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The effects of land titling on intergenerational transfers in rural China

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ABSTRACT

The motives behind transfers from adult children to parents hold significance in the well-being of the elderly. In the context of China's land titling program, we utilize a dominant child model to study the trade-off between altruism and exchange motives. Based on data from the China Health and Retirement Longitudinal Study, this paper employs the endogenous switching model to investigate the effects of land titling on children's pecuniary and time transfers. The results of the average treatment effect on the treated (ATT) indicate that for children whose parents receive land titling, land titling has significantly increased their pecuniary transfers while decreasing their time transfers. Mechanism analysis reveals that the land titling program results in higher parental income by incentivizing parents to rent out their land and engage in off-farm employment. These findings reveal the exchange motive, suggesting that children provide transfers out of concern about their parents' wealth. Heterogeneous analysis demonstrates that both sons and daughters lean towards exchange motives. Land titling effects are pronounced among children without siblings, those from parental households with lower land per capita, and those with higher income.

1. Introduction

The motive behind transfers from adult children to parents, including both pecuniary transfers and time transfers (e.g., visits, caregiving, and housework), is a theoretical focus on understanding resource allocation between generations and improving the well-being of the elderly (Becker, 1981; Altonji et al., 1997). Both the altruism motive and exchange motive are proposed to explain children's transfers. Under the altruism motive, where children derive utility from their parents' increased welfare, transfers are negatively related to the parents' income (Barro, 1974; Becker, 1974). The altruism motive has gained salience in empirical studies in the United States (McGarry and Schoeni, 1995), Philippines (Cox et al., 2004), and Mexico (Juarez, 2009), revealing that adult children tend to provide more pecuniary transfers for relatively disadvantaged parents. Alternatively, the exchange motive posits that

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children's transfers to parents may be motivated by an exchange of services or resources (e.g., bequests), particularly when parents are financially better off (Bernheim et al., 1985; Cox, 1987). Empirical studies in Botswana (Lucas and Stark, 1985), Kenya (Hoddinott, 1992), South Korea (Son, 2018), and Burkina Faso (Grimm et al., 2021) have identified the exchange motive, revealing that children's pecuniary transfers are positively correlated with parental income.[1]

The debates on the motives of intergenerational transfers hold significant implications for policy design across many domains (e.g., pension programs). This is because the effectiveness of public programs in enhancing well-being of the elderly depends on the joint effects of private and public transfers (Juarez, 2009). In the altruism framework, public transfers will crowd out the transfers, offsetting the impacts of government assistance programs (Barro, 1974; Becker, 1974; Jensen, 2004). By contrast, if intergenerational transfers are motivated by the exchange motive, the effects of public assistance programs would not be neutral because parents' increased wealth would likely enhance private transfers from children (Cox, 1987; Cox et al., 1998).

This study aims to investigate the underlying motives of intergenerational transfers from children to parents. Based on the dominant child model (Victorio and Arnott, 1993; Laferrère and Wolff, 2006), we derive a general model to explore the effects of parental income on pecuniary transfers and time transfers under altruism and exchange motives. To empirically identify whether the altruism or exchange motive predominates in practice, we analyze the effects of China's land titling program, notably the largest in the world, on transfers from children to parents. China's land titling program, initiated in pilot villages in 2008 and gradually expanded nationwide, aimed to ensure the stability of land property rights and optimize factor allocation in agricultural production (Bu and Liao, 2022). This reform provided legal protection of land property rights by clarifying the physical boundaries and issuing a uniform titling certificate to each household. It also introduced the three-rights division ("*sanquan fenzhi*") among ownership rights, contract rights, and operation rights. Notably, contract rights and operation rights are mutually independent. It allows peasants to keep contract rights when renting their land out, and land reclaim by the village collective is prohibited. As a result, peasants are incentivized to lease their land out and seek off-farm employment, leading to higher income (Xu and Du, 2022; Liu et al., 2023; Wen et al., 2023).

Given the important role of contracted land as an asset providing insurance for rural elders, this study aims to analyze the impact of land titling on intergenerational transfers and the underlying mechanisms. As outlined in the conceptual framework (Section 3), the effects of land titling on intergenerational transfers depend on whether the child is primarily motivated by pure altruism or exchange motives. Under the altruism motive, we hypothesize the negative effects of land titling on pecuniary transfers, suggesting that children would provide fewer pecuniary transfers as their parents' income is higher. Conversely, under the exchange motive, we hypothesize the positive effects of land titling on pecuniary transfers, positing that children would provide more pecuniary transfers as their parents' income rises. However, regarding children's time transfers, the effects of land titling become ambiguous under both altruism and exchange motives. This uncertainty arises because parents' utility depends not only on increased consumption from pecuniary transfers, but also on the services provided by their children. As previous research suggests (Cox, 1987; Victorio and Arnott, 1993; Laferrère and Wolff, 2006), the impact of land titling depends on the trade-off between consumption and services within parents' utility function.

Our empirical strategy addresses standard concerns arising in examining the effect of land titling on intergenerational transfers. The key empirical challenge is the potential selection bias. The distribution of pilot villages selected for the land titling program might not be random. For example, villages with fertile land, favorable land-to-labor ratios, or stronger governance capacity facilitating collective action, might be more likely to be chosen as pilot villages to promote the land titling process (Gao et al., 2021). Selection bias arises when the unobserved factors within villages can synchronously confound the phase-in nature of land titling and intergenerational transfers.

To account for the potential selection bias stemming from the implementation of the land titling program, this study employs the endogenous switching model. Wherein, we use whether a village implemented land reallocation between 2005 and 2008, the period before the process of land titling, as an instrumental variable (IV). The IV is valid intuitively. First, this IV satisfies the correlation condition logically. Land reallocation is a periodic land readjustment due to village demographic changes resulting from births, deaths, and marriage. Although its stated aim is to achieve equity in land ownership among households and alleviate poverty, frequent land reallocation harms peasants' tenure security and exacerbates land disputes (Brandt et al., 2002; Zhang et al., 2011; Ngai et al., 2019; Adamopoulos et al., 2024). Moreover, land reallocation lowers peasants' perceived security of their property rights, which reduces their incentives to participate in collective action like land titling (Ostrom and Gardner, 1993; Su et al., 2023). It is plausible that land reallocation hinders land titling. Second, the exclusion restriction condition of IV is justified by the fact that land reallocation is driven by demographic changes at the village level, which are exogenous to intergenerational transfers within a household. Namely, the IV has no direct effect on intergenerational transfers except through its association with land titling.

The data utilized in this study is obtained from the 2011 wave of China Health and Retirement Longitudinal Study (CHARLS) conducted by Peking University. The CHARLS provides valuable information on intergenerational transfers and land titling, making it

[1] While the majority of studies have predominantly focused on motives behind pecuniary transfers, the examination of motives driving time transfers has garnered relatively less attention (see Laferrère and Wolff (2006) for a comprehensive survey of the literature). One plausible reason for this disparity is the absence of a definite prediction regarding parental income effects on children's time transfers within both altruism and exchange motives (Victorio and Arnott, 1993). Some research reveals that children's time transfers increase with parental income, particularly in the presence of bequest expectations, providing suggestive evidence that exchange motives drive time transfers (Bernheim et al., 1985; Horioka et al., 2018). Some literature incorporates both time and pecuniary transfers. In the context of the United States, several studies have demonstrated that parental income negatively affects children's pecuniary transfers, while the effects on time transfers are not significant, suggesting that both pecuniary transfers and time transfers are motivated by altruism (Schoeni, 1997; Sloan et al., 1997, 2002).

suitable for our research objectives. We focus on both pecuniary transfers and time transfers of each child and construct six proxy measures. Regarding pecuniary transfers, we consider whether the child provides pecuniary transfers including monetary or in-kind transfers within a year, and the value of total transfers (the sum of monetary and in-kind transfers), monetary transfers, and in-kind transfers. For time transfers, we consider whether the child visits parents within a year and the frequency of visits to parents.[2]

The average treatment effect on the treated (ATT) indicate significant impacts of the land titling program on intergenerational transfers. For children whose parents receive land titling, land titling has significantly increased their pecuniary transfers, in terms of the probability of providing pecuniary transfers and the total value of pecuniary transfers. Land titling has also affected the composition of pecuniary transfers by resulting in higher monetary transfers while fewer in-kind transfers. Yet, for children whose parents receive land titling, land titling has also significantly decreased their time transfers, in terms of the probability and frequency of visiting parents. Mechanism analysis reveals that land titling results in higher parental income by incentivizing parents to rent out their land and engage in off-farm employment. The results are consistent with the exchange motive, indicating that transfers are predominantly motivated by concerns for parental wealth. Heterogeneity analysis indicates that both sons and daughters lean towards exchange motives. The effects of land titling are pronounced among children without siblings, those from parental households with lower land per capita, and those with higher income.

Our study is related to three strands of the literature. First, it can speak to a large literature investigating the motives behind transfers from children to parents (Becker, 1974; Bernheim et al., 1985; Cox, 1987; Cox et al., 2004; Juarez, 2009; Horioka et al., 2018). This study examines motives in the specific context of land titling in rural China, while addressing potential selection bias. Compared to using parents' wealth indicators like income and bequests, which may be challenged by measurement errors, land titling offers distinct advantages. It is relatively straightforward to determine definitely whether a village has implemented the program.[3] Moreover, as outlined in official documents, the reform is largely exogenous to intergenerational transfers, as its primary objective is to stabilize land property rights and facilitate land rental activities.

Second, it contributes to the literature examining the effects of parental wealth on children's time transfers (Bernheim et al., 1985; Schoeni, 1997; Sloan et al., 1997, 2002; Perozek, 1998; Horioka et al., 2018; Mukherjee, 2022). It is significant to identify the exact motive behind the time transfers, because caregiving services valued in old age cannot be purchased on the market. However, compared to pecuniary transfers, the wealth effects on time transfers are not fully examined by current research. One reason for this gap is that neither altruism nor exchange motives definitively predict the effects of parental wealth on children's time transfers (Victorio and Arnott, 1993). In the framework of exchange motives, we posit that if consumption and children's services are substitutable in the parents' utility function (which is plausible in many cases), there is a negative correlation between parental income and children's time transfers. This hypothesis is supported by our empirical results.

Finally, it extends the studies on the impacts of land property rights. Considerable literature has documented the impacts of stabilizing land property on land transfers (Deininger and Jin, 2008; Deininger et al., 2011), agricultural investment (Besley, 1995; Field, 2005) and human behaviors such as conflicts (Murphy and Rossi, 2016), cooperation and trust (Fabbri, 2021). As a policy tool aimed at securing land property, land titling has been implemented around the world including in Peru (Field, 2007), Vietnam (Do and Iyer, 2008), Ethiopia (Holden et al., 2011), Zambia (Sitko et al., 2014), Mexico (de Janvry et al., 2015), and India (Subramanian and Kumar, 2024). Existing research has investigated the effects of land titling on various outcome variables including land transfers (Xu and Du, 2022; Liu et al., 2023), off-farm employment (Field, 2007; Do and Iyer, 2008; Wen et al., 2023), agricultural investment (Holden et al., 2009; Wen et al., 2023; Subramanian and Kumar, 2024), human capital investment (Galiani and Schargrodsky, 2010), credit access (Besley and Ghatak, 2010), women empowerment (Wiig, 2013), and migration (de Janvry et al., 2015). Our research goes beyond the existing studies and finds the effects of the land titling program on intergenerational transfers. That is, well-defined land property rights can contribute to providing insurance for the elderly, which has important policy implications in ageing issues.

The remainder of our study proceeds as follows. Section 2 provides an overview of the context of land reforms and intergenerational transfers in rural China. Section 3 introduces the conceptual framework. Section 4 presents the empirical strategy, data source, variables, and the discussion on the validity of IV. Section 5 presents the empirical results. The final section summarizes the findings and the implications of this study.

