The Impact of Access to Credit and Capital Markets on Fertility: Evidence from China

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ABSTRACT

Based on the micro-financial perspective of optimizing household resource allocation, combined with Becker's family theory, this paper examines the impact of broader access to credit and capital market on household decisions with respect to the number of children by constructing a revised four-period life cycle model. The results show that loosening borrowing constraints significantly promotes the fertility rate, while opportunities for financial investment inhibits the fertility rate. We find that disposable income weakens the direct positive impact of credit quota and promotes the direct negative impact of on fertility. The excessive consumption of households strengthens credit constraints and encourages household consumption, which accelerates a crowding out effect on fertility. In addition, endowment insurance prompts households' investment in the capital market, which suppresses reproductive behavior. Further- more, credit constraint increases fertility by raising housing prices, while investment opportunities crowd out fertility by raising housing prices. There are differences in the impact of credit constraints and investment opportunities on fertility for different levels of households income.

INTRODUCTION

Financial development is of great interest to academics since it can deeply pro- mote economic growth and can serve as a catalyst for social development. The core of finance, the intertemporal resource allocation, profoundly facilitates or inhibits fertility (Filoso and Papagni, 2015; Empirik, 2018). The importance of access to credit and capital markets has become increasingly evident in recent years with the development of the demography and sociology generally. In China, financial development level is entering a new period of explosive growth. According to the China Statistical Yearbook Arcand et al. (2015) and China Financial Yearbook Bacchetta et al. (1997) published by the National Bureau of Statistics and The People's Bank of China, the annual growth rates of financial depth Bahadir et al. (2015), the scale of deposits and loans of financial institutions Basso et al. (2014) are 2.82%, 3.135% and 3.03% Beck et al. (2000) respectively between 2002 and 2021. The financial depth increased from 57.5% to 208.4% between 1985 and 2021 and the ratio of private sector credit to GDP, which is second only to the United States Becker et al. (1973), increased from 66.19% to 182.43% between 1985 and 2020.

However, the contemporaneous total fertility rate has fallen from 2.65 to 1.3 Becker et al. (1960), which is lower than the global average population turnover level (Chen, 2021). According to the data released by the National Bureau of Statistics, China's birth rate has dropped from 14.57‰ to 7.52‰ between 2012 and 2021, which means that it dropped by 48.4% in the past 10 years. Against the backdrop of the effect of the covid-19 pandemic and the dwindling domestic demand, the problems of the shrinking labor force and the accelerated aging caused by the low fertility level are the urgent and strategic problems that China is currently facing for the first time in the history of the country. As the largest developing country in the world, China can use the intertemporal nature of financial products to ease the population dilemma, and at the same time, it China is aware of the risk of accelerating the unstable development of the social economy and of aggravating the imbalance of economic structure caused by the non-linear complex relationship between fertility and financial development. Therefore, the objective of this paper is to explore the general and reliable evidence on of the effects of borrowing constraints and opportunities for financial investment on with regard to the choice of the number of children in the case of China and to provide micro-financial view that explains China's ultra-low fertility trap.

There are two kinds of defects in the financial market: borrowing constraint and savings constraint. There are two kinds of defects in the financial market: borrowing constraint and savings constraint. They directly reflect

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the depth of financial market development, so we use them to represent the level of financial development. If agents are allowed to loosen the credit limit, then they have more money to raise more children in the current period. Does lending restrictions have an impact on China's fertility? In low-income areas, savings constraints leads to serious deficiencies in the supply of financial market services, which may hinder effective intergenerational transfer to the elderly. Therefore, the expansion of capital markets may cause a decline in fertility. In high-income areas with high savings, increasing access to the capital market may also have an a crowding out effect on fertility. Does financial investment opportunity have an impact on China's fertility? To address those specific questions, first, we construct the micro theoretical basis of the impact of financial development on fertility based on China's national conditions, and describe the mechanism of the impact of the defects in the financial market on family fertility decisions from the perspective of economic theory. Second, this paper discusses moderating effects of directly effects of credit constraints and investment opportunities in capital markets on fertility. Third, we first study the impact of access to credit and capital markets on the number of children families decide to have under the background of China's rapid financial development in view of the fact that most previous studies ignored the impact of capital market investment by the family capital market on childbearing decisions in China. Fourth, we provide a micro financial perspective to explain the reasons for the low fertility rate in China. This study provides financial field empirical evidence and corresponding ideas for the formulation of policies related to the improvement of fertility in China.

The remainder of this paper is structured as follows. Section 2 reviews the related literature. Section 3 develops the theoretical framework and hypotheses. Section 4 details the data, variables, and methods. The empirical results are then described in Section 5, followed by robustness checks and a discus sion regarding endogeneity in Section 6. Furthermore, Section 7 describes the mediating effect and heterogeneity. Finally, Section 8 provides the conclusion.

LITERATURE REVIEW

Finance changes people's fertility behavior through the macroeconomic environment and the micro household consumption and investment, so the research on the impact of financial development on fertility can be divided into macro level and micro level. At the country level, substantial literature has shown that financial development has a significant impact on fertility (Basso et al, 2014; Boldrin et al, 2015; Cigno and Rosati, 1996; Filoso and Papagni, 2015; Habibul- lah et al, 2016; Sah, 1991; LIM et al, 2019; Rammohan, 2001; Steckel, 1992; Zakaria et al, 2017). Moreover, the relationship

Moreover, the relationship between financial development and fertility is different for different countries at different development levels.

They found that financial development tends to increase fertility in developed countries, but has an opposite effect in developing countries (Habibullah et al, 2016; Sethi et al, 2021). In developing countries, the relationship between financial development and the total fertility rate is a non-linear inverted U- shaped relationship, while in developed countries it is a non-linear U-shaped relationship Lai and Yip (2019). Among such countries, there is a non-linear inverted U-shaped relationship between economic development and fertility in Malaysia Tang and Tey (2017).

At the family level, researchers analyze the relationship between consumer behavior and fertility based on two situations. First, children are regarded as consumer goods. Leibenstein (1957) and Becker and Lewis (1973) proposed the relationship between consumer behavior and childbearing, that is, the demand for children depends on the utility and cost. According to the consumer behavior theory, the increase in income and the improvement of living standards inspire the increase in parents' demand for consumer goods. However, when the income elasticity of the number of children is low and the income elasticity of the quality of children is high, parents' demand for children tends to decline as they become rich. This proposition is called the "quality-quantity tradeoff" (Becker et al, 1960). It suggests the individual fertility behavior is a process that implies the intertemporal allocation of resources to satisfy the intertemporal consumption, making the consumption curve of the entire lifecycle smooth. People's behavior in making optimal intertemporal allocation decisions for resources in uncertain circumstances is consistent with the essence of finance. Second, children are regarded as investment products. Caldwell (1976) and Neher (1971) put forward the old age security hypothesis: children are treated as an asset, and parents can achieve sustainable consumption throughout their lives without resorting to a capital market that allows intertemporal borrowing. Some scholars discussed the role of the hypothesis of old-age security in fertility behavior from a theoretical perspective (Caldwell, 1982; Morand, 1999; Nugent, 1985; Boldrin and Jones, 2002; Ehrlich and Lui, 1991). Children are potential financial support mechanisms not only today but also when facing uncertainty risk in the future and when the financial market is imperfect or lacking (Cigno, 1993). Therefore, countries with weak financial systems have higher fertility rate because parents depend on their children to support them in their old age (Bhupatiraju, 2022). On the other hand, developed capital markets stimulate agents to have more children by borrowing. The perfect substitutability hypothesis assumes that the financial products and services area substitute for children

(Basso et al, 2014; Cigno, 1993; Filoso and Papagni, 2015; Sah, 1991; Zakaria et al, 2017). If the return on raising children is lower than the return on investment in the financial market, the demand for children will decrease. Therefore, a well-organized and diversified financial market pro- motes intertemporal trade by reducing the dependence of current consumption on current income. As a result, limited access to financial resources has been identified as one of the most important considerations for fertility behavior.

THEORETICAL FRAMEWORK AND HYPOTHESES

The case of no frictions

The four-period life cycle model proposed by Filoso and Papagni (2015) describes the optimal consumption and fertility decisions of a family in the four stages of the life cycle, which is determined by the returns of its children and the defects in the financial market. Based on the framework of Filoso and Papagni (2015), this paper builds a model which considers a combination situation with China's basic endowment insurance system and high emotional value provided by children to parents. For average Chinese families, parents obtain satisfaction by living with their children, and children also have altruistic attitudes towards their parents. Hence, suppose that parents care about their children and their parents' welfare, they either spend resources on raising their children or providing funds to support their retired parents. Similarly, children support their parents with a certain economic return when they grow up. Considering the traditional concept of raising children to guard against old age within the special family structure model in China, the number of children born will continue to affect the three stages after the agent reaches adulthood. We introduce it into the utility function of each stage. The life cycle utility function of family members whose life stage is young adults at date t is

$$U(c_t, n_t) = v(c_t^1 n_t) + u(c_{t+1}^2, c_{t+1}^3, n_t) + g(c_{t+2}^3, n_t), \quad (1)$$

Where the total consumption is $C_t = C_t^1, C_{t+1}^2, C_{t+1}^3, C_{t+2}^3$, superscript $(0, 1, 2, 3)$ represents the four stages of life, c_t^1 is the consumption of the agent in the early adulthood, C_{t+1}^2 is the late adulthood of the agent, C_{t+1}^3 is the consumption of the agent's parents in old age, C_{t+2}^3 is the consumption of the agent during their own old age, n_t represents the number of children raised by the family. $V(\cdot), u(\cdot), g(\cdot)$ are representing the utility functions that are strictly concave and satisfy Inada condition of three periods: $t, t + 1,$ and $t + 2$.

