefficient of the interactive term in column (6) reflects that digital finance can alleviate this phenomenon and improve the decision-making power of women who live with parents-in-law.

6.2. Fertility status

By considering the discrepancies in the fertility situation in each household, we again categorized our sample in terms of both the question of whether the couple has conceived a child and the gender of the first child. Table 14 illustrates that digital finance is more likely to play a positive role for women with children than in those without children. This finding corroborates the view that women with children take the primary responsibility of caregiving because of their innate physiological advantages and altruism, hindering women from participating in the labor market and financial activities. According to our previous analysis, digital finance not only promotes women's participation in economic activities via its superiorities in the transaction process and information transfer but also mitigates the potential time conflict between women's career development and family caregiving.

In addition, if the first child is female, digital finance will have a more positive impact on the wife's intra-household bargaining power. Owing to the norm of son preference in a traditional agricultural civilization, the birth of a son will enhance women's decision-making power in household affairs. The coefficients of columns (3)–(4) in Table 14 show that digital finance can break the traditional shackles and promote gender equity.

7. Conclusion

Intra-household inequality embodied in the status of husband and wife, labor division patterns, and the decision-making power of family affairs maps the gender inequality of the whole society to a certain extent. For a long time, women have been restricted by internal and external factors such as physiological characteristics, traditional norms, and government policies. Weak bargaining power, inferior family status, and lack of decision-making power are the main sources of gender inequality within households. By substantially breaking down the physical barriers for participation in financial activities, digital finance has opened new channels for vulnerable groups who used to be excluded from traditional financial institutions. Using data from household-level representative data in CFPS and city-level data of the PKU-DFIIC, we investigate the real impact of digital finance on women's bargaining power within families and illustrate the possible mechanisms.

Inequalities in labor division and resource allocation between men and women are universal in Chinese families. The proportion of wives withdrawing from the labor market is much higher than that of husbands because of pregnancy, childrearing, and housework burden. The development of digital finance has significantly reduced intra-household inequality. This study explains influential channels from two perspectives. First, digital finance promotes women's participation in economic activities by encouraging their entrepreneurial behaviors. Second, digital finance increases the likelihood of women involving in the financial market. We also notice that even though digital finance has promoted women entrepreneurship and increased women's working time, it does not have a negative impact on the time women spend on household responsibilities, indicating that digital finance can help women balance work and family life. The influence of digital finance on women's bargaining power is distinct for different household groups. We discover that the impact will be larger for women in a household living in rural areas than in urban districts, and for those who live with parents-in-law compared with living alone. Our findings suggest that digital finance does largely boost financial inclusion.

Data availability

Data will be made available on request.

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