2. Backgrounds

2.1. Land reforms in China before the land titling program

The success of rural reforms started with the Household Responsibility System (HRS) in 1978. This system granted peasants contract rights while retaining land ownership with village collectives. After fulfilling the quota, peasants were allowed to retain the surplus of agricultural products. The HRS provided peasants with autonomy and incentives to manage production, contributing to approximately 40 % of agricultural growth from 1978 to 1984 (Lin, 1992).

[2] To accommodate the requirements of the endogenous switching model, we utilize two specific modeling approaches according to the continuity of dependent variables: the endogenous switching probit (ESP) model and the endogenous switching regression (ESR) model. The details of the two models can be found in Section 4.1 and Appendix A.

[3] Given that the land titling program is considered the most important land reform in rural China since the 2000s, village cadres possess substantial knowledge regarding whether the villages have implemented the program. Consequently, it is relatively straightforward for them to provide accurate information about the implementation status of the land titling program, and recall bias is minimal.

To realize efficient production, the Chinese government has implemented some policies to ensure the stability of land property rights and develop rental markets. The Rural Land Contracting Law, which was announced officially in 2003, emphasized the 30-year land contracts and provided peasants the legal right to rent out and rent in the land (Chari et al., 2021). Furthermore, the Property Law promulgated in 2007 defined the contracted management of land as a transferable usufructuary right. Despite these legal documents, the development of land rental markets remained stagnant until 2008 due to high transaction costs and risks stemming from inadequate security and clarity of land property rights.[4] Periodic land reallocation by village collectives weakened the security of land property rights (Zhang et al., 2011; Giles and Mu, 2018; Ngai et al., 2019; Adamopoulos et al., 2024). Meanwhile, detailed land records including location, size, quality, and physical boundaries led to may reduce the probality of land disputes and favor peasants to rent out their land (Liu et al., 2023). A less functional rental market strengthened the fragmentation of cultivated land, leading to land misallocation and low productivity (Gao et al., 2021). Consequently, the Chinese government realized the necessity of unambiguous legal definitions of contractual management rights and initiated the land titling program in 2008.

2.2. The context of the land titling program in China

The land titling program was gradually implemented nationwide as a strategy to stabilize land property rights and facilitate land rental activities (Bu and Liao, 2022; Liu et al., 2023). In early 2008, land titling was initiated in rural Chengdu, Sichuan Province (Deininger et al., 2020). The initial pilot villages were from eight provinces including Shandong, Sichuan, Hunan, Chongqing, Guangdong, Guangxi, Heilongjiang, and Jiangxi. Buoyed by the success of the pilot villages, the land titling program extended on an incremental, county-by-county basis.

The land titling process consisted of three steps. The first step was technical measurements of farmland location and size to confirm each farmer's rights and obligations. It should be noted that if peasants encountered disputes regarding their own farmland, then the executors were required to coordinate or remap. These procedures would be repeated until all disputes were solved. The second step was the establishment of a registration system to record land rights unambiguously, serving as a legal reference for potential land disputes. The final step was the issuance of a uniform land ownership certificate to each household. It is vital to note that land titling was conducted at the village level, meaning that if a village was selected for participation, all households in the village participated in the process.

The land titling program has established a new system that distinguishes three separate rights: ownership rights, contract rights, and operation rights, in contrast to the HRS which contains only ownership and contract rights (Liu et al., 2023). Ownership rights continue to be held by village collectives. Contract rights are individual households' entitlement to contract the collectively owned land with the village collectives. It is based on the membership identification within a village and is inalienable. Operation rights are the households' rights to use contracted land for agricultural production and obtain income. In the scenario of renting out their contracted land to others, operation rights can be rented out for a period of time with the oral or formal rental contracts, while contract rights and ownership rights remain with the lessor and village collectives, respectively. In this framework, three rights are explicitly defined and mutually independent, which can clarify farmers' legal rights while renting out land and thus decrease risks of land reclaim.

The land titling program enhances the security of land property (Bu and Liao, 2022). First, this reform adheres to the principle of "no additional land for population expansion and no reduction of land for population reduction", which consolidates the identity of collective membership and constrains the power of village collectives to reallocate the land frequently. Second, the "four boundaries" policy ensures clear records of plot coordinates, demarcating concrete land boundaries. Third, with the three-right division mentioned above, peasants are protected from the risk of losing their land when renting it out. Finally, the legally binding land ownership certificate defines and reinforces the holder's land rights, strengthening the enforcement through relevant institutions such as title issuance and dispute resolution mechanisms.

In addition, the land titling program provides more transparent information, which can reduce transaction costs and promote the development of rental markets (Gao et al., 2021). With land certificates, potential tenants can easily identify legitimate landholders and obtain explicit details about the land characteristics including location, quality, and boundaries. This reduces information asymmetry and the need for physical inspections. Furthermore, the program allows land rental contracts to be facilitated through land exchange platforms (Huang and Ding, 2016), making the rental market more accessible to a wider range of participants beyond relatives and friends within a village.

With more stable land property and more active rental markets, the land titling program can increase peasants' income through three channels. First, peasants are incentivized to rent out their contracted land and earn higher rents (Xu and Du, 2022). Second, more secure land property indicates that peasants need not oversupply labor in the agricultural sector, which encourages them to seek off-farm employment opportunities and earn higher income (Liu et al., 2023). Finally, for those who are still operating agricultural production, the more stable land property rights motivate them to increase land investment, leading to higher agricultural productivity and agricultural income (Wen et al., 2023).

[4] By 2008, the total area of land in circulation was 7.07 million hectares, accounting for only 8.7 % of the contracted land (Ye, 2015). For those participating in the rental markets, transaction contracts usually took place among relatives and friends without official rental contracts and rents (Gao et al., 2012).

2.3. Intergenerational transfers in rural China

Intergenerational transfers, especially transfers between parents and children, are prevalent in rural China. Rooted in kinship-based Chinese society and Confucian norms, the transfers go mostly from adult children to parents in rural China, which is remarkably different from the downward pattern observed in many developed countries (Secondi, 1997; Lei et al., 2012). In the Confucian system, family members are embedded in a network of lifelong mutual obligations towards each other, and filial piety is emphasized as the core of the family's cohesiveness and the most valued virtue. Filial piety indoctrinates children to provide direct physical, financial, and emotional support for their parents (Zhan and Montgomery, 2003). Additionally, filial piety is gendered because the Confucian system is characterized by patrilineality, where only males can carry family names, making sons the primary providers of intergenerational transfers.

Due to the inadequate pension income, intergenerational pecuniary transfers serve as crucial means to ensure a decent standard of living for the elderly (Lei et al., 2012). In the 2011 wave of CHARLS utilized in our study, a bit more than three-quarters of interviewees in rural China regard their children as their primary income source. With a growing ageing population in rural China,[5] it is significant to identify the motives behind intergenerational transfers. Traditionally, intergenerational transfers are driven by altruism due to filial piety. Yet, economic development and modernization have posed challenges to traditional family ties and the practice of filial piety (Xie and Zhu, 2009). The obligation to provide support has diminished and children can voluntarily choose how much they provide for their parents. These transfers may be driven by either concern for parents (Wu and Li, 2014; Jiang et al., 2015; Nikolov and Adelman, 2019) or exchange for service or bequests (Secondi, 1997; Almås et al., 2020). Our research aims to figure out whether altruism or exchange motives plays a dominant role in driving children's transfers.

3. Conceptual framework

The conceptual framework is designed to illustrate how children with both altruism and exchange motives decide their transfers to their parents and the effects of land titling on their transfers. A large volume of literature has demonstrated that land titling can enhance the income of rural households (Field, 2007; Holden et al., 2009; Bu and Liao, 2022; Liu et al., 2023; Subramanian and Kumar, 2024).[6] In this conceptual framework, we abstract from the pathway of land tiling's impact on income. Instead, drawing on evidence from previous studies (Field, 2007; Holden et al., 2009; Bu and Liao, 2022; Liu et al., 2023; Subramanian and Kumar, 2024), we regard land titling as a policy to increase parental income and focus on how the increased income induced by land titling affects intergenerational transfers from adult children to parents. The mechanism analysis (Section 5.2) provides evidence that land titling does affect children's intergenerational transfers through increasing parents' income in our setting.

In this study, we focus on children's behavior which aims to improve their long-run utility while concurrently taking into account their parents' well-being and the probability of receiving bequest from parents. One way to model the transfers from the children's perspective is the dominant child model (Victorio and Arnott, 1993; Laferrère and Wolff, 2006). The model assumes that the children have all the bargaining power in deciding the wealth allocation.[7] The exchange motive stems from the fact that children have to raise their transfers to induce parents' participation in the wealth allocation plan. We believe that the dominant child model can provide a rich yet tractable framework that aligns both pecuniary and non-pecuniary transfers of children.

Consider a game of wealth allocation between a child who lives in two periods and a parent who lives only in period 1. Initially, the dominant child proposes a wealth allocation plan, specifying the pecuniary transfers T and time transfers (such as service or attention) S provided to the parent in period 1, and the bequest B to be received in period 2. Subsequently, the parent decides whether to accept the offer. If he rejects the offer, the parent's reservation utility, i.e., the "threat point" utility, is determined based on his wealth or income in period 1.

The problem for an altruistic child k can be stated as follows:

$$\max_{T,S,B} V = v_1(C_{k1}) - \phi(S) + \delta v_2(C_{k2}) + \lambda U(C,S) \tag{1}$$

$$\text{s.t.} \quad C_{k1} = Y_{k1} - T \tag{2}$$

[5] According to the 2020 census, there were 90.34 million people aged 65 or older in rural China, accounting for 17.72 % of rural residents. http://english.scio.gov.cn/pressroom/2021-05/14/content_77497508_7.htm [Accessed 20 April 2023].

[6] Land titling can affect the income of rural households through three channels. First, land titling can incentivize peasants to lease out their land and increase rental income, which has been documented in Vietnam (Deininger and Jin, 2008), Ethiopia (Holden et al., 2011), China (Bu and Liao, 2022; Xu and Du, 2022; Liu et al., 2023). Secondly, land titling can offer peasants opportunities for off-farm employment, which has been confirmed in Peru (Field, 2007), Vietnam (Do and Iyer, 2008), and China (Bu and Liao, 2022; Wen et al., 2023). Thirdly, land titling can incentivize peasants to increase investment in land and gain higher agricultural production, which has been supported by evidence from Ethiopia (Holden et al., 2009), China (Wen et al., 2023), and India (Subramanian and Kumar, 2024).

[7] An alternative way to capture transfers between the child and the parent is a Nash bargaining model (Cox, 1987). In this model, if the parent derives higher reservation utility from increasing his own income than he would gain from bargaining with the child, the exchange motive of the child to please the parent with increasing transfers still exists. In other words, our result that $\frac{\partial T}{\partial Y_p} > 0$ if $u_0'(Y_p)$ is large remains valid within the Nash bargaining context.

$$C_{k2} = Y_{k2} + B \tag{3}$$

$$C = Y_p + T - B \tag{4}$$

$$U(C,S) \geq u_0\left(Y_p\right) \tag{5}$$

From condition (1), the child's utility function comprises three components: 1) the utility of period 1 $v_1(C_{k1}) - \phi(S)$, where $v_1(C_{k1})$ represents the utility derived from period 1's consumption C_{k1}, and $\phi(S)$ represents the cost of providing time transfers, such as services or attention to parents; 2) the utility derived from period 2's consumption $v_2(C_{k2})$, discounted at a rate of δ; and 3) the altruistic utility $\lambda U(C,S)$, where λ captures the degree of altruism (i.e., the child's concern for the parent's utility), and $U(C,S)$ denotes the parent's utility derived from his own consumption C and the time transfers S provided by the child. We assume that all functions are well-behaved so that the problem is quasi-concave in all its arguments.[8]

Conditions (2)-(4) are budget constraints for the child in periods 1 and 2 and for the parent, respectively.[9] Y_{k1} and Y_{k2} are the child's income in periods 1 and 2, respectively. Y_p is the parent's income, which is the crucial parameter affected by land titling and influences the equilibrium wealth allocation plan. Condition (5) is the parent's participation constraint. It implies that the parent's utility from the wealth allocation plan $U(C,S)$ must be no less than $u_0\left(Y_p\right)$, which is the parent's reservation utility derived from consuming out of his own income. Essentially, $u_0\left(Y_p\right)$ serves as the threat point for the parent when considering whether to accept the wealth allocation plan proposed by the child.