In the first period of their life, childhood t 1, the agents are busy with learning the skills in the roles that they can occupy as an adult. They do not have the ability to make consumption and investment decisions.

In the second period of their life, young adulthood t, agents exchange their own human capital for income, then transition to a debt situation to purchase a house and pay for childcare expenses. They naturally face a borrowing constraint. Considering the situation of China's endowment insurance system Bhupatiraju et al. (2022), agents should pay insurance premium that is KW_t^1 before retirement, K is a proportion of the insurance premium and salary. The budget constraint is:

$$c_t^1 = (1 - \tau n_t - k) w_t^1 + D_t, \quad (2)$$

where τ is the cost of raising a child, w_t^1 is salary and D_t is the optimal the amount of debt Boldrin et al. (2002).

In the third period of their life, middle adulthood $t + 1$, the agents repay their debts and save for their old years. In addition, they also need to transfer some funds to support their parents. At the same time, their children start to enter the labour market. The budget constraint is:

$$C_{t+1}^2 = w_{t+1}^2 - R_{t+1}D_t - q_{t+1} - S_{t+1}, \quad (3)$$

Where S_{t+1} is the optimal saving amount, $R_{t+1} \equiv 1 + r_{t+1}$ and r_{t+1} is the interest of $t + 1, q_{t+1}$ is a money transfer towards parents. Contemporaneously, the consumption of parents consists of the saving, the economic returns of their children and pension. We introduce a pension A_{t+1} the constraints according to the pension of the old which mainly comes from the basic endowment insurance in China, and the parent face the following budget constraint:

$$C_{t+2}^3 = R_{t+2}S_{t+1} + n_t q_{t+2} A_{t+1} \quad (4)$$

After retirement $t + 2$, agents live on the return from financial products, money from their children and pension A_{t+2}. The budget constraint is:

$$C_{t+2}^3 = R_{t+2}s_{t+1} + n_t q_{t+2} + A_{t+2} \quad (5)$$

When the capital market is perfect, families can obtain the optimal amount of borrowing and saving according to the intertemporal allocation. Under the case of perfect financial market, the consumption-fertility choice problem the agent faces can be expressed as

$$\underset{c_t^1, n_t, c_{t+1}^2, c_{t+1}^3, c_{t+2}^3}{\text{Max}} \quad U(c_t^1, n_t, c_{t+1}^2, c_{t+1}^3, c_{t+2}^3) = v(c_t^1, n_t) + u(c_{t+1}^2, c_{t+1}^3, n_t) + q(c_{t+2}^3, n_t)$$

s.t. $(1-\tau h_t - k)\, w_t^1 + \frac{(1-k)w_{t+1}^2}{R_{t+1}} + \frac{n_t\, q_{t+2}}{R_{t+1}R_{t+2}} + \frac{s_t}{n_{t-1}} +$

$\frac{A_{t+1}}{n_{t-1}R_{t+1}} + \frac{A_{t+2}}{R_{t+1}R_{t+2}} - c_t^1 + \frac{c_{t+1}^2}{R_{t+1}} + \frac{c_{t+2}^3}{R_{t+1}R_{t+2}} + \frac{c_{t+1}^3}{n_{t-1}R_{t+1}}$

$= 0.$

Due to space limitation, the first-order conditions of the consumption-fertility choice problem the agent faces are placed in supplementary files.

The case of frictions

Now, suppose agents cannot borrow the required amount of resources in an economy with weak credit market. This additional constraint prevents the spending by children and young people from exceeding the highest amount of resources that can be borrowed during young adulthood. The budget constraint under the financial market assumption with such a borrowing constraint is

$$c_t^1 = (1 - \tau h_t - k)w_t^1 + \overline{D}_t,$$

here $\overline{D}_t$ is the maximum amount that the family can borrow at t, that is, $\overline{D}_t < D_t$.

In an economic environment, a household interacts with the financial market not only as a borrower, but also as a lender. In the role of lender, they may face different types of market defects: poorly organized financial markets — perhaps for technical or institutional reasons — which either provides few investment opportunities and effective risk diversification, or may bring serious costs to those who enter such a market. This situation is called savings constraint (Pollin, 1996), which refers to the adverse effect of low-level financial deepening on savings (McKinnon, 1973; Shaw, 1973). When the opportunity to obtain financial investment as a lender is limited by savings constraints, investment in children becomes an alternative option.

Now, suppose that the development of financial markets is still insufficient, such that economic entities face large access costs. The budget constraint under the financial market assumption with savings constraint is

$$c_{t+1}^3 = R_{t+2}\, \bar{s}_{t+1} + n_t q_{t+2} + A_{t+2},$$

where $\bar{s}_{t+1}$ is the maximum amount of saving at $t + 1$, satisfying $\bar{s}_t < s_t$.

Comparative statics analysis in imperfect market

The influence of credit quota and basic endowment insurance on the number of children in financial markets with borrowing constraint

The change in the number of children n_t due to a change in credit quota $\overline{D}_t$ with borrowing constraint is

$$dn_t/D_t = \Gamma^{-1}\tau w_t^1 \frac{\partial^2 v}{\partial(c_t^1)^2} - \frac{\partial^2 v}{\partial c_t^1\, \partial n_t}\, \Gamma_{11} + \Gamma_{51}, \quad \textbf{(6)}$$

where Γ and Γ_{ij} represents the determinant and the cofactor of $(i, j) -$ th of the bordered Hessian matrix with borrowing constraint, respectively. In this case, the second derivative of the problem of maximizing the utility function satisfies the following conditions: $\Gamma > 0$ and $\Gamma_{11} < 0$.

$$\Gamma_{51} = \frac{q_{t+2}}{R_{t+1}R_{t+2}}\, |H(u)|_{22}\, \frac{\partial^2 g}{\partial(c_{t+2}^3)^2} > 0,$$

where $|H(u)|$ is the determinant of the Hassian matrix of utility function $u(\cdot)$, $|H(u)|_{22}$ is the principal minor of $(2, 2)$ eliminating in the determinant of the Hessian matrix $H(u)$.

Similarly, the change in the number of children due to pension changes n_t is given by

$$dn_t/dA = \frac{-\Gamma_{51}}{\Gamma}\, \frac{1}{n_{t-1}R_{t+1}} + \frac{1}{R_{t+1}R_{t+2}} < 0, \quad \textbf{(7)}$$

when credit constraints exist in the financial market, the increase of pension have a crowding out effect on fertility.

Equation (6) indicates that the availability of credit $\overline{D}_t$ have two effects on the family fertility rate n_t. On the one hand, with the growth of $\overline{D}_t$, young parents transfer more future resources and use them on consumption and children. If children are regarded as normal commodities Boldrin et al. (2015) in parent's preferences, they are inclined to raising more children. In addition, the increase of $\overline{D}_t$ means that the income available for consumption during the retirement period decreases, whereby a household needs more generations to maintain consumption. Therefore, the response of families is to increase the number of children

they are having. Both effects indicate that $dn_t/d\overline{D}_t > 0$. On the other hand,

a pension can play a role in smoothing consumption and investment. The formula (7) shows that the increase of basic endowment insurance has a crowding out effect on fertility. Under the background of credit constraint, the family has limited resource allocation capacity and insufficient cost bearing capacity to bear children. Thus, it is more likely to increase the willingness to participate in endowment insurance; therefore, improving the endowment insurance causes the fertility rate to decline.

The influence of savings quota, investment opportunities and basic endowment insurance on the number of children in financial markets with savings constraints

The effect of a change in investment opportunities on the number of children n_t is

$$\frac{dn_t}{d\overline{s}_t} = \frac{1}{\phi}\frac{\phi_{52}}{R_{t+1}} - q_{t+1}R_{t+1}\;\frac{\partial^2 g}{\partial(c_{t+2}^3)^2}\;\phi_{22}, \qquad (8)$$

where ϕ and ϕ_{ij} represent the determinant of the $(i, j) - th$ cofactor of the bordered Hessian matrix with savings constraint. In the second order condition of the maximum value of the problem, we have $\Phi > 0$ and $\phi_{52} < 0$. In this expression, $-q_{t+2}R_{t+2}\frac{\partial^2 g}{\partial(c_{t+2}^3)^2}\phi_{22} < 0$ refers to the trade-off between investment in children and investment in financial activities. The expression is negative due to substitutability of financial products for kids. The sign of another part ϕ_{52}/R_{t+1} is determined by the sign of ϕ_{52}. If a parent appreciates children as a normal good, the following equation

$$\phi_{52} = |H(u)|_{22}\;\tau w_t^1\frac{\partial^2 v}{\partial(c_t^1)^2} - \frac{\partial^2 v}{\partial c_t^1\,\partial n_t}$$

shows Φ_{52} to be negative with positive $|H(u)|_{22}$. Therefore, a liberated access to capital market depresses the fertility rate. Given the intertemporal budget constraint, young adults reduce their debt with $\overline{s}_{t+1}$ increases. The case of children as inferior goods implies the opposite positive effect.