Taking account of all the constraints above, the Lagrangian function can be written as:

$$L = v_1(Y_{k1} - T) - \phi(S) + \delta v_2(Y_{k2} + B) + (\lambda + \eta)U\left(Y_p + T - B, S\right) - \eta u_0\left(Y_p\right) \tag{6}$$

where η is the Lagrangian multiplier. We focus on the interior solution (i.e., $T > 0$, $S > 0$, and $B > 0$). The first-order conditions (FOC) can be derived as:

$$\frac{\partial L}{\partial T} = -v_1'(Y_{k1} - T) + (\lambda + \eta)U_C = 0 \tag{7}$$

$$\frac{\partial L}{\partial S} = -\phi'(S) + (\lambda + \eta)U_S = 0 \tag{8}$$

$$\frac{\partial L}{\partial B} = \delta v_2'(Y_{k2} + B) - (\lambda + \eta)U_C = 0 \tag{9}$$

Conditions (7) and (9) yield

$$v_1'(Y_{k1} - T) = \delta v_2'(Y_{k2} + B) \tag{10}$$

Intuitively, the child will allocate the pecuniary transfers and bequest to smooth out his consumption across periods 1 and 2. Based on this condition, the bequest of parents can be represented as a function of the pecuniary transfers, denoted as $B(T)$. It is easily checked from the Implicit Function Theorem that $B'(T) = \frac{v_1''}{-\delta v_2''} < 0$. Inserting this condition, the equilibrium pecuniary and time transfers (T^*, S^*) can be defined by

$$\frac{\partial L}{\partial T} = -v_1'(Y_{k1} - T) + \delta v_2'(Y_{k2} + B(T))B'(T) + (\lambda + \eta)U_C\left(Y_p + T - B(T), S\right) = 0 \tag{11}$$

$$\frac{\partial L}{\partial S} = -\phi'(S) + (\lambda + \eta)U_S\left(Y_p + T - B(T), S\right) = 0 \tag{12}$$

Following Cox (1987), we discuss how parental income affects the child's transfers in two cases: *pure altruism* and *exchange motives*, respectively.

3.1. Pure altruism regime

When the child is effectively altruistic, the participation constraint is not binding (i.e., $\eta = 0$), which means the parent's utility gain from the wealth allocation plan is strictly positive. Condition (11) reveals the incentive of pecuniary transfers T with the time transfers S held constant. In this scenario, as Y_p increases, U_C decreases and then $\frac{\partial L}{\partial T} < 0$. To achieve a higher utility level, the child reduces T to raise both consumption in period 1 and the parent's marginal utility from consumption U_C. Consequently, it is likely that $\frac{\partial T}{\partial Y_p} < 0$ for a given S.

[8] The quasi-concavity requires that $v_i' > 0,\ v_i'' < 0,$ for $i = 1,\ 2;\ \phi' > 0$ and $\phi'' > 0$; $U_C \equiv \frac{\partial U}{\partial C} > 0$ and $U_S \equiv \frac{\partial U}{\partial S} > 0$; $U_{CC} \equiv \frac{\partial^2 U}{\partial C^2} < 0, U_{SS} \equiv \frac{\partial^2 U}{\partial S^2} < 0$ and $U_{cc}U_{SS} - U_{SC}^2 > 0$.

[9] We assume there is no intertemporal borrowing for simplicity.

Similarly, the incentive for time transfers can be observed in condition (12). Keeping T unchanged, the direct effect of an increase in parental income depends on U_{SC}. If $U_{SC} > 0$ (i.e., S and C are complements for the parent), then the rise in Y_p leads to an increase in U_S, resulting in $\frac{\partial L}{\partial S} > 0$. In this scenario, the child will increase S to raise parent's marginal utility from consumption U_C, implying $\frac{\partial S}{\partial Y_p} > 0$ for a given T. Conversely, if $U_{SC} < 0$ (i.e., S and C are substitutes for the parent), an increase in Y_p leads to a decrease in U_S, hence $\frac{\partial L}{\partial S} < 0$. In this case, the child tends to decrease services S to raise his utility and parent's marginal utility from consumption U_C, making it more likely that $\frac{\partial S}{\partial Y_p} < 0$.

As an illustration, Fig. 1 plots the equilibrium pecuniary transfers and time transfers (T^*, S^*) varying with the parent's income Y_p. Panel A presents the case where the parent's marginal utility from consumption increases with the child's service or attention (i.e., $U_{SC} > 0$). In this scenario, an increase in the parent's income leads to a reduction in pecuniary transfers but an increase in time transfers (i.e., $\frac{\partial T^*}{\partial Y_p} < 0$ and $\frac{\partial S^*}{\partial Y_p} > 0$). However, if consumption and child's service are substitutable for the parent (i.e., $U_{SC} < 0$), both pecuniary transfers and time transfers decrease with the parent's income (i.e., $\frac{\partial T^*}{\partial Y_p} < 0$ and $\frac{\partial S^*}{\partial Y_p} < 0$) (panel B).

3.2. Impure altruism regime

When the participation constraint is binding (i.e., $\eta > 0$), the exchange motive may arise. From condition (11), the direct impact of parental income Y_p on T appears ambiguous. On the one hand, an increase in Y_p leads to a reduction in the parent's marginal utility from consumption U_C, potentially leading to $\frac{\partial L}{\partial T} < 0$ and consequently, downward pressure on T. On the other hand, η increases accordingly as the participation constraint becomes more stringent, resulting in $\frac{\partial L}{\partial T} > 0$ and hence, upward pressure on T. Overall, if the parent's reservation utility largely increases with his own income, i.e., $u_0'(Y_p)$ is large, it is likely that $\frac{\partial T^*}{\partial Y_p} > 0$.[10] Intuitively, an increase in parental income also increases the parent's required compensation for a given wealth allocation plan, since the parent's threat point utility rises. Therefore, the child will increase pecuniary transfers to make the participation constraint binding.

Concerning the effect of parental income on time transfers $\left(\frac{\partial S^*}{\partial Y_p}\right)$, there is no definite prediction. Previous studies have found that time transfers may increase or decrease with parental income under exchange motives (Cox, 1987; Victorio and Arnott, 1993; Laferrère and Wolff, 2006). From condition (12), if $U_{SC} > 0$, an increase in Y_p which raises the parent's consumption leads to a rise in U_S. Simultaneously, if η increases, it is highly likely that $\frac{\partial L}{\partial S} > 0$, leading to upward pressure on S. If $U_{SC} < 0$, there are two forces influencing the direction of S. On the one hand, an increase in Y_p leads to an increase in the parent's consumption, thereby reducing the parent's marginal utility with respect to time transfers U_S. Moreover, the increase in pecuniary transfers T with Y_p strengthens this effect, which imposes downward pressure on S. On the other hand, η increases with Y_p, imposing upward pressure on S. If the former force is dominant, it is possible that $\frac{\partial S^*}{\partial Y_p} < 0$.

Table 1 presents the summary of comparative statistics predictions on the effects of parental income on children's intergenerational transfers. As parental income increases with the land titling program, our conceptual framework is suitable for analyzing the effects of land titling on intergenerational transfers. Specifically, when the child is motivated by pure altruism (i.e., $\eta = 0$), the land titling program is expected to reduce both the child's pecuniary and time transfers provided that consumption and services are substitutes for the parent (i.e., $\frac{\partial T^*}{\partial Y_p} < 0$ and $\frac{\partial S^*}{\partial Y_p} < 0$ when $U_{SC} < 0$). Conversely, when the child is motivated by exchange motives (i.e., $\eta > 0$) and the parent regards services as substitutes to consumption, the land titling program will possibly increase pecuniary transfers while decreasing time transfers (i.e., $\frac{\partial T^*}{\partial Y_p} > 0$ and $\frac{\partial S^*}{\partial Y_p} < 0$ when $U_{SC} < 0$). Given the ambiguous effects of land titling on intergenerational transfers, it remains an empirical issue to identify whether altruism or exchange motive plays a dominant role in practice.

4. Empirical strategy, data source, and descriptive statistics

4.1. Empirical model

The empirical strategy addresses selection bias that can arise in examining the effects of land titling on intergenerational transfers from adult children to parents. In China, the land titling program was initiated by pilot villages and then gradually expanded nationally. The observed and unobserved factors in a village might significantly affect the probability of villages implementing land titling, making the pilot villages are not randomly distributed. For example, the government might choose villages with more fertile land and favorable land-to-labor ratios, or with better governance capability which facilitates collective action, to promote land titling. If there exist some unobserved factors simultaneously impacting the implementation of land titling and intergenerational transfers, self-selection bias will arise.

[10] Conditions (7) and (8) yield $\frac{\phi'(S)}{V_1'(Y_{k_1}-T)} = \frac{U_S(Y_p+T-B(T),S)}{U_C(Y_p+T-B(T),S)}$, by which we can define $S(T, Y_p)$. The equilibrium (T^*, S^*) can be derived by inserting $S(T, Y_p)$ into the participation constraint $U(Y_p+T-B(T), S) = u_0(Y_p)$. Implicit Function Theorem yields that $\frac{\partial T}{\partial Y_p} = \frac{u_0'-U_C-U_S\frac{\partial S}{\partial Y_p}}{U_C(1-B'(T))+U_S\frac{\partial S}{\partial T}}$. If $\frac{\partial S}{\partial Y_p}$ is not very large, it is very likely that $\frac{\partial T}{\partial Y_p} > 0$ when $u_0' - U_C > 0$.

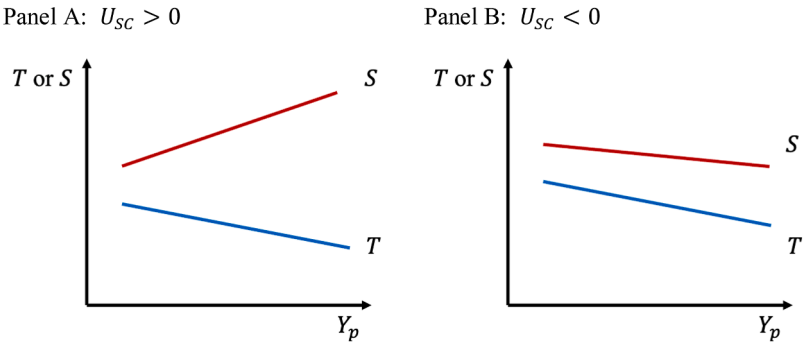

Fig. 1. Effects of the parent's income on pecuniary and time transfers: Pure altruism.

Note: This figure is illustrated by setting $v_i(C_{ki}) = aC_{ki} - \frac{C_{ki}^2}{2}, (i = 1, 2)$, $\phi(S) = \frac{\beta}{2}S^2$, and $U(C,S) = a(C+S) - \frac{C^2}{2} - \frac{S^2}{2} + \gamma C \times S$. With this setting, $U_{SC} = \gamma$.

Table 1
Comparative statistics predictions on children's intergenerational transfers.