Similarly, the change in the number of children n_t due to pension changes A is given by the following formula

$$dn_t/dA = \frac{\phi_{52}}{\phi}\frac{1}{q_{t+2}R_{t+2}} < 0. \qquad (9)$$

The increase of pension has a crowding out effect on fertility with savings constraint. In fact, the basic endowment insurance has a direct and an indirect negative impact on the fertility rate. The former is caused by fertility Purpose of parents. The essence of the concept of raising children to cater to old age is to prevent the steep decline in elderly consumption. The basic endowment insurance plays the same role, in that it has a direct crowding out effect. The latter is caused by investment in financial assets. Participating in the endowment insurance can enable families to reduce preventive savings and increase investment in financial assets, thereby indirectly reducing the fertility rate by increasing investment opportunities.

From the perspective of the classical economic theory of fertility, if children are regarded as commodities, they can be divided into normal commodities and inferior commodities. The increase of $\overline{D}_t$ means that a household can obtain more future resources for consumption and raising children. If a household prefers to regard kids as a normal commodity, then n_t will increase; otherwise, it will decrease. In addition, the increase of $\overline{D}_t$ means that the income available for consumption during the retirement period decreases; therefore, the household chooses to increase their investment in children. Then both of these effects imply

$dn_t/d\overline{D}_t$ is positive. If children are inferior goods, from a mathematical point of view, the sign of $dn_t/d\overline{D}_t$ has not been determined. Hence, we assume that parents regard children as normal commodities and propose the hypothesis

H1: The credit quota has a direct positive effect on fertility. On the other hand, in the savings constraint case, we proposes the hypothesis

H2: Investment opportunities have a direct negative effect on fertility.

Moderating effect of income, excess consumption and basic endowment insurance

According to theoretical analysis, the increase in income increases the cost of raising children. Under the assumption that children are normal commodities, this produces a positive income effect and increases investment in children. The increase of household income makes it possible for households to enhance their credit quota and obtain borrowing funds from formal financial institutions or obtain more convenient digital financial services with lower transaction costs through more flexible transfer and remittance, which is conducive to families in terms of quickly using social capital to obtain external help, thus weakening the impact of liquidity constraints and credit constraints. However, with income further increasing, families may pay more attention to the quality of children, and the increase of wage will weaken the impact of relaxation of credit constraints on fertility. Therefore, income weakens the direct positive impact of the ease of access to borrowing on fertility. On the other hand, the growth of income relaxes the access threshold to the capital market. Thus, investment opportunities have significantly negative effects on the birth rate. Families that can withstand investment losses in the capital market generally have higher incomes. Such families may prefer the quality of their children, and the financial products have the same attributes for children, which will produce a crowding out effect (Basso et al, 2014; Cigno, 1993; Filoso and Papagni, 2015; Sah, 1991; Zakaria et al, 2017). Therefore, the impact path of investment opportunities on family fertility is to increase income, then income facilitates the direct negative impact of investment opportunities on fertility. Therefore, we propose the following hypothesis:

H3: Disposable income weakens the direct positive impact of credit quota and promotes the direct negative impact on fertility.

According to the theory of consumer behavior, if the parent regards children as a kind of "durable consumer goods", they can obtain spiritual utility by raising children Leibenstein (1957). Theoretically, there is a substitution effect between commodities, and the demand of households for other consumer goods may crowd out the demand for children. If the household income is not enough to make up for current consumption, then borrowing activities emerge. With the rapid development

of digital inclusive finance, this not only improves the availability of consumer credit and expands the scope of its application, but also promotes the change of Chinese residents' consumption concept and behavior in a short period of time due to its symbiotic development with e-commerce. Consumer credit emerges as having significant effect on household consumption behavior (Bacchetta and Gerlach, 1997). Households increase both expenditures and debt when their income prospects improve (McCarthy, 1997). With the rapid economic development since China's reform and opening up, people are optimistic about future income and consumer credit can promote consumption by easing liquidity constraints. Naturally, consumer credit stimulates excess consumption. However, consumer credit may aggravate credit constraints because of force majeure or the possibility that the reduction in borrower's repayment ability, thus strengthening credit constraints (Dynan et al, 2012, 2013). Therefore, excess consumption weakens the direct positive impact of borrowing constraints on fertility. That is, the higher the advanced consumption is, the weaker the impact of credit constraint on fertility. Therefore, we propose the following hypothesis:

H4: Excess consumption weakens the direct positive impact of credit quota on fertility.

The capital market is not the only way to save for the elderly and to achieve stable consumption throughout the life cycle. In many countries, the government provides public pension funds for the elderly through the pay as you go system. This intergenerational transfer is composed of taxation on young people and the corresponding transfer of the elderly. The public pension system reduces the necessity of entering the financial market to provide for the elderly, at least partially offsetting the free choice of savings. In other words, although the public pension system is not a real market, it provides a very similar intertemporal transaction. According to theoretical analysis, when the financial market is imperfect, the improvement of basic endowment insurance inhibits the number of children raised. That is, when children are used as investment goods, endowment insurance has a substitute effect on childbearing, and families may reduce their investment in children. Previous studies have shown that the improvement of family endowment insurance coverage, basic medical insurance coverage and unemployment insurance coverage significantly promote family risk asset investment. Participating in endowment insurance can significantly increase family investment in total financial assets and various financial assets, and can increase the proportion of investment in risky financial assets and stock assets

(Gormley et al, 2010; Goldman and Maestas, 2013; Cavapozzi et al, 2013). This shows that the increase of pension insurance may indirectly reduce the fertility rate by increasing the family's financial asset investment. Then basic endowment insurance promotes the direct negative impact of investment opportunities on fertility. Therefore, we propose the following hypothesis:

H5: Basic endowment insurance promotes the direct negative impact of investment opportunities on fertility.

DATA AND EMPIRICAL MODEL

Data and description

The data in this paper are all from the National Bureau of Statistics, China Statistical Yearbook, provincial statistical yearbooks and Wind database. The research year period of all variables is 2011-2020. The research objects are 31 provinces in China except Hong Kong, Macao and Taiwan. The total number of samples is 310. Due to the change of statistical caliber, some samples of variables are missing. For example, household loans have been counted starting in 2015. This paper uses personal loans and overdrafts to replace the sample data from 2011 to 2014. For investment, a sub-index of the digital inclusive financial index released by the Digital Finance Research Center of Peking University, has been counted starting in 2014. In August 2012, the new rural social endowment insurance and urban residents' social endowment insurance system have been fully launched, and they have been merged into urban and rural residents' social endowment insurance. Therefore, the variable endowment insurance lacks data in 2011. After data cleaning, matching and processing, the total number of samples was adjusted to 279 valid samples.

The explained variables used in this paper is the crude birth rate, that is, the number of newborn babies per 1000 people. It can objectively reflect the fertility level of each province. On the one hand, the period studied in this paper is 2011-2020. Although the fertility rate can be obtained from the data of the sixth population census in 2010 and the data of the seventh population census in 2020, the time span for both is large, and it is difficult to capture the changes in fertility rate in each province for this period. On the other hand, due to various reasons such as underreporting of births and statistical errors, the fertility data obtained from the census are not accurate (Guo, 2008; YinWenyao et al, 2014). The effect of replacing the total fertility rate with the birth rate is very small and unimportant (Entwisle, 1981). And there is a specific proportional relationship between the birth rate and the fertility rate (Qiao and Zhu, 2018).

The key explanatory variables are the indicator of the development level of credit market — the ratio of

non-state owned enterprise loans to GDP—the private sector credit and the indicator of investment opportunities for capital market — the development level of the securities industry. They both are determined by the financial development level of the country. First, most researchers choose the ratio of private sector credit to GDP as an indica- tor, such as King and Levine (1993), Beck et al (2000), Arcand et al (2015), Bahadir and Valev (2015), Filoso and Papagni (2015), Muhammad et al (2016) and Zhu et al (2020). It reflects the development of the overall credit market and household credit market and the depth of financial intermediation. The deepening of financial intermediation leads to an increase in the liquidity of investment, improvement in the availability of financial services, promoting the return on financial resources, and accelerating economic growth. However, there is no uniform definition of private sector loans in China, and China's official statistical yearbook does not release data on the definition. According to the statistics released by People's Bank of China in 2021, the amount of RMB loans issued by banks to real economic sectors accounts for 60.97% of the total social financing. The total shares of non-financial enterprises in China account for 3% of the total social financing, which indicates that the allocation of bank credit largely represents the allocation of financial resources in China. Yao (2010) pointed out that the bank loans in China mainly flow to state-owned enterprises, and less than 20% of bank loans flow to non-state-owned sectors, which contributes about 65% of GDP. Based on the current situation of China's financial development, the loans of non-state owned enterprises can replace the private sector loans, which is a substitutable way to measure the credit con- straint of the financial market. However, China's official statistical yearbook did not release the data of non-state-owned enterprises loans in various regions. Therefore, this paper uses the method of Zhang and Jin (2005), YAO (2012) to calculate the loans of non-state-owned enterprises in China from 2011 to 2020, and replaces the private sector credit. Thus, the higher the ratio of non-state-owned enterprise loans to GDP, the weaker the loan constraint. Second, this paper selects the ratio of trading volume of securities market to GDP to measure the development level of the securities industry, that is, investment opportunities. The higher the total trading volume of the securities market, the lower the threshold for people to enter the capital market for investment. Moderating variables are selected are express volume, personal loans and basic endowment, which are measured by express volume, the ratio of personal loans to per capita GDP and the ratio of the balance of basic endowment to GDP. Express volume and personal loans measure express consumption.

Control variables are selected as follows: (1) The per capita GDP of each region (GDP): the fertility rate of

each province is closely related to the economic development. Macroeconomy directly affects household income and consumption expenditure. (2) The educational level of men and women (MEL, FEL): the direct cost and opportunity cost of parents education directly affect whether they raise children, and determine the number of children raised. (3) The real wages of residents (WAGE): the main source of consumption expenditure of families is the real wage. The birth decision is the optimal strategy for parents to achieve the maximum utility under the budget constraint. (4) Saving (SA): saving is expressed as the ratio of provincial household deposits to GDP. Household income is mainly used for consumption, investment and savings. Savings are future consumption. The increase in savings will lead families to make decisions to reduce fertility behavior. (5) Basic endowment (BE): it is expressed as the ratio of urban and rural residents' social endowment insurance fund income to GDP, is considered in the constraints of the theoretical model in this paper. It is the source of income for the future elderly and it also affects the fertility rate. (6) Urbanization rate (URBAN): the gap between rural and urban fertility concepts is large, and the cost of living in cities is higher. The improvement of the urbanization rate may also have an impact on fertility. (7) House price (HP): it is expressed as the average price of residential commercial housing. The largest borrowing expenditure of Chinese households is housing loans, and the house price will directly affect the cost of birth and living. (8) Old age dependency ratio (OADR) and child dependency ratio (CDR): they are the number of elderly members and children in the family and they affect the family's fertility decisions.

The description of the data of each variable are reported in Table A1, while summary statistics and a correlation matrix are reported respectively in Table A2 and in Table A3.

Empirical model

Considering the inertia of the birth rate, this paper uses a short dynamic panel model to examine whether the actual impact of borrowing constraints and access to the capital market on fertility is consistent with the impact predicted by the theoretical model. Hence, we construct the following model:

$$\text{CBR}_{i,t} = \beta_0 + \text{CBR}'_{i,t-1}\beta_1 + \text{BOR}'_{i,t}\beta_2 + \text{FIN}'_{i,t}\beta_3 + \text{X}'_{i,t}\beta_4 + u_i + \varepsilon_{i,t} \qquad \textbf{(10)}$$

where i represents the province and t represents the year, $\text{CBR}_{i,t}$ is the crude birth rate of province i in year t, $\text{BOR}'_{i,t}$ represents the variable vector used to approximate the ease of access to borrowing.

$\mathrm{FIN}'_{i,t}$ represents the variable vector used to measure investment opportunity in the capital market. $\mathrm{X}'_{i,t}$ is the control variable, u_i is a province specific, time invariant random variable, which may be related to the explanatory variables, $\varepsilon_{i,t}$ is scalar disturbance term with $E[\varepsilon_{i,t}] = 0$.

It can be seen from theoretical analysis that income, excess consumption and basic endowment may have a moderating effect. Therefore, this study adds some interaction variables and constructs the following moderated mediation effect models:

$$\mathrm{CBR}_{i,t} = a_0 + \mathrm{CBR}'_{i,t-1}a_1 + \mathrm{BOR}_{i,t}a_2 + \mathrm{BOR}'_{i,t} \times \mathrm{WAGE}'a_3 + \mathrm{WAGE}'\,a_4 + \mathrm{FIN}'_{i,t}a_5 + \mathrm{FIN}'_{i,t} \times \mathrm{WAGE}'\varrho_6 + \mathrm{X}'_{i,t}a_7 + u_i + \varepsilon_{i,t} \tag{11}$$

$$\mathrm{CBR}_{i,t} = \gamma_0 + \mathrm{CBR}_{i,t-1}\gamma_1 + \mathrm{BOR}'_{i,t}\gamma_2 + \mathrm{BOR}_{i,t} \times \mathrm{EV}_{i,t}\gamma_3 + \mathrm{EV}'_{i,t}\gamma_4 + \mathrm{X}'_{i,t}\gamma_5 + u_i + \varepsilon_{i,t} \tag{12}$$

$$\mathrm{CBR}_{i,t} = \phi_0 + \mathrm{CBR}_{i,t-1}\phi_1 + \mathrm{BOR}'_{i,t}\phi_2 + \mathrm{BOR}_{i,t} \times \mathrm{PI}_{i,t}\phi_3 + \mathrm{PI}'_{i,t}\phi_4 + \mathrm{X}'_{i,t}\phi_5 + u_i + \varepsilon_{i,t} \tag{13}$$

$$\mathrm{CBR}_{i,t} = \delta_0 + \mathrm{CBR}_{i,t-1}\delta_1 + \mathrm{FIN}'_{i,t}\delta_2 + \mathrm{FIN}_{i,t} \times \mathrm{EI}_{i,t}\delta_3 + \mathrm{BE}'_{i,t}\delta_4 + \mathrm{X}'_{i,t}\delta_5 + u_i + \varepsilon_{i,t} \tag{14}$$

where WAGE_{it} represents the average wage of employees, which is the mediator. $\mathrm{BOR}'_{i,t} \times \mathrm{WAGE}'$ represents the interaction variable of the borrowing constraint and moderator, and the meaning of the other variables is the same as in formulas (12)–(14). The coefficient a_3 in formula (11) tests whether the direct effect of ease of access to borrowing on fertility is affected by the moderator. If the coefficient a_3 in Model (11) is significant, the moderating effect is established. The meaning of the other coefficients is the same as in formulas (12)–(14).

RESULTS

Baseline results

This paper conducts systematic GMM estimation regression analysis on the panel data of 31 provinces in China from 2011 to 2020. The results are shown in Table 1. Since the precondition for using GMM regression of the system is that the disturbance term does not have autocorrelation, in order to test whether the residual term $\varepsilon_{i,t}$ has second-order sequence correlation, this paper carries out AR (1) and AR (2) tests for first-order and second-order sequence

The results show that there are no first-order and second-order autocorrelation of random disturbance terms. The Sargan test result does not reject the original hypothesis, that is, all tool variables are valid, so the setting of tool variables is appropriate.

Table 1 shows the system GMM regression results of model (10). The coefficients of all explained variables in (1)-(4) are positive and they all passed the test of 1% significance level, which indicates that the increase of birth rate depends not only on the current borrowing constraint and investment opportunities, but also on the birth rate in the previous period. China's statis- tics also confirm the conclusion of Lai and Yip (2019) that fertility in both developed and developing countries is cumulative, and that the current fertility depends on the previous fertility. The findings indicate that the ease of access to borrowing (BOR) has significant positive effects on fertility (CBR), regardless of whether the control variables are added or not, indicating that the development of credit market can directly drive fertility.

Column (1) includes all the key explanatory variables. The ratio of loans of non-state owned enterprises to GDP shows a significant positive effect with an elasticity of 3.442‰ and is statistically significant at the 1% level. The ratio of trading volume of securities market to GDP shows a significant negative effect with an elasticity of 0.318‰ and is statistically significant at the 1% level. The variables BOR and FIN have significant parameter estimates with a positive sign and a negative sign as expected. Column (2) includes only the key explanatory variable BOR, the ease of access to borrowing, and its estimate is 3.37‰ and is statistically significant at the 1% level. Column (3), includes only the key explanatory variable FIN, investment opportunity in the capital market, resulting in an estimate of 0.243‰ , which is statistically significant at the 1% level. Column (4) includes only the control variables. Hence, H1 and H2 are supported.

Moderating effects

Table 2 presents the moderating effects results in model (11) - (14).

The moderating effect of disposable income on the impact of credit constraints and investment opportunities on fertility

Columns (1) - (3) represent the moderating effect of disposable income in model (11). The results show that the coefficient of BOR × WAGE is -0.895, and is significant at the 1% level, indicating that the higher the income is, the smaller the impact of credit constraints on the birth rate, which is consistent with expectations. This result shows that the promotion of income on fertility can have an impact by weakening

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Table 1: Baseline results: The impact of borrowing constraint and investment opportunity on fertility.

	(1)	(2)	(3)	(4)
L.CBR	0.393***	0.419***	0.412***	0.426***
	(11.9916)	(13.7861)	(17.4781)	(20.0572)
BOR	3.442***	3.370***		
	(2.9294)	(2.9142)		
FIN	-0.318***		-0.243***	
	(-4.5118)		(-2.6269)	
WAGE	0.265**	0.243**	0.344***	0.256***
	(2.5268)	(2.2941)	(4.7775)	(2.9376)
SA	-4.599***	-4.085***	-2.781***	-2.434***
	(-3.5409)	(-3.1505)	(-4.5333)	(-4.4087)
URBAN	-0.125***	-0.133***	-0.104***	-0.0966***
	(-3.3650)	(-4.9573)	(-3.5446)	(-3.1975)
GDP	-0.153	-0.0751	0.0493	0.108
	(-1.1192)	(-0.5674)	(-0.2943)	(-0.5751)
MEL	-0.180***	-0.206***	-0.188***	-0.211***
	(-5.2457)	(-4.8230)	(-5.5949)	(-6.5718)
FEL	0.156***	0.159***	0.194***	0.197***
	(2.8092)	(2.8592)	(3.5012)	(4.1639)
PIN	107.2	120.3	155.6*	118.4
	(0.8290)	(0.8798)	(1.8640)	(1.2418)
OADR	-0.114**	-0.125***	-0.0746*	-0.0699
	(-2.0501)	(-2.5975)	(-1.7298)	(-1.6076)
CDR	-0.220***	-0.221***	-0.238***	-0.214***
	(-7.4155)	(-6.8537)	(-7.0284)	(-5.6178)
HP	-0.771	-1.121	-1.803**	-1.854**
	(-1.1003)	(-1.5461)	(-2.2817)	(-2.5341)
Constant	20.65***	20.62***	19.77***	18.69***
	(14.9433)	(18.8003)	(14.8892)	(11.4351)
Observations	279	279	279	279
Wald	2274.9	51256.9	15706.9	4977.5
AR(1)	0.1574	0.1876	0.1453	0.1466
AR(2)	0.5296	0.4617	0.4881	0.4656
Sargan test (p-value)	0.1897	0.1876	0.1666	0.2012
Fixed effect	YES	YES	YES	YES