	$U_{SC} > 0$ (Consumption and service are complements) (1)	$U_{SC} < 0$ (Consumption and service are substitutable) (2)
Panel A:Pure altruism ($\eta = 0$)		
$\frac{\partial T^*}{\partial Y_p}$	< 0	< 0
$\frac{\partial S^*}{\partial Y_p}$	> 0	< 0
Panel B: Exchange motives (or Impure altruism) ($\eta > 0$)		
$\frac{\partial T^*}{\partial Y_p}$	> 0	> 0
$\frac{\partial S^*}{\partial Y_p}$	> 0	< 0

Note: In the exchange motive framework, all effects of land titling on intergenerational transfers are likely effects under the condition that the parent's reservation utility largely increases with his own income (i.e., $u_0'(Y_p)$ is large).

We address the potential issue of self-selection bias by accounting for both observed and unobserved factors using the endogenous switching model (Lokshin and Sajaia, 2004, 2011). The model is developed by Lee (1982) as a generalization of Heckman's selection correction approach (Abdulai and Huffman, 2014). The endogeneous switching model accounts for the self-selection bias in the estimation by bringing in the instrumental variable and counterfactual analysis, which has advantages over the propensity score matching (PSM) and instrumental variable regressions (e.g., IV-2SLS, IV-Probit, and IV-Tobit).[11] It has been applied widely in empirical analyses (e.g., Di Falco et al., 2011).

The endogenous switching model consists of one selection equation and two outcome equations. The selection equation describes that a representative utility-maximizing village chooses to implement land titling if it generates net benefits. The outcome equations describe the determinants of intergenerational transfers for adult children who face two regimes: (1) their parents receive land titling, and (2) their parents don't receive land titling, respectively. To obtain consistent standard errors, a full information maximum likelihood (FIML) estimator is utilized to simultaneously estimate the selection equation and the outcome equation. Based on the estimation results of the endogenous switching model, a counterfactual analysis can be conducted to further simulate the average treatment effect on the treated (ATT) of land titling on intergenerational transfers (Lokshin and Sajaia, 2004, 2011).

Two forms of the endogenous switching model are used in the analysis, namely, the endogenous switching probit (ESP) model and the endogenous switching regression (ESR) model.[12] The dependent variable of the outcome equation in the ESP model is dichotomous, while that in the ESR model is continuous. Here, the ESP model with counterfactual analysis is used to estimate the treatment effects of land titling on the probability of providing pecuniary transfers and visiting parents, and the ESR model is to estimate the

[11] Although the propensity score matching (PSM) is also used to solve the self-selection issue, it has the drawback that it is unable to address selection bias originating from unobserved factors (Smith and Todd, 2005). Compared to IV regressions, the endogenous switching model is more suitable for endogenous binary variables and can estimate the average treatment effect on the treated (ATT) by counterfactual analysis (Miranda and Rabe-Hesketh, 2006; Di Falco et al., 2011).

[12] For simplicity, the endogenous switching probit model and the endogenous switching regression model are abbreviated to the ESP and the ESR models hereafter, respectively.

treatment effects of land titling on the value of total pecuniary transfers, monetary transfers, in-kind transfers, and the frequency of visiting parents.

4.1.1. The selection equation

The selection equation remains consistent across the ESP and ESR models. Considering the stylized fact that villages voluntarily choose whether to implement land titling, we construct a selection model in which village v in province p decides to implement land titling if it generates net benefits. Let $D^*_{vp} = D^*_{1,vp} - D^*_{0,vp}$ be the latent variable that captures the expected net benefits from implementing the land titling ($D^*_{1,vp}$) with respect to not implementing land titling ($D^*_{0,vp}$). If $D^*_{vp} > 0$, the village will implement land titling, vice versa. We specify the selection equation for the ESP and ESR models as follows:

$$D^*_{vp} = Z_{vp}\alpha + \gamma_p + IV_{vp}\delta + \mu_{vp} \text{ with } D_{vp} = \begin{cases} 1 \text{ if } D^*_{vp} > 0 \\ 0 \text{ otherwise} \end{cases} \tag{13}$$

where D_{vp} is a binary variable that equals 1 when the village v where the child's parents reside had implemented the land titling program before 2011 and 0 otherwise; Z_{vp} is a vector of village-level variables that may influence the implementation of land titling, including the ageing ratio, agricultural income share, net income per capita, infrastructure (access to all-weather roads), and the implementation of the new rural pension scheme. α is a vector of parameters to be estimated. γ_p presents province fixed effects, absorbing all time-invariant province-level variables that may be associated with land titling such as climate, terrain, and land productivity. μ_{vp} is an error term assumed to be normally distributed with zero means.

4.1.2. The outcome equations

The outcome equations are different for the ESP and ESR models. For the ESP model, the outcome equations of intergenerational transfers for child i whose parent h lives in village v and province p are defined as follows:

Regime 1.1

$$Y^*_{1,ihvp} = X_{ihvp}\beta_1 + \lambda_p + \varepsilon_{1,ihvp} \text{ if } D_{vp} = 1 \text{ with } Y_{1,ihvp} = \begin{cases} 1 \text{ if } Y^*_{1,ihvp} > 0 \\ 0 \text{ if } Y^*_{1,ihvp} \le 0 \end{cases} \tag{14a}$$

Regime 1.2

$$Y^*_{0,ihvp} = X_{ihvp}\beta_0 + \lambda_p + \varepsilon_{0,ihvp} \text{ if } D_{vp} = 0 \text{ with } Y_{0,ihvp} = \begin{cases} 1 \text{ if } Y^*_{0,ihvp} > 0 \\ 0 \text{ if } Y^*_{0,ihvp} \le 0 \end{cases} \tag{14b}$$

where $Y^*_{1,ihvp}$ and $Y^*_{0,ihvp}$ are the latent variables indicating the propensity for intergenerational transfers, which determine the observed binary outcomes $Y_{1,ihvp}$ and $Y_{0,ihvp}$. D_{vp} is a binary variable that equals 1 when the village v in province p where the child's parents reside had implemented the land titling program before 2011 and 0 otherwise. X_{ihvp} includes the covariates of child i, parent h, and village v that may influence intergenerational transfers (see Section 4.3 for the discussion of control variables), the interaction between village-level and child-level covariates, and the interaction between village-level and parent-level covariates. The interactions help exclude village effects from the land titling effects.[13] β_1 and β_0 are vectors of parameters to be estimated. λ_p represents province fixed effects, which absorb all time-invariant province-level variables that may be associated with intergenerational transfers such as social norms. $\varepsilon_{1,ihvp}$ and $\varepsilon_{0,ihvp}$ are both random disturbance terms assumed to be normally distributed with zero means.

For the ESR model, the outcome equations of intergenerational transfers for child i whose parent h lives in village v and province p are defined as follows:

Regime 2.1

$$Y_{1,ihvp} = X_{ihvp}\varphi_1 + \vartheta_p + \eta_{1,ihvp} \text{ if } D_{vp} = 1 \tag{15a}$$

Regime 2.2

$$Y_{0,ihvp} = X_{ihvp}\varphi_0 + \vartheta_p + \eta_{0,ihvp} \text{ if } D_{vp} = 0 \tag{15b}$$

where $Y_{1,ihvp}$ and $Y_{0,ihvp}$ are intergenerational transfers provided by children. D_{vp} is a binary variable that equals 1 when the village v in province p where the child's parents reside had implemented land titling before 2011 and 0 otherwise. X_{ihvp} is a vector of covariates the same as those in Eqs. (14a) and (14b). φ_1 and φ_0 are vectors of parameters to be estimated. ϑ_p represents province fixed effects, which absorb all time-invariant province-level variables that may be associated with intergenerational transfers such as social norms. $\eta_{1,ihvp}$ and $\eta_{0,ihvp}$ are both random disturbance terms assumed to be normally distributed with zero means.

For the identification of the ESP model (Eqs. (13), (14a) and (14b)) and the ESR model (Eqs. (13), (15a) and (15b)), it is essential to include at least one instrumental variable (IV) in the selection Eq. (13) that does not appear in the outcome equations. This IV should

[13] We thank one anonymous reviewer for the suggestion of controlling interactions.

correlate with land titling and be orthogonal to omitted variables impacting intergenerational transfers. Here, whether the village implemented land reallocation between 2005 and 2008 is used as the IV. The validity of the IV is discussed in Section 4.4.

To obtain consistent standard errors, both ESP and ESR models utilize the full information maximum likelihood (FIML) method to simultaneously estimate the selection equation and the outcome equations (Lokshin and Sajaia, 2004, 2011). The details of the FIML method are presented in Appendix A.

4.1.3. Treatment effects

Using parameters estimated by the full-information maximum likelihood (FIML) method, a counterfactual analysis is further conducted to simulate the ATT, which captures the impact of land titling on intergenerational transfers provided by children whose parents receive land titling.

For the ESP model, the ATT can be calculated as follows:

$$ATT = \frac{1}{N_T}\sum_{i=1}^{N_T}\frac{\Phi\left(X_{ihvp}\beta_1, Z_{vp}\alpha, \rho_1\right) - \Phi\left(X_{ihvp}\beta_0, Z_{vp}\alpha, \rho_0\right)}{F\left(Z_{vp}\alpha\right)} \tag{16}$$

where N_T is the number of children whose parents receive land titling. F is a cumulative normal distribution function, Φ is the cumulative function of a bivariate normal distribution, ρ_1 is the correlation between $\varepsilon_{1,ihvp}$ and μ_{vp}, and ρ_0 is the correlation between $\varepsilon_{0,ihvp}$ and μ_{vp}.

For the ESR model, the ATT (conditional on X_{ihvp}) is expressed as follows:

$$ATT = X_{ihvp}(\beta_1 - \beta_0) + (\sigma_1\rho_1 - \sigma_0\rho_0)\frac{f\left(Z_{vp}\alpha\right)}{F\left(Z_{vp}\alpha\right)} \tag{17}$$

where F is a cumulative normal distribution function, f is a normal density distribution function, σ_1 is the standard deviation of $\eta_{1,ihvp}$, σ_0 is the standard deviation of $\eta_{0,ihvp}$, ρ_1 is the correlation between $\eta_{1,ihvp}$ and μ_{vp}, and ρ_0 is the correlation between $\eta_{0,ihvp}$ and μ_{vp}.

4.2. China health and retirement longitudinal study

The data used in the study is obtained from the China Health and Retirement Longitudinal Study (CHARLS) conducted by Peking University. Similar to Health and Retirement Survey in the United States, CHARLS is a survey that aims to collect data on a nationally representative sample of Chinese residents aged 45 and older. In this study, we utilize the survey conducted in 2011 because only this wave publicized whether the village had implemented the land titling program. The analysis sample is constructed following three steps. First, rural households with contracted land are retrieved from CHARLS survey. Second, we collect information on each adult child based on the family structure questionnaires, excluding those who were still in school or co-resided with parents.[14] Finally, due to missing information on land titling, land reallocation, and parental income, some observations are excluded from the baseline sample.[15] The final cross-sectional dataset includes 10,803 adult children from 4354 rural households across 262 villages in 26 provinces.

4.3. Variables and descriptive statistics

The main outcome of interest is children's transfers to their parents. CHARLS records both pecuniary transfers and time transfers of each child who does not co-reside with his/her parents. We construct four variables to measure pecuniary transfers. The first measure is *Pecuniary transfers*, a binary variable that equals 1 if the child provided monetary or in-kind transfers for his/her parents in a year and 0 otherwise. The second measure is *Total pecuniary transfers*, a continuous variable that equals the sum of the values of monetary transfers and in-kind transfers. The third and fourth measures are the values of *monetary transfers* and *in-kind transfers*, respectively.[16] Based on the survey question "How often do you see this child?", we construct two variables of time transfers. One is a binary variable *Visit* that equals 1 if the child visited his/her parents in a year and 0 otherwise. The other one is *Visit frequency,* an ordinal variable that ranges from 0 (never) to 8 (every day). Table A2 presents the definition of *Visit frequency*.

The explanatory variable of interest is *Titling*, a binary variable which equals 1 if the village where the child's parents reside had implemented land titling until 2011 and 0 otherwise. In 2011, 47 out of 262 villages had implemented the land titling program, covering 19.7 % of the whole sample (Table 2).