Table 2: The moderating effect of disposable income, excess consumption, basic endowment insurance on the impact of borrowing constraint and investment opportunity on fertility.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
L.CBR	0.334***	0.417***	0.317***	0.378***	0.292***	0.290***	0.391***
	(10.4743)	(18.0184)	(9.8551)	(11.5410)	(7.0687)	(5.9068)	(12.2071)
BOR	10.12***	-	10.63***	2.934**	6.469***	6.318***	-
	(6.8335)	-	(6.1647)	(2.2909)	(7.3371)	(3.9572)	-
BOR×WAGE	-0.895***	-	-0.870***	-	-	-	-
	(-4.2818)	-	(-4.1941)	-	-	-	-
WAGE	0.804***	0.334***	0.723***	0.195**	0.0575	0.0651	0.357**
	(6.0994)	(4.5591)	(4.9511)	(1.9724)	(0.6761)	(0.6920)	(2.5025)
FIN	-	-0.549	-1.426***	-	-	-	-1.034***
	-	(-1.6448)	(-3.1676)	-	-	-	(-2.6976)
FIN×WAGE	-	0.0268	0.108***	-	-	-	-
	-	(0.9228)	(2.7580)	-	-	-	-
BOR×EV	-	-	-	-2.434***	-	-0.735	-
	-	-	-	(-4.1159)	-	(-0.6237)	-
EV	-	-	-	3.105***	-	1.064	-
	-	-	-	(3.4758)	-	(0.5990)	-
BOR×PI	-	-	-	-	-25.53***	-25.06***	-
	-	-	-	-	(-4.9591)	(-2.8994)	-
PI	-	-	-	-	29.77***	28.84***	-
	-	-	-	-	(4.7675)	(2.8008)	-
FIN×BE	-	-	-	-	-	-	9.608**
	-	-	-	-	-	-	(1.9920)
BE	-	-	-	-	-	-	24.6
	-	-	-	-	-	-	(1.3901)
SA	-3.884**	-2.925***	-4.684***	-4.250***	-4.618***	-4.600***	-2.022***
	(-2.4628)	(-4.7070)	(-2.6752)	(-3.3164)	(-3.8402)	(-3.4877)	(-2.6688)
Control variables	YES	YES	YES	YES	YES	YES	YES
Observations	279	279	279	279	279	279	279
Wald	3496.2	16160.4	7306.8	3865.1	2506.8	1973.1	4915.4
AR(1)	0.176	0.1422	0.1863	0.1731	0.1755	0.1801	0.1331
AR(2)	0.441	0.4725	0.4662	0.5344	0.3712	0.4032	0.5781
Sargan test (p-value)	0.2191	0.2186	0.2959	0.1861	0.2566	0.2509	0.1591
Fixed effect	YES	YES	YES	YES	YES	YES	YES

the credit constraint. Increasing disposable income enables families to quickly use social capital to obtain external help in a short period of time, thus weakening the inhibition of liquidity constraint on fertility, but it will weaken the effect of credit constraint weakening on fertility. The weaker the credit constraint is, the higher the funds that families can borrow, and the lower the future disposable income. The householder hopes to make up for the income that supports future consumption through the returns of childbearing. The results show that the coefficient of $\mathrm{FIN \times WAGE}$ is -1.426, and it is significant at the 1% level, indicating that the higher the income, the greater the impact of families with strong financial investment opportunities on the birth rate, which is consistent with expectations. After the family continues to increase income, households are optimistic about their future income. Then the threshold for entering the capital market trends to be lower, and the financial products have a substitution effect on children, so the family will choose to reduce the fertility behavior. So H3 is supported.

The moderating effect of excess consumption on the impact of credit constraint on fertility

The express delivery volume and personal consumption loans can more accurately measure the excess consumption of households. Express delivery volume can reflect e-commerce consumption, and personal consumption loans reflect that individuals or families obtain consumer loans from banks. Columns (4) to (6) represent model (12) and model (13). The cross-term coefficients of the two variables, EV and PI, are negative, which is significant at the 1% level and consistent with expectations. It shows that excessive consumption weakens the promotion effect of LOCs on fertility. The increase of excess consumption leads to parents leaning less towards offsetting the cost of raising children, hence, they choose to reduce feritility. It shows that excess consumption weakens the direct positive impact of borrowing constraints on fertility. So H4 is supported.

The moderating effect of basic endowment insurance on the impact of investment opportunities on fertility

Column (7) represents model (12). The cross-term coefficient of investment opportunities and basic endowment insurance is positive and significant, which is consistent with expectations. It shows that because participating in endowment insurance reduces the risk and uncertainty faced by families in the future, according to the life cycle hypothesis theory of Modigliani and Friedman, endowment insurance can play a role in smoothing the family's consumption, savings and

investment in each period, and participating in endowment insurance can enable families to reduce the capital reserve for future loss prevention of pension (Hubbard et al, 1995) to promote investment in financial assets. The higher the level of social endowment insurance, the more sufficient are the funds available for consumption for the elderly in the household. Then house-holds put more money into the capital market to reduce childbearing behavior, because there are returns from pension insurance and financial products in the future; hence, the demand for childbearing will be reduced. So H5 is supported.

Robustness check and endogenous discussion

Robustness check

We conduct a series of tests to show the robustness of our results.

Alternative indicators. We replace the measurement indicators of core explanatory variables. The statistical content of private sector credit variables includes not only credit to households, but also credit to commercial sectors. In order to test the robustness of the regression results, we replace the core explanatory variables with the ratio of household debt to GDP (HD) and the index measuring the development of investment opportunities in the capital market — the sub index of digital inclusive financial index (including investment, insurance and credit businesses) Caldwell et al. (1976). This paper chooses the digital inclusive financial index to measure the threshold of capital market entry, because the modern information technology and product innovation of digital inclusive finance are developing more rapidly than traditional finance. It greatly reduces the cost and threshold of financial services, expands the ser- vice scope of traditional finance, and provides appropriate financial services for all sectors in society. Investment, insurance, credit, payment and other businesses in digital inclusive finance have improved to better extend intertemporal resource allocation services for normal families. As a result, the majority of families in society reduce the impact of liquidity constraints, as they can more easily access external social capital and can promote consumption, which further affects the family's reproductive behavior. The digital inclusive financial index covers a wider range of social strata. Table 3 shows that the results are robust to the use of an extended alternative indicators.

Alternative sample. On November 15, 2013, China's policy of single second child was officially opened. The policy of a limiting the number of children in China was relaxed, and the cost for families to choose the number of children was lower. Considering the hysteresis of the policy and the influence of limited number of children, we repeat the above analysis using the data from 2014

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Table 3: Alternative indicators: sub-index of resident loans and digital inclusive finance

	(1)	(2)	(3)	(4)	(5)
L.BOR	0.397***	0.313***	0.267***	0.218***	0.291***
	(14.2784)	(10.65520	(9.0545)	(7.1531)	(7.2184)
HD	4.399***	-	3.512**	7.571***	1.838
	(4.5966)	-	(2.1623)	(3.6392)	(0.6778)
DIFD	-	0.0371***	0.0265***	0.0142**	0.0228***
	-	(14.303)	(5.7723)	(2.5217)	(4.1296)
DIFINS	-	0.0102*** (18.1763)	0.00933*** (10.6095)	0.00846*** (8.4509)	0.00894*** (9.2545)
DIFINV	-	-0.00410*** (-5.2807)	-0.00461*** (-5.9112)	-0.00350*** (-3.5613)	-0.00366*** (-4.5054)
HD×PI	-	-	-	-28.12**	-
	-	-	-	(-2.1441)	-
PI	-	-	-	12.94(1.6213)	-
HD×EV	-	-	-	-	-4.017** (-2.1955)
EV	-	-	-	-	3.212*(1.8348)
Control variables	YES	YES	YES	YES	YES
Observations	255	217	209	209	209
Wald	9437.54	30809.15	12410.39	6109.7	29876.87
AR(1)	0.1593	0.0793	0.1464	0.1771	0.1834
AR(2)	0.3304	0.2854	0.2965	0.2909	0.3373
Sargan test (p-value)	0.2117	0.2303	0.4102	0.4282	0.5542
Fixed effect	YES	YES	YES	YES	YES

Notes: *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels. T-statistics are shown in parentheses. The variable L.CBR is the lagged of crude birth rate.

Table 4: Alternative sample

	(1)	(2)	(3)	(4)	(5)	(6)
L.CBR	0.497***	0.459***	0.492***	0.494***	0.404***	0.506***
	(20.0113)	(30.1620)	(12.6076)	(23.2035)	(11.5638)	(8.7099)
BOR	1.732***	-	1.757*	-	5.872***	2.519***
	(2.6043)	-	(1.8040)	-	(4.7963)	(2.8081)
FIN	-	-0.628***	-0.601***	-	-0.591**	-0.545**
	-	(-4.6694)	(-4.3422)	-	(-2.5414)	(-2.4758)
BOR×PI	-	-	-	-	-21.18***	-
	-	-	-	-	(-4.0375)	-
pd	-	-	-	-	24.99***	-
BOR×EV	-	-	-	-	-	-1.804***
	-	-	-	-	-	(-2.9016)
EV	-	-	-	-	-	2.294**
Control variables	YES	YES	YES	YES	YES	YES
Observations	186	186	186	186	186	186
Wald	14897.1	7368.4	46231	14865.8	47949	9605.1
AR(1)	0.0036	0.0062	0.0014	0.0033	0.01	0.0057
AR(2)	0.1578	0.1286	0.1751	0.1633	0.1374	0.1527
Sargan test(p-value)	0.1131	0.1006	0.115	0.0687	0.2496	0.1606
Fixed effect	YES	YES	YES	YES	YES	YES

to 2020. The results are reported in columns (1) - (3) of Table 4. The coefficients of the core explanatory variables are still significant and the conclusions are consistent with the full sample data. The results in columns (5) - (6) of Table 4 show that the regression results of excess consumption affecting fertility through credit constraints are also consistent with the full sample data. Alternative regression model. Due to the long inertial impact and the potential endogenous problems of birth rate, we add the lag order of the explained variable to 2 and 3, and take the logarithm. The regression results are shown in Table 5 The conclusion is still robust. In addition, in order to control the time trend of the dependent variable and the nonlinear change in time, we take 2010 as the base period, and the difference between each year and 2010 is set as the time item t. The regression results are shown in Table 6. The results show that the conclusion are still robust. Grouping regression. Housing loans account for the

largest proportion of household loans, and the average house price in the area directly affect the cost of living of the family. Due to the different housing prices in different regions, the birth costs are also distinct. In order to eliminate the regression error caused by this factor, we divided the total sample into two sub samples of high house price regions and low house price regions for regression, and the results are shown in Table 7. The regions with different housing price levels still support our hypothesis.

Endogenous problem

With the increase of family population being usually accompanied by the increase of household expenditure and potential risk, households have an incentive to purchase financial products to hedge risks and improve the investment opportunities to enter the financial market, which also drive them to reduce leisure time and increase income to offset the increased

Table 5: Alternative regression model

	(1)	(2)	(3)	(4)	(5)	(6)
	The explained variable lags by order 2			The explained variable lags by order 3		
L.ln CBR	0.384***	0.370***	0.409***	0.484***	0.502***	0.394***
	(6.7010)	(4.5497)	(5.8402)	(4.9694)	(4.6401)	(5.7909)
L2.ln CBR	0.129**	0.144**	0.196***	0.0896*	0.156*	0.134
	(2.2112)	(2.2640)	(3.2715)	(1.9585)	(1.7110)	(1.3429)
L3.ln CBR				0.306***	0.381***	0.334***
				(4.6022)	(4.6041)	(4.8412)
BOR	0.359***	0.503***	0.263***	0.304***	0.632***	0.207***
	(8.8062)	(4.4821)	(4.7388)	(3.2101)	(3.4544)	(2.8411)
FIN	-0.0321***	-0.0259***	-0.0196*	-0.0903***	-0.0865***	-0.0638**
	(-3.2211)	(-2.9739)	(-1.7435)	(-3.7564)	(-3.4554)	(-2.2866)
BOR×PI		-1.740***			-1.942***	
		(-3.3451)			(-2.6951)	
PI		1.989***			2.197**	
BOR×EV			-0.182*** (-6.7683)			-0.181*** (-5.3637)
EV			0.228***			0.214***
Control variables	YES	YES	YES	YES	YES	YES
Observations	248	248	248	217	217	217
Wald	2789.01	10881.41	3458.15	2809.2	3510.75	4783.58
AR(1)	0.0288	0.0231	0.0425	0.0023	0.0018	0.007
AR(2)	0.4328	0.1979	0.17	0.3365	0.0959	0.1492
Sargan test (p-value)	0.8555	0.9473	0.9178	0.8458	0.9416	0.8181
Fixed effect	YES	YES	YES	YES	YES	YES

consumption expenditure and the amount of loans. Therefore, the nonlinear relationship between finance and birth rate may be caused by the increase of family financial demand caused by fertility, that is, there can be an endogenous problem of cause and effect inversion.

In order to solve the above endogenous problem, this paper selects the use of the depth indicator (L.DIFW) in the Peking University digital inclusive financial index with a lag of one period and the private sector credit (L.BOR) with a lag of one period as the tool variables to explain the credit constraint of variables from the perspective of digital finance, and it uses two-stage least square method for estimation. On the one hand, the low cost and low thresh-old advantages of digital inclusive financial services enable ordinary families to further reduce the credit constraint and improve investment opportunities. However, there is no inevitable link with the birth rate, which is even less likely to adversely affect the digital inclusive financial indicators of the previous year. The coverage of the digital inclusive financial index represents the account coverage rate, which can reflect the convenience of ordinary families to access financial services. It includes the indicators: the number of Alipay accounts per 10000 people, the proportion of Alipay card binding users, and the average number of bank cards per Alipay account. To some extent, it reflects the degree of difficulty for families to obtain micro loans and other financial activities, and has a strong correlation with the key explanatory variable BOR. Moreover, its weight accounts for 54% of the digital inclusive financial indicator system Caldwell et al. (1982). On the other hand, the borrowing constraint of the previous period have an impact on the current financial development. The model is esti-mated under different specifications and with different methods. Specifications

Table 6: Add time trend term and nonlinear term

	(1)	(2)	(3)	(4)	(5)	(6)
L.CBR	0.352***	0.282***	0.344***	0.227***	0.172***	0.222***
	(10.8314)	(7.3480)	(8.4765)	(5.8424)	(5.1843)	(5.5139)
BOR	3.177**	8.107***	3.172*	1.764	5.675***	2.086
	(2.0722)	(3.6678)	(1.7994)	(1.2614)	(2.8374)	(1.1467)
FIN	-0.239***	-0.220***	-0.257***	-0.671***	-0.541***	-0.627***
	(-3.1277)	(-2.7596)	(-3.2003)	(-4.3164)	(-3.3911)	(-4.4378)
	(0.7116)	(-0.2999)	(1.2061)	(-0.0464)	(-1.4185)	(0.1027)
BOR×PI		-27.43***			-20.15**	
		(-4.0069)			(-2.3529)	
PI		30.87***			23.34**	
BOR×EV			-2.334*** (-2.7933)			-1.207
						(-1.2911)
EV			3.061**			1.343
t	0.545***	0.158	0.391***	1.080***	0.617***	0.957***
	(4.3747)	(1.0363)	(3.1268)	(7.1476)	(2.6351)	(2.6864)
t2				-0.100***	-0.0786***	-0.0921***
				(-9.0156)	(-5.1929)	(-7.5581)
Control variables	YES	YES	YES	YES	YES	YES
Observations	279	279	279	279	279	279
Wald	7824.8	3346.8	2129.7	2365.8	5263.2	3685.7
AR(1)	0.1514	0.1721	0.1655	0.1484	0.1782	0.1616
AR(2)	0.5526	0.4788	0.6147	0.5872	0.3462	0.5488
Sargan test	0.1863	0.3081	0.2145	0.1965	0.3422	0.2155
(p-value)						
Fixed effect	YES	YES	YES	YES	YES	YES

Table 7 Grouping regression

	(1)	(2)	(3)	(4)	(5)	(6)
	High housing price area			Low housing price area		
L.CBR	0.428***	0.422***	0.433***	0.0427*	0.0936***	0.0824***
	(8.6905)	(4.4374)	(14.0201)	(1.8826)	(5.2047)	(4.3692)
BOR	2.194**	6.871***	3.666*	2.761***	2.315***	2.251***
	(2.0004)	(2.9554)	(1.7271)	(3.9896)	(5.0853)	(2.6115)
FIN	-0.650***	-0.585***	-0.629***	-0.222*	-0.325***	-0.258*
	(-3.3551)	(-3.2835)	(-3.3886)	(-1.8358)	(-2.7447)	(-1.7449)
BOR PI		-18.49***		-2.192		
		(-2.8874)		(-0.2481)		
PI		21.87***		8.882		
		(2.6316)		(0.9393)		
BOR × EV			-0.551			1.090
			(-0.5694)			(0.8670)
EV			0.250			-1.391
			(0.1431)			(-0.8061)
Control variables	YES	YES	YES	YES	YES	YES
Observations	131	131	131	148	148	148
Wald	26255.82	25887.35	15422.69	24743.34	19575.98	8751.14
AR(1)	0.0526	0.0533	0.0647	0.2562	0.2625	0.2633
AR(2)	0.7539	0.7862	0.6374	0.1517	0.2054	0.2093
Sargan test (p-value)	0.7566	0.8439	0.8479	0.406	0.3668	0.4003
Fixed effect	YES	YES	YES	YES	YES	YES

start from the basic equation, to which we add BOR and FIN. We estimate a panel fixed effects model using OLS and two IV methods: two-step Generalized Method of Moments (GMM) and Limited Information Maximum Likelihood (LIML). OLS, GMM and LIML adopt a clustered by country robust estimators of the standard errors of the model. Table 8 demonstrates that the borrowing constraint significantly drives fertility after adopting the instrumental variables. The Kleibergen–Paap rk LM statistic and the Kleibergen–Paap rk Wald F statistic significantly reject the null hypothesis, showing it has passed the endogenous test. At the same time, the p-value of Sargan test shows that the selection of instrumental variables is effective.