[14] CHARLS only records information on intergenerational transfers for non-coresident children.

[15] Table A1 shows that most of characteristics of children, parents and villages are not significantly different between the analysis sample and the baseline sample and attrition analysis shows that these characteristics do not account for attrition jointly, releasing the concerns about selection bias further.

[16] The CHARLS survey asks the following two questions "How much monetary support did you receive from this child in the past year?" and "How much in-kind support did you receive from this child in the past year?" to record the real money transfer and normal gift giving, separately. The answers to these two questions facilitate us to define real money transfers, normal gift giving, and the sum of them. We define the value of real money transfers as *Monetary transfers*, the value of normal gift giving as *In-kind transfers*, and the sum of both real money transfers and normal gift giving as *Total pecuniary transfers*.

Table 2
Descriptive statistics.

Variables	Full sample (1)	With land titling (2)	Without land titling (3)	Difference (4)=(2)-(3)
Pecuniary transfers	0.448	0.460	0.445	0.015
	(0.497)	(0.499)	(0.497)	
Total pecuniary transfers	668.339	735.233	651.978	83.255
	(2109.304)	(2311.789)	(2056.559)	
Monetary transfers	587.905	699.816	560.533	139.283***
	(2051.517)	(2299.023)	(1985.478)	
In-kind transfers	80.434	35.417	91.445	−56.028***
	(353.883)	(240.329)	(375.670)	
Visit [a]	0.947	0.925	0.952	−0.027***
	(0.225)	(0.264)	(0.214)	
Visit frequency [a]	3.679	3.435	3.738	−0.304***
	(2.632)	(2.677)	(2.617)	
Titling	0.197	1.000	0.000	
	(0.397)	(0.000)	(0.000)	
Age	36.589	37.497	36.367	1.130***
	(8.799)	(9.127)	(8.703)	
Male	0.447	0.478	0.439	0.039***
	(0.497)	(0.500)	(0.496)	
Education	0.501	0.464	0.510	−0.046***
	(0.500)	(0.499)	(0.500)	
Sibling	2.813	2.827	2.810	0.017
	(1.551)	(1.575)	(1.545)	
Rich	0.609	0.624	0.605	0.019
	(0.488)	(0.484)	(0.489)	
Same village	0.316	0.292	0.322	−0.030***
	(0.465)	(0.455)	(0.467)	
Parent age	63.852	64.777	63.626	1.150***
	(9.406)	(9.703)	(9.318)	
Single	0.226	0.222	0.227	−0.005
	(0.418)	(0.416)	(0.419)	
Co-residence	0.398	0.306	0.421	−0.115***
	(0.490)	(0.461)	(0.494)	
Land	5.513	5.497	5.517	−0.020
	(3.624)	(3.873)	(3.560)	
Debt	5016.269	4550.622	5130.159	−579.537*
	(13,226.830)	(12,517.693)	(13,392.787)	
Medical expense	29.574	38.327	27.433	10.894**
	(221.002)	(354.901)	(173.119)	
Senior	0.169	0.208	0.160	0.048***
	(0.118)	(0.167)	(0.101)	
Agriculture	0.334	0.390	0.320	0.070***
	(0.229)	(0.267)	(0.217)	
Income per capita	3769.088	3550.931	3822.445	−271.514***
	(2246.876)	(2053.823)	(2288.567)	
Road	0.624	0.671	0.612	0.059***
	(0.484)	(0.470)	(0.487)	
NRPS	0.430	0.239	0.477	−0.238***
	(0.495)	(0.426)	(0.499)	
Land reallocation	0.051	0.000	0.064	−0.064***
	(0.221)	(0.000)	(0.245)	
Number of clusters	262	47	215	
Observations	10, 803	2123	8680	

Note: The standard deviations are reported in parentheses.*, ** and *** denote significance at 10 %, 5 % and 1 % levels respectively.
Data source: CHARLS (2011).

[a] The observation of *Visit* and *Visit frequency* variables is 10,545 due to missing information.

This study controls for the characteristics of children, parents, and villages, which may correlate with intergenerational transfers and the land titling program following previous studies (Altonji et al., 1997; Secondi, 1997; Fan, 2010). Considering that the characteristics of the adult children may determine the intergenerational transfers (Xie and Zhu, 2009; Hu, 2017; Horioka et al., 2018), we control for children's age (*Age*), gender (*Male*), educational attainment (*Education*), number of siblings (*Sibling*), whether the child has a high income (*Rich*),[17] and whether the child lives with parents in the same village (*Same village*). Intergenerational transfers may be also affected by the characteristics of the parents (McGarry and Schoeni, 1995; Juarez, 2009; Mukherjee, 2022), thus, a set of variables at the parent level are controlled, including the parents' age (*Parent age*), marriage status (*Single*), whether they live with children (*Co-residence*), the area of their contracted land (*Land*), debt value (*Debt*), and medical expenses (*Medical expense*).[18] To control for the possible impacts of village's characteristics on land titling and intergenerational transfers (Nikolov and Adelman, 2019; Gao et al., 2021), the variables at the village level include the ageing ratio (*Senior*), the agricultural income share of the village (*Agriculture*), net income per capita (*Income per capita*), whether the village has access to all-weather roads (*Road*), and whether the village has implemented the new rural pension scheme (*NRPS*). The definitions of these variables are shown in Table A2.

Table 2 presents descriptive statistics of variables and compares their differences between children whose parents receive land titling and those whose parents don't. Nearly half of the children report they provide pecuniary transfers for their parents, and the (unconditional) average value of pecuniary transfers is 668.34 yuan (around $103.59 in 2011).[19] Monetary transfers account for 88 % of total pecuniary transfers. Compared to pecuniary transfers, time transfers are more common among children in our sample. 95 % of the children visit their parents. Columns 2–4 of Table 2 also justify whether the intergenerational transfers are significantly based on the parents' land titling status. Both the probability of providing pecuniary transfers and the average value of total pecuniary transfers are higher for children whose parents receive land titling, although the difference is not significant. The structure of pecuniary transfers is significantly different between these two groups. Children whose parents receive land titling tend to provide more monetary transfers and fewer in-kind transfers. This structure change shows the substitution between monetary transfers and in-kind transfers.

As it turns to time transfers, both the probability and frequency of visiting parents are significantly lower for the children whose parents receive land titling. Overall, it appears that land titling has positive effects on pecuniary transfers, while it has negative effects on time transfers, aligning with the prediction of the exchange motive. Yet, there also exist systematic differences in characteristics between the two groups. For example, for children whose parents receive land titling, they tend to be less educated and less likely to live in the same village as their parents. Parents with land titling are older, less likely to co-reside with their children, and have less debt but more medical expenses. Villages with land titling have higher ageing ratios and lower income per capita, and are less likely to implement the new rural pension scheme. These significant differences show the confounders and potential selection bias in land titling, which should be accounted for in the empirical strategy.

4.4. Instrumental variable and its validation

As discussed in Section 4.1, the identification of the motive behind intergenerational transfers is challenged by selection bias. Unobserved factors within villages simultaneously impact the implementation of land titling and intergenerational transfers. To address the potential endogeneity in land titling, we employ a variable *Land reallocation* defined as "whether the village implemented land reallocation between 2005 and 2008 (1=Yes, 0=No)" as the instrumental variable (IV). A valid IV should satisfy both the correlation condition and the exclusion restriction. First, the correlation condition requires that land reallocation is correlated to land titling. Land reallocation is a periodic land adjustment conducted by the local government due to village demographic changes resulting from births, deaths, and marriages.[20] Its stated aim is to achieve equity in land ownership among households and alleviate poverty (Zhang et al., 2011; Ngai et al., 2019; Adamopoulos et al., 2024). Land reallocation was frequent before the launch of the Rural Land Contracting Law in 2003 and continued afterwards, albeit at a lower rate (Brandt et al., 2002; Deininger and Jin, 2009; Deininger et al., 2014).[21]

The correlation and exclusion restriction conditions can be justified as follows. First, it is plausible that land reallocation reduces the probability of implementing land titling. Land reallocation poses challenges to land tenure security and exacerbates land disputes, which can hinder the process of land titling in two ways. First, land reallocation lowers peasants' perception of the security of their property rights and reduces their incentives to participate in collective action like land titling (Ostrom and Gardner, 1993; Su et al., 2023). Second, land disputes can be exacerbated during land titling, especially in the step of measuring land size and location. This can

[17] CHARLS records the child's income as a categorized variable ranging from 1 (No income) to 11 (Above 300,000 yuan). This facilitates us to construct a binary variable *Rich* which equals to 1 if the child's income is above or equal to the per capita income of the city where the child lives and 0 otherwise to control for the child's income. The source of per capita income at the city level is statistical yearbooks of prefecture-level cities.

[18] Controlling for parents' debt and medical expense can help us rule out confounding effects of debt and medical expense, which may largely drive pecuniary transfers, from the land titling effects. We thank an anonymous reviewer for suggestion.

[19] The (conditional) average amount of pecuniary transfers is 668.34/0.45=1485.2 yuan (around $230.21 in 2011).

[20] It should be noted that the form of land reallocation in our study is different from that in other research which corresponds to land renting decisions made by the household (e.g., Chari et al., 2021; Gao et al., 2021).

[21] Some research has revealed the high frequency of land reallocation in rural China. In a survey of 215 villages across 8 provinces, Brandt et al. (2002) show that 72 % of villages experienced land reallocation from 1983 to 1995. In a survey of 60 villages across 6 provinces, Wang et al. (2015) report that the percentage of villages experiencing land reallocation declined from 66 % in 1995-2000 to 16 % in 2003-2008.

Table 3
Estimates of determinants of implementing land titling programs and its impacts on intergenerational transfers: Pecuniary transfers.

	Selection equation	Outcome equation		Selection equation	Outcome equation					
		Pecuniary transfers			Log Total pecuniary transfers		Log Monetary transfers		Log In-kind transfers	
		With land titling	Without land titling		With land titling	Without land titling	With land titling	Without land titling	With land titling	Without land titling
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Land reallocation	−7.863***			−6.687***						
	(0.447)			(0.424)						
Age		0.079	−0.083*		0.342*	−0.166	0.316*	−0.142	0.023	−0.104
		(0.059)	(0.048)		(0.184)	(0.113)	(0.173)	(0.110)	(0.083)	(0.067)
Male		0.257	1.255***		2.847	3.671***	2.250	2.966***	1.362*	0.236
		(0.500)	(0.444)		(2.063)	(1.075)	(2.052)	(1.067)	(0.723)	(0.735)
Education		0.749	0.239		0.976	0.203	1.112	0.861	0.600	−0.337
		(0.568)	(0.545)		(1.851)	(1.257)	(2.110)	(1.152)	(0.937)	(0.741)
Sibling		−0.942***	0.163		−2.649**	0.548	−3.015***	0.589	0.350	0.140
		(0.346)	(0.281)		(1.136)	(0.617)	(1.058)	(0.558)	(0.442)	(0.382)
Rich		−0.843	0.459		−3.307	0.900	−2.519	−0.101	−1.679**	1.096
		(0.565)	(0.555)		(2.295)	(1.273)	(2.250)	(1.116)	(0.828)	(0.996)
Same village		−1.236*	−0.578		−4.655*	−1.883	−2.835	−2.058	−3.502**	−0.630
		(0.712)	(0.607)		(2.638)	(1.360)	(2.704)	(1.283)	(1.597)	(0.838)
Parent age		−0.043	0.056		−0.347*	0.060	−0.290*	0.029	−0.030	0.046
		(0.069)	(0.059)		(0.185)	(0.139)	(0.175)	(0.143)	(0.079)	(0.065)
Single		−0.777	−0.245		−1.191	−0.252	1.359	−1.155	−2.535	1.085
		(1.116)	(0.926)		(4.023)	(2.132)	(3.490)	(2.071)	(1.827)	(1.069)
Co-residence		−0.076	−0.382		1.019	−1.776	−1.073	−2.524*	1.644	−0.360
		(0.842)	(0.696)		(2.973)	(1.547)	(2.699)	(1.428)	(1.125)	(1.094)
Land		0.001	−0.044		0.068	−0.159	−0.049	−0.274	0.169	0.079
		(0.090)	(0.108)		(0.412)	(0.245)	(0.436)	(0.216)	(0.179)	(0.154)
Log Debt		0.028	0.045		0.111	0.151	0.155	0.120	0.096	−0.010
		(0.099)	(0.077)		(0.455)	(0.178)	(0.428)	(0.161)	(0.109)	(0.117)
Log Medical expense		−0.369	0.037		−1.011	0.147	−0.615	0.209	−0.372	0.018
		(0.304)	(0.218)		(1.157)	(0.496)	(1.066)	(0.460)	(0.392)	(0.404)
Senior	0.852	−0.358	2.162	0.916	5.680	3.108	5.444	4.030	−0.026	−3.919
	(0.956)	(1.542)	(1.966)	(1.007)	(4.495)	(4.695)	(4.087)	(4.934)	(1.696)	(2.432)
Agriculture	0.693	0.835	0.003	0.714	2.231	−0.833	2.376	−1.258	0.636	1.009
	(0.555)	(0.948)	(0.853)	(0.571)	(3.406)	(2.084)	(3.064)	(2.230)	(1.568)	(1.228)