Further discussion

Mediating effects of house price
With the development of the digital economy, the convenience of bank credit process and the enhanced availability of financial services, the gradual expansion of credit scale is promoted. The growth in house prices is supported by loose credit policies. Bank credit provides financial support for the rise of house prices. The expansion of bank credit stimulates real estate development and investment, and the demand for housing rises, thus raising house prices. At the same time, the rise in housing prices has led to the rise in the mort-gage value of commercial housing and the

increase in personal mortgage credit lines. Furthermore, the increase in purchasing power has promoted the rise in demand for housing, further driving up housing prices. This shows that LOCs of residents affect the average house price of each region. The housing purchase expenditure is the largest living expenditure of Chinese residents, and the house price naturally affect the family's fertility decision, so the credit constraint will affect the fertility rate through the housing price. At present, the real estate market and the stock market are the two main investment markets in China. A significant degree of dynamics of connectedness across the returns of the three markets exists, including direct real estate, securitized real estate, and stock markets (Nguyen et al, 2022). There is a wealth effect between the real estate market and the stock market, including the direct wealth effect and the indirect wealth effect. From the perspective of the direct wealth effect, when the real estate price rises, the wealth owned by households and enterprises increases, and the ability to lend to financial institutions as collateral increases. Therefore, more funds are available to invest in the stock market, thus driving the stock market up. When the stock price rises, the wealth owned by investors increase, which leads to the further desire for consumption and investment, and the funds flow back

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Table 8 Endogenous test.

Estimation technique	EC2SLS		GMM		LIML	
variables	IV: L.BOR and L.DIFW					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
BOR	2.055**	1.986**	3.611***	3.356***	2.055***	1.986***
	(2.1103)	(2.0420)	(3.1367)	(3.4639)	(2.9991)	(2.9133)
FIN	0.252		-0.302***		0.252	
	(1.4375)		(-3.7330)		(-1.6135)	
Control variables	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES
Observations	279	279	279	279	279	279
R-squared	0.3149	0.3098			0.8297	0.8284
Kleibergen-Paap rk LM statistic	26.988	26.75			30.361	30.094
p-value	0	0			0	0
Kleibergen-Paap rk Wald F statistic	133.649	134.641			133.649	133.641
sargan (p-value)	0.3357	0.6183	0.2814	0.2766	0.3072	0.5972

Into the real estate market, causing the real estate price to rise. From the perspective of indirect wealth effect, when the price of real estate rises, households and enterprises expect that the future cash flow will increase, the investment desire is strengthened, and the funds flow into the stock market, leading to the rise of the stock market. When the stock price rises, investors expect the return to increase, which drives the real estate consumption and raise the real estate price. According to the above analysis, the wealth effect makes the real estate market and the stock market present a positive mean value spillover effect. This shows that the improvement of investment opportunities will also increase the average house price in all regions. Therefore, the analysis shows that credit constraints and investment opportunities have crowding in and crowding out effects on fertility through housing prices. To examine the mediating effect of house price, this study constructs the following regression model:

$$CBR_{i,t} = \xi_0 + CBR'_{i,t-1}\xi_1 + BOR'_{i,t}\xi_2 + X'_{i,t}\xi_3 + u_i + \varepsilon_{i,t} \quad (15)$$

$$HP_{i,t} = \varphi_0 + HP'_{i,t-1}\varphi_1 + BOR'_{i,t}\varphi_2 + X'_{i,t}\varphi_2 + u_i + \varepsilon_{i,t} \quad (16)$$

$$CBR_{i,t} = \eta_0 + CBR'_{i,t-1}\eta_1 + BOR'_{i,t}\eta_2 + HP'_{i,t}\eta_3 + X'_{i,t}\eta_4 + u_i + \varepsilon_{i,t} \quad (17)$$

where the variable HP refers to the average price of residential commercial housing in each region, and the formula (15) corresponds to the benchmark regression model. If all three coefficients, that is, coefficient ξ_1 in (15), coefficient φ_2 in (16), coefficient η_3 in (17), are significant, the mediating effect of house price on the ease of access to borrowing is significant. If coefficient η_2 in (17) is significant, the direct effects of the ease of access to borrowing and fertility are also significant; otherwise, there is only a mediating effect. The mediating effect of house price on impact of investment opportunities on fertility are tested by constructing the model with the variable BORi,t in formula (15), (16), (17) replaced with FINi,t.

Columns (1), (2) and (3) in Table 9 reports the results of the mediating effect test of house prices on BOR. In column (1), the coefficient of BOR is 0.158, and it is significant at the 1% level, indicating that the amount of loans has a significant positive impact on house prices, that is, reducing credit constraints can improve house prices, which verifies the real economic logic. In column (2), the coefficient of BOR is 3.667, and it is significant at the 1% level and is consistent with H1. In column (3), the coefficients of BOR and house prices are 4.086 and -1.594, respectively and are significant at the 1% level and 10% level, respectively. Compared with 3.442, the basic regression result in Table 1, the absolute value of the coefficient of BOR is larger. It indicates that increasing the LOCs can improve the fertility rate by increasing the house prices, hence, rising the net value of the house. The above results indicate that there is a mediation mechanism in which borrowing constraints stimulate the increase of fertility by raising house prices.

Columns (1), (2) and (4) in Table 9 reports the results of

the mediating effect test of house prices on FIN. In column (1), the coefficient of FIN is 0.0104, which is significant at the 1% level, indicating that increasing investment opportunities promotes house prices, which is consistent with the wealth effect between the real estate market and the stock market. In column (2), the coefficient of FIN is -0.353, which is significant at the 1% level, indicating that loosening access to capital market has a significant negative impact on fertility, which is consistent with H2. In column (4), the coefficients of FIN and HP are -0.361 and -1.517 respectively and are significant at the 1% level and 5% level, respectively. Compared with -0.318, the basic regression result in Table 3, the absolute value of the coefficient of FIN is larger, which implies that families have more funds to invest in the stock market to reduce the fertility rate by increasing house prices. The rising house prices aggravate the heavy pressure on the family's cost of living and greatly reduce the parents' demand for children. The above results indicate that there is a mediation mechanism for investment opportunities to restrain fertility through raising house prices.

In summary, the access to credit and capital markets affect fertility by raising house prices, while house prices have negative effects on fertility.

HETEROGENEITY

We further examine the heterogeneous impacts. The selected samples are considered from the high-income regions and low-income regions. We divide the part of the income that is higher than the average into the high-income regions group, with the other part being the low-income regions group.

The heterogeneity test results are presented in Table 10. The findings indicate that ease of access to borrowing still have a significant positive effect on fertility in high-income regions and low-income regions. Families with higher income have higher LOCs and stronger incentives for childbearing. However, the financial asset investment of regions with high income has a significant negative effect on fertility, while the low-income regions has no significant impact on fertility. Because families with low income will generally use their income for living consumption, children's education and savings; hence, they have a high threshold to enter the capital market. The substitution of financial products for children has been greatly weakened. Compared with the whole sample, the crowding out effect of investment opportunities on fertility is stronger for regions with high income, because the impact of regions with low income is eliminated. Therefore, there is a significant difference between the two groups of regions in terms of credit constraints and investment opportunities.

Conclusion

How to improve the fertility level has become a key issue for China's sustainable and stable development under the situation that the fertility rate continues to decline and the demographic dividend is exhausted. The effect of the fertility incentive policy is not significant and the long-term low fertility level seriously hinders economic development and social stability. Based on the similar characteristics between the financial intertemporal resource allocation and fertility behavior, this paper first theoretically analyzes the relationship between the two defects in financial development, borrowing constraint, savings constraint, and family fertility behavior, and obtains the corresponding hypotheses in China's case. Then, the study uses a dynamic panel model, a moderating model and a mediating model based on panel data of Chinese provincial data from 2011 to 2020 to investigate how access to credit and capital markets changes fertility and what roles is income, excess consumption, basic endowment and house price play. The findings confirm that, first, the development of credit market has a significant positive effect on fertility with an elasticity of 3.442‰. Second, investment opportunities in the capital market have a significant negative effect on fertility with an elasticity of 0.318‰. Third, we further explore the moderating mechanism, finding that disposable income weakens the direct positive impact of borrowing constraints on fertility and it facilitates the direct negative impact of investment opportunities on fertility; excessive consumption weakens the direct positive impact of borrowing constraints on fertility and basic endowment insurance promotes the direct negative impact of investment opportunities on fertility. Finally, through the mediating effects test and heterogeneity test, we find that credit scales and investment opportunities promote and inhibit fertility by raising house prices. There are significant differences in the impact of credit scales and investment opportunities on fertility among regions with different incomes.

Based on the above conclusions, this paper puts forward the following policy recommendations. First, governments should strategically continue to promote mobile payment projects to trickle down to county villages. The banking and insurance industry should be encouraged to strengthen the application of financial technology and digital technology in agricultural finance, improve the credit efficiency of long tail customers in rural areas, and promote the digital and intelligent management level of agricultural insurance. The availability of financial services should be continuously improved at the individual level and financing should be provided financing for small and micro businesses founded by couples with more than two children. Reducing people's worries about childbearing and

improving their willingness to bear children should be encouraged. Second, governments should moderately develop consumer credit, strengthen risk management and control of consumer credit, advocate rational consumption, and avoid excessive consumption which crowds out childbearing demand. Third, governments should promote the nationwide policy of providing credit support for marriage and childbearing, and provid different levels of interest rate cuts according to the different quantity of birth babies. The VAT and coprate

income tax for small and micro businesses established for couples with more than two children should be reduced or exempted. Fourth, under the background of the current three childbirth policy, the government can embed the birth subsidy mechanism in the old-age insurance system by giving preferential payment to families with more than two children. It can partly offset the crowding out effect of the basic endowment insurance system on childbearing willingness.