(*continued on next page*)

Table 3 (*continued*)

	Selection equation	Outcome equation		Selection equation	Outcome equation					
		Pecuniary transfers			Log Total pecuniary transfers		Log Monetary transfers		Log In-kind transfers	
		With land titling	Without land titling		With land titling	Without land titling	With land titling	Without land titling	With land titling	Without land titling
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log Income per capita	−0.211	−0.431	0.046	−0.204	−2.608**	−0.169	−2.424**	−0.523	0.088	0.137
	(0.241)	(0.438)	(0.363)	(0.249)	(1.210)	(0.862)	(1.146)	(0.851)	(0.469)	(0.442)
Road	0.222	−0.643	−0.958**	0.213	−1.786	−2.331**	−1.502	−2.078*	−0.248	−0.923
	(0.251)	(0.563)	(0.449)	(0.256)	(1.962)	(1.113)	(1.755)	(1.128)	(0.640)	(0.567)
NRPS	−0.636**	1.430**	0.870*	−0.634**	3.068	1.864*	2.867	1.194	0.303	1.100**
	(0.266)	(0.592)	(0.452)	(0.268)	(2.221)	(1.101)	(2.038)	(1.119)	(0.784)	(0.541)
Constant	0.123	3.712	−1.538	0.062	20.064***	2.875	18.849**	5.340	−0.966	0.368
	(1.897)	(3.031)	(2.804)	(1.960)	(8.850)	(6.618)	(8.434)	(6.611)	(3.460)	(3.519)
Interactions [a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log σ					1.116***	1.136***	1.091***	1.099***	0.323***	0.731***
					(0.031)	(0.011)	(0.029)	(0.014)	(0.093)	(0.029)
ρ		−17.234	−0.131		−0.275*	−0.109	−0.226	−0.138	−0.108	0.048
		(13.534)	(0.329)		(0.160)	(0.203)	(0.145)	(0.224)	(0.119)	(0.274)
Wald test of indep. eqns.		1.959	1.959		3.130	3.130	2.690	2.690	0.847	0.847
Log likelihood		−9908	−9908		−30,706	−30,706	−30,347	−30,347	−25,556	−25,556
Observations	10,803	10,803	10,803	10,803	10,803	10,803	10,803	10,803	10,803	10,803

Note: Columns 1–3 present the estimation results of the endogenous switching probit (ESP) model, and columns 4–10 present the estimation results of the endogenous switching regression (ESR) model. Both the ESP and ESR models are estimated by the full information maximum likelihood (FIML) method. Standard errors in parentheses are clustered at the village level. *, **, and *** denote significance at 10 %, 5 % and 1 % respectively.

Data source: CHARLS (2011).

[a] The interactions include the interaction between child-level and village-level covariates, and the interaction between parent-level and village-level covariates.

delay the land titling process since the executors are required to coordinate or remap until all the disputes are solved. Such evidences and anecdotes imply that villages with frequent land reallocation were less likely to conduct land titling. Note that in 2008, the government announced the start of the trial of land titling programs in pilot villages across eight provinces. To alleviate the concerns about reverse causation, we construct the IV based on whether the village implemented land reallocation between 2005 and 2008. In column 1 of Table A3, we do find a strong negative correlation between the IV and land titling.

Second, the exclusion restriction requests that land reallocation has no direct impact on intergenerational transfers with its influence channeled exclusively through land titling. As noted before, land reallocation is primarily attributed to demographic changes at the village level, which are largely exogenous relative to intergenerational transfers within a household. Moreover, the IV is constructed based on the period between 2005 and 2008, which hardly has direct effects on intergenerational transfers in 2011 other than through the channel of land titling implementation since 2008. To release the concern that the IV may violate the exclusion restriction condition, we examine whether the IV is "plausibly exogenous" by using the zero-first-stage method suggested by Van Kippersluis and Rietveld (2018) to estimate the IV's impact on intergenerational transfers, based on the sample of children whose parents don't receive land titling. Columns 2–7 of Table A3 show that the IV has no significant impacts on most dependent variables of intergenerational transfers including pecuniary transfers and the frequency of visiting parents for the children whose parents don't receive land titling,[22] satisfying the exclusion restriction requests.

The statistical validity of the IV is further confirmed by the under-identification test and the weak-identification test (see Table A4). The Kleibergen-Paap rk LM statistic (8.062, $p < 0.01$ for the dependent variables concerning pecuniary transfers and 7.933, $p < 0.01$ for the dependent variables concerning time transfers) rejects the null hypothesis of under-identification, indicating that the IV has sufficient explanatory power to predict the endogenous variable *Titling*. The Cragg-Donald Wald F statistic (197.1 for pecuniary transfers and 189.3 for time transfers) and Kleibergen-Paap rk Wald F statistic (12.3 for pecuniary transfers and 12.2 for time transfers) jointly indicate that the IV is not weak.

Comparing the chosen IV to other potential instruments, we employ a machine learning method - IV-LASSO - to scrutinize the instrument setting. This approach estimates sparse high-dimensional models (Belloni et al., 2014; Chernozhukov et al., 2015), relying on a sparsity assumption and employing high-quality variable selection along with appropriate moment functions. Drawing on theoretical analysis and existing research (e.g., Wong et al., 2017), we include potential variables such as whether the village is located in plain areas, land per capita at the village level, standard deviation of slope at the city level, number of villages at the city level, and land titling proportion of households in other villages within the province, in addition to the primary IV (*Land reallocation*).[23] As presented in Table A5, the results of IV- LASSO indicate that the primary IV (*Land reallocation*) provides a high-quality prediction of endogenous variable-land titling. Thus, the ideal set of instruments identified using IV-LASSO is the primary IV (*Land reallocation*). This result, combined with the preceding discussion on the correlation condition and the exclusion restriction, highlights that the primary IV (*Land reallocation*) in this study is not simply spuriously correlated to the endogenous variable but possesses true predictive power.

5. Results

5.1. Baseline empirical results

5.1.1. Baseline empirical results: pecuniary transfers

This study employs the ESP model to estimate the impacts of land titling on the probability of providing pecuniary transfers, and the ESR model to estimate the impacts of land titling on the value of total pecuniary transfers, monetary transfers, and in-kind transfers. Table 3 reports the estimates of the ESP model (columns 1–3) and the ESR model (columns 4–10) estimated by the full-information maximum likelihood (FIML) with clustered standard error at the village level. Columns 1 and 4 present the estimates of the selection Eq. (13), columns 2–3 present the estimates of outcome Eqs. (14a) and (14b), and columns 5–10 present the estimates of outcome Eqs. (15a) and (15b).

The estimated ρ in column 5 is significantly negative, indicating the selection bias: children who provide more total pecuniary transfers are more likely to have parents living in villages that implement land titling. However, the estimated ρ in the other equations is insignificant, implying that the selection bias is not serious. Also, the results of the Wald test of independent equations suggest that the selection equation and outcome equations are independent; thus, the simultaneous regression is not superior to separate regressions.

The results of the selection equation present the dominants of land titling (columns 1 and 4). Notably, the estimated coefficient of the IV (i.e., *Land reallocation*) is statistically significant and negative, suggesting that villages that implemented land reallocation between 2005 and 2008 are less likely to conduct land titling since 2008. This aligns with the expectation that land reallocation harms tenure security, which may weaken peasants' incentive to participate in collective action, thereby hindering the process of land titling. In addition, other village characteristics may also correlate with the implementation of the land titling. For example, the statistically negative coefficient of *NRPS* suggests that once the new rural pension scheme is implemented, it is less likely to implement the land titling program. This may be attributed to the substitution between land titling and social insurance in providing supports for the

[22] While the IV has a significant impact on the probability of visiting parents, the impact magnitude is rare and almost could be ignored.

[23] The data source of whether the village is located in plain areas, land per capita at the village level, and land titling proportion of households in other villages within the province is CHARLS. The standard deviation of slope at the city level is sourced from ASTER Global Digital Elevation Model V003. The number of villages at the city level is sourced from statistical yearbooks of prefecture-level cities.

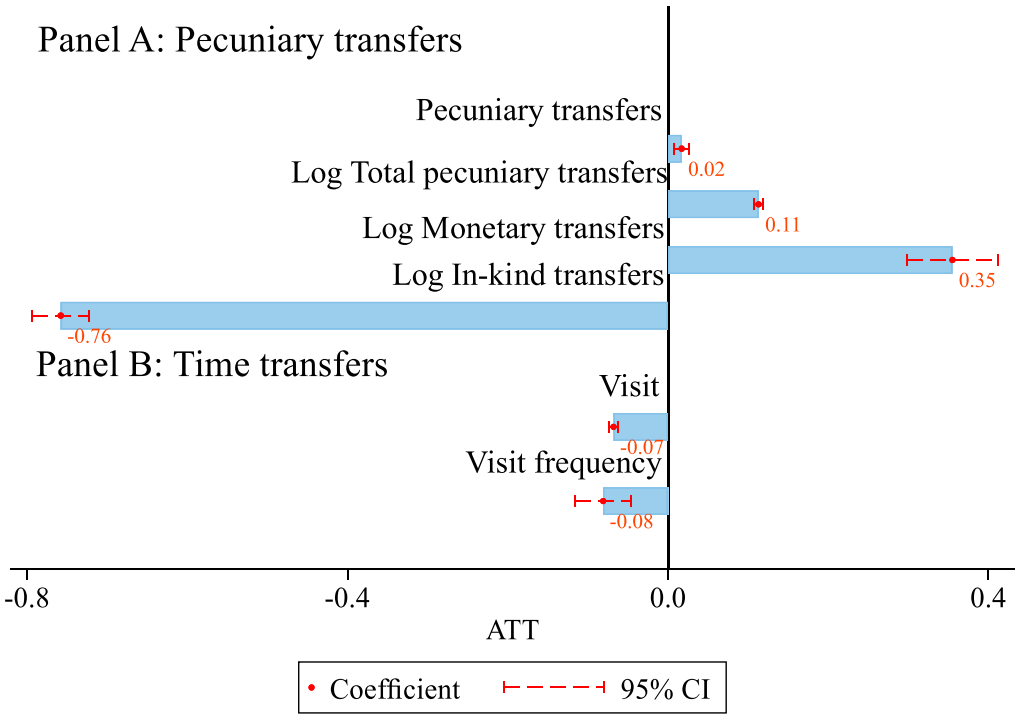

Fig. 2. ATT of land titling on intergenerational transfers.
Note: This figure shows the effects of land titling on intergenerational transfers including pecuniary transfers (panel A) and time transfers (panel B) provided by children whose parents receive land titling, respectively. Definitions of dependent variables are presented in Table A2. The endogenous switching probit (ESP) model is employed to estimate the ATT of land titling on the probability of providing pecuniary transfers (*Pecuniary transfers*) and visiting parents (*Visit*). The endogenous switching regression (ESR) model is employed to estimate the ATT of land titling on the log form of total pecuniary transfers (*Log Total pecuniary transfers*), monetary transfers *(Log Monetary transfers*), in-kind transfers (*Log In-kind transfers*), and the frequency of visiting parents (*Visit frequency*). For ESP and ESR models, the ATTs are estimated as described in Eqs. (16) and (17), respectively.

elderly. Although official portfolios declare that the main objective of land titling is to clarify property rights and promote the development of land rental markets, we can not completely rule out the possibility that land titling is implemented to provide support for the elderly due to its effects on intergenerational transfers.[24]

The estimated results from the outcome equations shed light on the factors influencing pecuniary transfers between children whose parents receive land titling and those whose parents don't. The differences in the coefficients of the outcome equations between these two groups illustrate the heterogeneity in the sample. First, there is a significant gender difference in transfers for children whose parents don't receive land titling. Compared to daughters, sons exhibit a propensity to provide more pecuniary transfers, particularly in the form of monetary transfers. This observation resonates with patriarchal norms emphasizing sons' heightened responsibility for financially supporting their parents. However, for children whose parents receive land titling, there is no significant gender difference in most forms of pecuniary transfers, except for in-kind transfers. This shift can be attributed to the clarification of land property rights, incentivizing both sons and daughters to contribute financially under the exchange motive, thus mitigating the gender difference.