Table 9: Mediating effects.

Explained variable	(1)	(2)	(3)	(4)
	HP	CBR	CBR	CBR
BOR	0.158***	3.667***	4.086***	
	-6.4279	-5.9552	-3.7386	
FIN	0.0104***	-0.353***		-0.361***
	-7.8649	(-4.2104)		(-3.5958)
HP			-1.594*	-1.517**
			(-1.7448)	(-2.0267)
Control variables	YES	YES	YES	YES
Observations	279	279	279	279
Fixed effect	YES	YES	YES	YES

Table 10: Heterogeneity by income.

	(1)	(2)	(3)
	High-income regions	Low-income regions	Full sample
L.CBR	0.333***	0.183***	0.346***
	-21.7362	-4.1403	-11.3627
BOR	1.948*	1.752***	4.281***
	-1.7424	-2.6937	-3.5345
FIN	-0.489***	-0.0768	-0.302***
	(-2.9173)	(-0.5777)	(-3.9663)
Control variables	YES	YES	YES
Observations	149	130	279
Wald	7963.26	2784.05	1308.56
AR(1)	0.0029	0.2404	0.1778
AR(2)	0.2146	0.9339	0.5505
Sargan test	0.5972	0.2477	0.8706
(p-value)			
Fixed effect	YES	YES	YES

DECLARATIONS

Competing Interest

The authors declare that they have no known com- peting financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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REFERENCES

1.Arcand JL, Berkes E, Panizza U. 2015. Too much finance? Journal of economic Growth .20(2):105-148.

2.Bacchetta P, Gerlach S. 1997. Consumption and credit constraints: International evidence. Journal of Monetary Economics. 40(2):207–238.

3.Bahadir B, Valev N. 2015. Financial development convergence. Journal of Banking & Finance. 56:61–71.

4.Basso A, Bodenhorn H, Cuberes D. 2014. Fertility and financial development: Evidence from us counties in the 19th century. Tech. rep., National Bureau of Economic Research.

5.Beck T, Demirgüç-Kunt A, Levine R. 2000. A new database on the structure and development of the financial sector. The World Bank Economic Review. 14(3):597–605.

6.Becker GS, Lewis HG. 1973. On the interaction between the quantity and quality of children. Journal of political Economy. 81(2, Part 2):S279–S288.

7.Becker GS. 1960. An economic analysis of fertility. demographic and economic change in developed countries. In: NBER conference series. pp 209–231.

8.Bhupatiraju S. 2022. Fertility and financial development: an analysis of indian households. Quality & Quantity. 56(2):589–606.

9.Boldrin M, Jones LE. 2002. Mortality, fertility, and saving in a malthusian economy. Review of Economic Dynamics. 5(4):775–814.

10.Boldrin M, De Nardi M, Jones LE. 2015. Fertility and social security. Journal of Demographic Economics. 81(3):261–299.

11.Caldwell JC. 1976. Toward a restatement of demographic transition theory. Population and development review. pp 321–366.

12.Caldwell JC. 1982. Theory of fertility decline. academic press.

13.Cavapozzi D, Trevisan E, Weber G. 2013. Life insurance investment and stock market participation in europe. Advances in life course research. 18(1):91–106.

14.Chen W. 2021. China's low fertility and the three-child policy: analysis based on the data of the severth national census. Popul Econ. 5:25–35.

15.Cigno A.1993. Intergenerational transfers without altruism: family, market and state. European Journal of Political Economy. 9(4):505–518.

16.Cigno A, Rosati FC. 1996. Jointly determined saving and fertility behaviour: theory, and estimates for germany, italy, uk and usa. European Economic Review. 40(8):1561–1589.

17.Dynan K, Mian A, Pence KM. 2012. Is a household debt overhang holding back consumption?[with comments and discussion]. Brookings Papers on Economic Activity. pp 299–362.

18.Dynan K, Edelberg W, et al. 2013. The relationship between leverage and household spending behavior: evidence from the 2007-2009 survey of consumer finances. Federal Reserve Bank of St Louis Review. 95(5):425–448.

19.Ehrlich I, Lui FT. 1991. Intergenerational trade, longevity, and economic growth. Journal of political Economy. 99(5):1029–1059.

20.Empirik SP. 2018. Does financial development contribute to fertility decline in malaysia? an empirical investigation. Jurnal Ekonomi Malaysia. 52(1):191– 203.

21.Entwisle B. 1981. Cbr versus tfr in cross-national fertility research. Demography. 18(4):635–643.

22.Filoso V, Papagni E. 2015. Fertility choice and financial development. European Journal of Political Economy. 37:160–177.

23.Goldman D, Maestas N. 2013. Medical expenditure risk and household portfolio choice. Journal of Applied Econometrics. 28(4):527–550.

24.Gormley T, Liu H, Zhou G. 2010. Limited participation and consumption- saving puzzles: A simple explanation and the role of insurance. Journal of Financial Economics. 96(2):331–344.

25.Guo Z. 2008. China's low fertility and its determinants. Population Research. 32(4):1-12

26.Habibullah MS, Farzaneh N, Din BH. 2016. Declining fertility and financial development in high-income and low-income countries. International Journal of Applied Business and Economic Research. 14(1):277–290.

27.Hubbard RG, Skinner J, Zeldes SP. 1995. Precautionary saving and social insurance. Journal of political Economy. 103(2):360–399.

28.King RG, Levine R. 1993. Finance and growth: Schumpeter might be right. The quarterly journal of economics. 108(3):717–737.

29.Lai SL, Yip TM. 2019. Fertility in sixty-four developing and developed coun- tries: The role of financial development. Journal of Population and Social Studies. 27(4):334–346.

30.Leibenstein H. 1957. Economic backwardness and economic growth.

31.LIM ZK, LAI SL, TANG TC. 2019. Does financial openness tell much about fertility transitions? International Journal of Economics & Management. 13(1).

32.McCarthy J. 1997. Debt, delinquencies, and consumer spending. Current Issues in Economics and Finance. 3(3).

33.McKinnon RI. 1973. Money and Capital in Economic Development. The Brookings Institution, Washington.

34.Morand OF. 1999. Endogenous fertility, income distribution, and growth. Journal of Economic Growth. 4(3):331–349.

35.Muhammad N, Islam ARM, Marashdeh HA. 2016 Financial development and economic growth: an empirical evidence from the gcc countries using static and dynamic panel data. Journal of Economics and Finance. 40(4):773–791.

36.Neher PA. 1971. Peasants, procreation, and pensions. The American Economic Review. 61(3):380–389.

37.Nguyen TTH, Balli F, Balli HO, et al. 2022. Direct real estate, securitized real estate, and equity market dynamic connectedness. Applied Economics. 54(23):2658–2677.

38.Nugent JB. 1985. The old-age security motive for fertility. Population and development review. pp 75–97.

39.Pollin R. 1996. Financial intermediation and the variability of the saving constraint. Department of Economics, University of California, Riverside.

40.Qiao X, Zhu B. 2018. How to estimate total fertility rate given the crude birth rate. Population and development. 2:65–70.

41.Rammohan A. 2001. Development of financial capital markets and the role of children as economic assets. Journal of International Development: The Journal of the Development Studies Association. 13(1):45–58.

42.Sah RK. 1991. The effects of child mortality changes on fertility choice and parental welfare. Journal of Political Economy. 99(3):582–606.

43.Sethi N, Jena NR, Loganathan N. 2021. Does financial development influ- ence fertility rate in south asian economies? an empirical insight. Business Strategy & Development. 4(2):94–108.

44.Shaw ES. 1973. Financial deepening in economic development.

45.Steckel RH. 1992. The fertility transition in the united states: Tests of alter- native hypotheses. In: Strategic factors in nineteenth century American economic history: A volume to honor Robert W. Fogel. University of Chicago Press. p 351–374.

46.Tang CF, Tey NP. 2017. Low fertility in malaysia: Can it be explained? Journal of Population Research. 34(2):101–118.

47.Yao Y. 2010. Financial intermediation development and economic growth: does the chinese counterexample exist? China & World Economy. 18(5):22–36.

48.YAO Yj. 2012. Financial development and total factor productivity growth: Does regional disparity matter? Contemporary Finance & Economics. (03):1489.

49.YinWenyao, YaoYinmei, LiFen. 2014. Evaluation of fertility levels and adjust- ment of fertility policy: Based on the current situation of the chinese mainland's provincial fertility levels. Social Sciences in China. 35(2):83–105.

50.Zakaria M, Fida BA, Janjua SY, et al. 2017. Fertility and financial develop- ment in south asia. Social Indicators Research. 133(2):645–668.

51.Zhang J, Jin Y. 2005. Analysis on relationship of deepening financial intermediation and economic growth in china. Economic Research Journal. 11:34–45.

52.Zhu X, Asimakopoulos S, Kim J. 2020. Financial development and innovation- led growth: Is too much finance better? Journal of International Money and Finance. 100:102,083.