Second, for children whose parents receive land titling, those with siblings demonstrate a lower probability of providing pecuniary transfers and fewer total pecuniary transfers and monetary transfers than those without siblings. Conversely, for children whose parents don't receive land titling, there is no significant difference between those with and without siblings. One possible reason behind this finding can be attributed to the fact siblings alleviate the financial burden of supporting parents, particularly when parents have gained higher income from land titling.

Third, for children whose parents receive land titling, those residing in the same village with their parents are less likely to provide pecuniary transfers and tend to contribute fewer total pecuniary transfers and in-kind transfers, compared to those residing outside the village. However, for children whose parents don't receive land titling, there is no significant difference between those living in the same village with parents and those residing outside. This finding suggests that children living near their parents have inherent advantages in providing care. When parental income rises from land titling, children who live in the same village as their parents are more likely to reduce pecuniary transfers and increase time transfers, due to partial substitution between pecuniary transfers and time transfers.

[24] We thank an anonymous reviewer for pointing it out.

Table 4
Estimates of determinants of implementing land titling programs and its impacts on intergenerational transfers: Time transfers.

	Selection equation	Outcome equation		Selection equation	Outcome equation	
		Visit			Visit frequency	
		With land titling	Without land titling		With land titling	Without land titling
	(1)	(2)	(3)	(4)	(5)	(6)
Land reallocation	−7.393***			−6.633***		
	(0.421)			(0.404)		
Age		0.055	0.086		0.121	0.001
		(0.044)	(0.067)		(0.133)	(0.071)
Male		−0.229	0.278		0.977	−0.288
		(0.303)	(0.797)		(1.159)	(1.010)
Education		0.093	1.517*		−1.358	0.597
		(0.357)	(0.813)		(1.186)	(0.852)
Sibling		0.309*	−0.594*		0.874*	−0.665*
		(0.173)	(0.351)		(0.490)	(0.359)
Rich		0.524	−0.033		−0.137	1.011
		(0.403)	(0.831)		(1.835)	(0.826)
Same village		1.335**	1.456		3.704	1.359
		(0.555)	(1.026)		(3.209)	(1.327)
Parent age		−0.048	0.018		−0.007	0.136**
		(0.032)	(0.064)		(0.100)	(0.068)
Single		0.065	0.846		−0.924	−0.430
		(0.465)	(0.980)		(1.942)	(0.996)
Co-residence		−0.396	0.165		0.015	2.780***
		(0.445)	(0.849)		(2.193)	(0.893)
Land		−0.036	0.044		−0.164	−0.041
		(0.081)	(0.105)		(0.210)	(0.115)
Log Debt		0.006	0.190*		0.043	−0.028
		(0.047)	(0.104)		(0.248)	(0.089)
Log Medical expense		0.038	−0.367		0.239	0.289
		(0.243)	(0.293)		(0.641)	(0.336)
Senior	0.967	2.558*	1.708	0.920	−3.015	−1.465
	(0.990)	(1.482)	(2.114)	(1.006)	(2.984)	(2.503)
Agriculture	0.679	−0.153	0.183	0.688	0.792	−2.136*
	(0.556)	(0.745)	(1.019)	(0.575)	(2.070)	(1.122)
Log Income per	−0.211	−0.157	0.614	−0.204	1.024	1.359***
capita	(0.244)	(0.302)	(0.390)	(0.253)	(0.677)	(0.506)
Road	0.220	−0.033	−0.167	0.211	0.209	−0.316
	(0.252)	(0.323)	(0.501)	(0.258)	(0.910)	(0.620)
NRPS	−0.616**	−1.310***	0.127	−0.623**	−3.350***	0.690
	(0.263)	(0.437)	(0.497)	(0.271)	(1.242)	(0.609)
Constant	0.178	−0.036	−3.377	0.130	−5.465	−7.935**
	(1.927)	(2.361)	(3.039)	(1.984)	(5.070)	(3.842)
Interactions [a]	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Log σ					0.755***	0.787***
					(0.026)	(0.012)
ρ		2.887***	2.351***		0.118	0.015
		(0.988)	(0.807)		(0.154)	(0.209)
Wald test of indep. eqns.		14.79***	14.79***		0.612	0.612
Log likelihood		−5013	−5013		−26,318	−26,318
Observations [b]	10,545	10,545	10,545	10,545	10,545	10,545

Note: Columns 1–3 present the estimation results of the endogenous switching probit (ESP) model, and columns 4–6 present the estimation results of the endogenous switching regression (ESR) model. Both the ESP and ESR models are estimated by the full information maximum likelihood (FIML) method. Standard errors in parentheses are clustered at the village level. *, **, and *** denote significance at 10 %, 5 % and 1 % respectively. Data source: CHARLS (2011).

[a] The interactions include the interaction between child-level and village-level covariates, and the interaction between parent-level and village-level covariates.

[b] The observation is 10,545 due to missing information on dependent variables *Visit* and *Visit frequency*.

Finally, for children whose parents don't receive land titling, the implementation of the new rural pension scheme significantly and positively affects pecuniary transfers, diverging from the crowding-out effects of pension schemes on intergenerational transfers observed in previous studies (Cox et al., 2004; Juarez, 2009; Nikolov and Adelman, 2019). This offers suggestive evidence supporting the exchange motive. However, for children whose parents receive land titling, the new rural pension scheme has no significant effect on pecuniary transfers, except for the probability of providing pecuniary transfers. This may be attributed to the stabilization of land property rights, which incentivizes children to provide pecuniary transfers in exchange for land inheritance, thus mitigating the impact of social insurance.

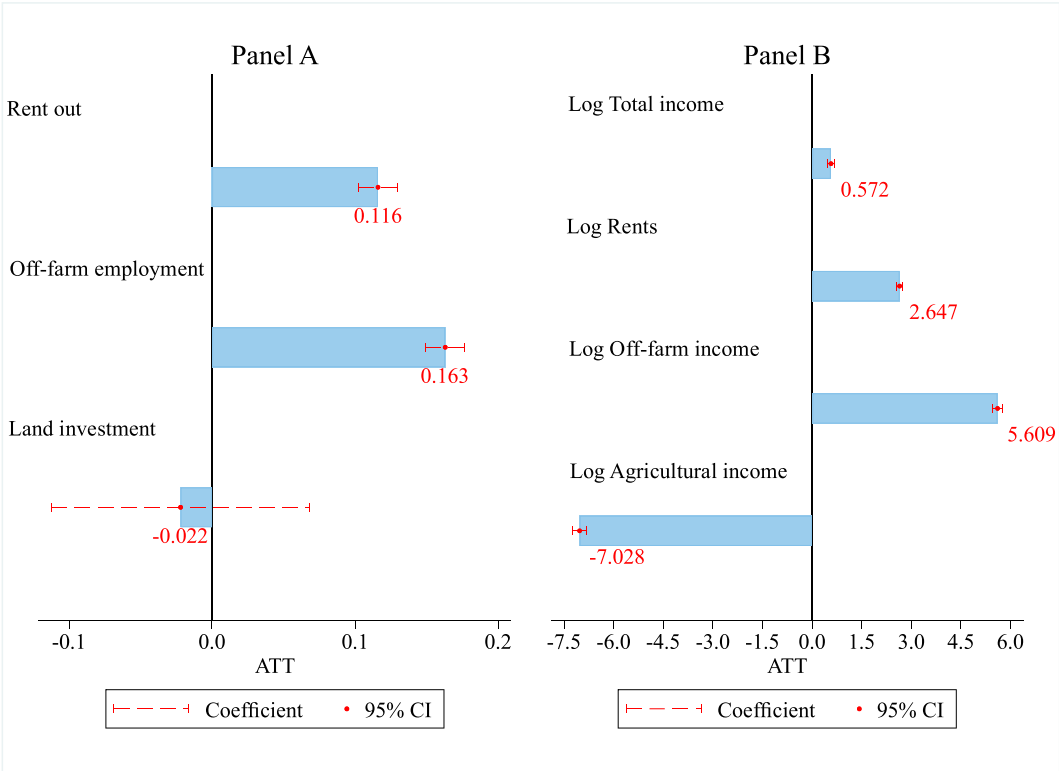

Fig. 3. Mechanism analysis.
Note: This figure shows the effects of land titling on mechanism variables for parents or villages with land titling, based on the estimation results of the endogenous switching probit (ESP) model (panel A) and the endogenous switching regression (ESR) model (panel B). Definitions of mechanism variables are presented in Table A7. Mechanism variables in panel A include the probability of renting the land out at the parent level (*Rent out*), engaging in off-farm employment at the parent level (*Off-farm employment*), and implementing land investment at the village level (*Land investment*). Mechanism variables in panel B include the log form of parents' total income (*Log Total income*), rental income (*Log Rents*), off-farm income (*Log Off-farm income*), and agricultural income (*Log Agricultural income*).

Panel A of Fig. 2 shows the treatment effects of land titling on pecuniary transfers based on the estimation results of Table 3. For children whose parents receive land titling, land titling has significantly increased their probability of providing pecuniary transfers for their parents by 3.84 % (0.017), and increased their total pecuniary transfers by 29.336 yuan (equals $4.547 in 2011).[25] The results of ATT also indicate that for children whose parents receive land titling, land titling has significantly changed their pecuniary transfer structure, increasing monetary transfers while decreasing in-kind transfers. This may be attributed to the substitution between monetary transfers and in-kind transfers. In addition, the estimates for the average treatment effect on the untreated (ATU) are presented in panel A of Table A6, which further indicates that land titling would also significantly affect pecuniary transfers for children whose parents don't receive land titling. Overall, the empirical results support the prediction of the exchange motive proposed by Cox (1987).

5.1.2. Baseline empirical results: time transfers

This study employs the ESP model to estimate the impacts of land titling on the probability of visiting parents, and the ESR model to estimate the impacts of land titling on the frequency of visiting parents. Table 4 reports the estimates of the ESP model (columns 1–3) and the ESR model (columns 4–6) estimated by the full-information maximum likelihood (FIML) with clustered standard errors at the village level. Specifically, columns 1 and 4 present the estimates of the selection Eq. (13), columns 2–3 present the estimates of outcome Eqs. (14a) and (14b), and columns 5–6 present the estimates of outcome Eqs. (15a) and (15b).

[25] For children whose parents receive land titling, the probability of providing pecuniary transfers is 0.46 while it decreases to 0.443 if those children were in the counterfactual group where their parents had not received land titling. The magnitude of ATT for *Pecuniary transfers* is (0.46-0.443)/0.443=3.84 %. For children whose parents receive land titling, the mean value of total pecuniary transfers (log) is 2.947 while the value decreases to 2.834 if those children were in the counterfactual group where their parents had not received land titling. The magnitude of ATT for *Total Pecuniary transfers* is (2.947-2.834)/2.834=3.99 %. Given that the average value of total pecuniary transfers for children whose parents receive land titling is 735.233 yuan, we can infer that land titling has increased their total pecuniary transfers by 735.233*3.99 %=29.334 yuan.

The estimated ρ in column 2 is significantly positive, indicating the selection bias: children who are less likely to visit parents have a higher probability of having parents living in villages with land titling. However, the estimated ρ in columns 4–5 are insignificant, implying that the selection bias is not serious. The results of the Wald test of independent equations in columns 2–3 suggest that the selection equation and outcome equations are not independent for the dependent variable of *Visit*. In this case, the simultaneous regression is superior to separate regressions. However, the results of the Wald test of independent equations in columns 4–5 suggest that the selection equation and outcome equations are independent for the dependent variable of *Visit frequency*; thus, the simultaneous regression is not superior to separate regressions in this case.

Similarly, the estimated coefficients for the selection equation show that the IV (i.e., *land reallocation*) has significantly negative effects on land titling, and the villages with the new rural pension scheme are less likely to implement land titling.

The estimated outcome equation reveals heterogeneous effects of factors on time transfers between children whose parents receive land titling and those whose parents don't. Notably, for children whose parents receive land titling, those with siblings exhibit a significantly higher probability and frequency of visiting their parents compared to those without siblings. This finding appears consistent with the idea that pecuniary transfers and time transfers are partially substitutable above. Conversely, for children whose parents don't receive land titling, those with siblings demonstrate a lower probability and frequency of visiting their parents than those without siblings. This interesting finding can be attributed to the fact that more siblings may fulfill parental caregiving demands and consequently alleviate the burden of care provision for each child.

Panel B of Fig. 2 shows the treatment effects of land titling on time transfers based on the estimation results of Table 4. The estimated ATT illustrates that for children whose parents receive land titling, land titling has significantly reduced their time transfers with respect to both the probability and frequency of visiting their parents. ATT in terms of visiting probability reveals that for children whose parents receive land titling, land titling has decreased their probability of visiting parents by 6.85 % (0.07).[26] The estimates for ATU are presented in panel B of Table A6, indicating that land titling would also significantly affect time transfers for children whose parents don't receive land titling.

5.2. Mechanism analysis

This part further explores the possible channels through which land titling affects intergenerational transfers. According to the theoretical model, parental income determines adult children's intergenerational transfers, while parental income may be affected by land titling. We propose that land titling may affect parental income through the following channels. First, by providing more secure property rights, land titling encourages ageing peasants to rent out their land, resulting in higher rental income (Deininger and Jin, 2008; Holden et al., 2011; Bu and Liao, 2022; Xu and Du, 2022; Liu et al., 2023). Second, land titling motivates peasants to seek off-farm employment opportunities, leading to higher income (Field, 2007; Do and Iyer, 2008; Bu and Liao, 2022; Wen et al., 2023). Third, land titling incentivizes peasants to increase their investment in land, thereby enhancing agricultural productivity and increasing agricultural income (Holden et al., 2009; Wen et al., 2023; Subramanian and Kumar, 2024).

The potential mechanism variables include the parental total income (*Total income*) which is the aggregation of rental income, off-farm income, and agricultural income, whether the parent rents out land (*Rent out*), the parental rental income (*Rents*), whether the parent engages in off-farm employment (*Off-farm employment*), the parental off-farm income (*Off-farm income*), parental agricultural income (*Agricultural income*), and whether the village implemented land investment after land titling (*Land investment*). The specific definitions and descriptive statistics of these variables are presented in Table A7.

Fig. 3 presents the treatment effects of land titling on these mechanism variables based on the estimation results of ESP and ESR models. Panel A shows that for parents who receive land titling, land titling has increased their probability of renting out land by 483 % (0.116) and the probability of off-farm employment by 362 % (0.163). For villages that have land titling, however, land titling can insignificantly decrease the probability of land investment by 14.1 % (0.022).[27] Panel B shows that for parents who receive land titling, land titling has significantly increased their rental income and off-farm income, but reduced their agricultural income. This suggests a substitution effect among renting out land, off-farm employment, and agricultural production. After taking into account the combined effects, the effect of land titling on total income is still significantly positive.[28] Hence, the mechanism analysis suggests that land titling can result in higher parental income mainly by incentivizing parents to participate in the rental markets and off-farm employment, and then earn higher rental income and off-farm income, thereby influencing intergenerational transfers.

[26] For children whose parents receive land titling, the probability of visiting parents is 0.925 while it increases to 0.993 if those children were in the counterfactual group where their parents had not received land titling. The magnitude of ATT for *Visit* is (0.925-0.993)/0.993=−6.85 %.

[27] For parents who receive land titling, the probability of renting their land out is 0.14 while it decreases to 0.024 if those parents were in the counterfactual group where they had not received land titling. The magnitude of ATT for *Rent out* is (0.14-0.024)/0.024=483 %. For parents who receive land titling, the probability of participating in off-farm employment is 0.208 while it decreases to 0.045 if those parents were in the counterfactual group where they had not received land titling. The magnitude of ATT for *Off-farm employment* is (0.208-0.045)/0.045=362 %. For villages that implement land titling, the probability of implementing land investment is 0.128 while it increases to 0.149 if those villages were in the counterfactual group where they had not implemented land titling.The magnitude of ATT for *Land investment* is (0.128-0.149)/0.024=−14.1 %.

[28] We estimate the effects of land titling on the value of total income as follows. First, for parents whose households have land titling, the mean value of total income (log) is 6.124 while it decreases to 5.552 if those parents were in the counterfactual group where their households do not have land titling. The magnitude of ATT is (6.124-5.552)/5.552=10.30 %. Second, given that the mean value of the total income of parents whose households have land titling is 6954.764 yuan, we can infer that land titling has increased their total income by 6954.764*10.30 %=716.34 yuan (equals $111.032 in 2011).

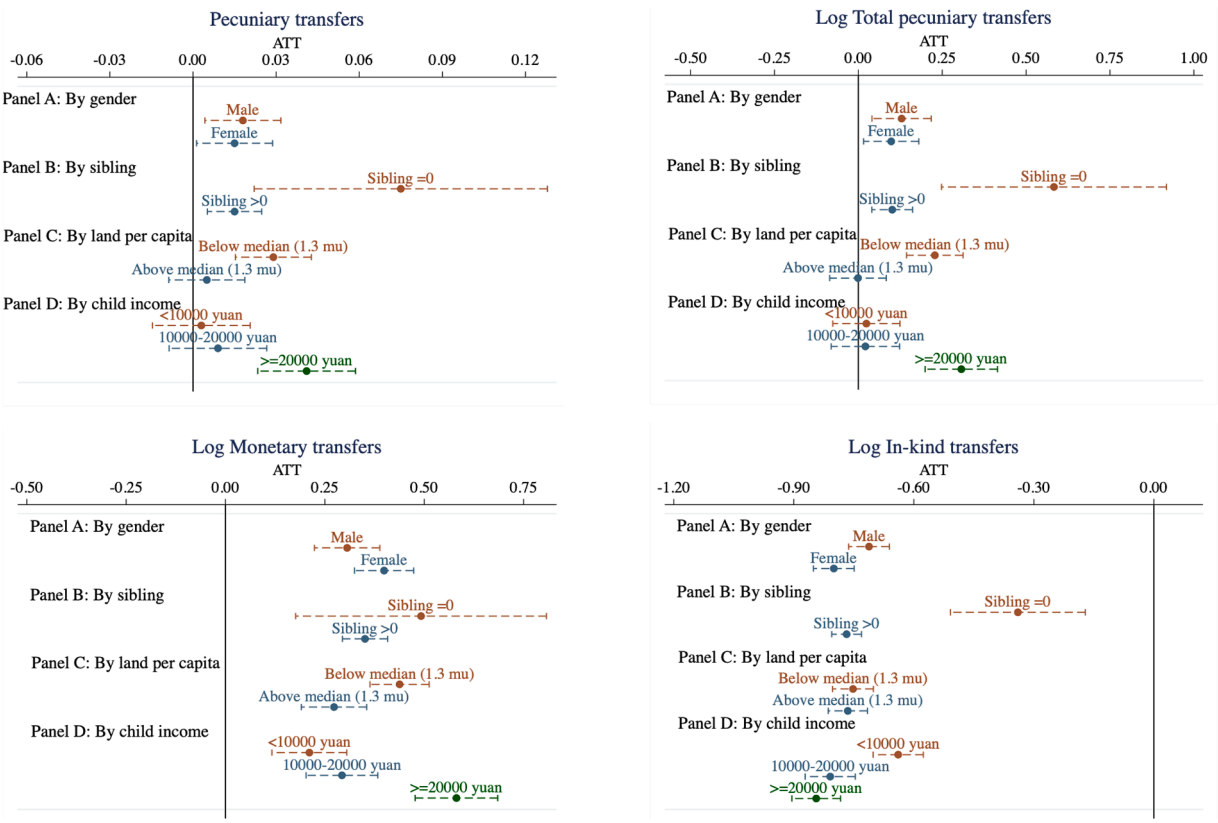

Fig. 4. Heterogeneity analysis: Pecuniary transfers.
Note: The points represent the estimated ATT, and the capped spikes represent the 95 % confidence intervals. 1 yuan = 0.155 dollars (2011). 1 mu=0.067 hectare.

5.3. *Heterogeneity analysis*

To gain a deeper understanding of the impacts of land titling on intergenerational transfers across various groups of children, we conduct a series of heterogeneous analyses. Accordingly, Figs. 4-5 respectively present the heterogeneous ATTs of land titling on pecuniary transfers and time transfers among various groups.

First, we explore the divergent responses of sons and daughters to the land titling of their parents. In traditional Chinese families, patriarchal norms often prioritize sons in inheriting family properties over daughters. The gender inequality in inheritance may intensify daughters' exchange motive, resulting in the fact that sons exhibit characteristics of pure altruism, while daughters lean towards strategic altruism (Hu, 2017). However, the empirical results show that for both sons and daughters whose parents receive land titling, land titling has increased their probability of providing pecuniary transfers and value of total pecuniary transfers, while the gender difference is not significant.[29] This finding provides evidence that both sons and daughters lean towards exchange motives. As for the time transfers, it is interesting that sons tend to provide more time transfers than daughters. This may be attributed to the patriarchal filial piety that requires sons to provide more support for their parents.

Second, we investigate the heterogeneous effects of land titling on intergenerational transfers between children with and without siblings. Children with siblings tend to provide less pecuniary transfers significantly. This may be attributed to that siblings could help release each child's financial burden of supporting the elderly. As for the time transfers, there is no heterogeneity between children with and without siblings.

Third, we detect the possible heterogeneity in the effects of land titling on intergenerational transfers based on land areas. We divide the sample into two groups by the median of the parental household land per capita (1.3 mu).[30] Children from parental households with less land per capita tend to provide more pecuniary transfers for the parents and be less likely to visit parents. This response may be attributed to the scarcity of land resources within these households, which could intensify children's exchange motives, holding other variables constant.

[29] The heterogeneity analysis also reveals that sons tend to provide more in-kind transfers while daughters tend to provide more monetary transfers.
[30] 1 mu=0.067 hectare.

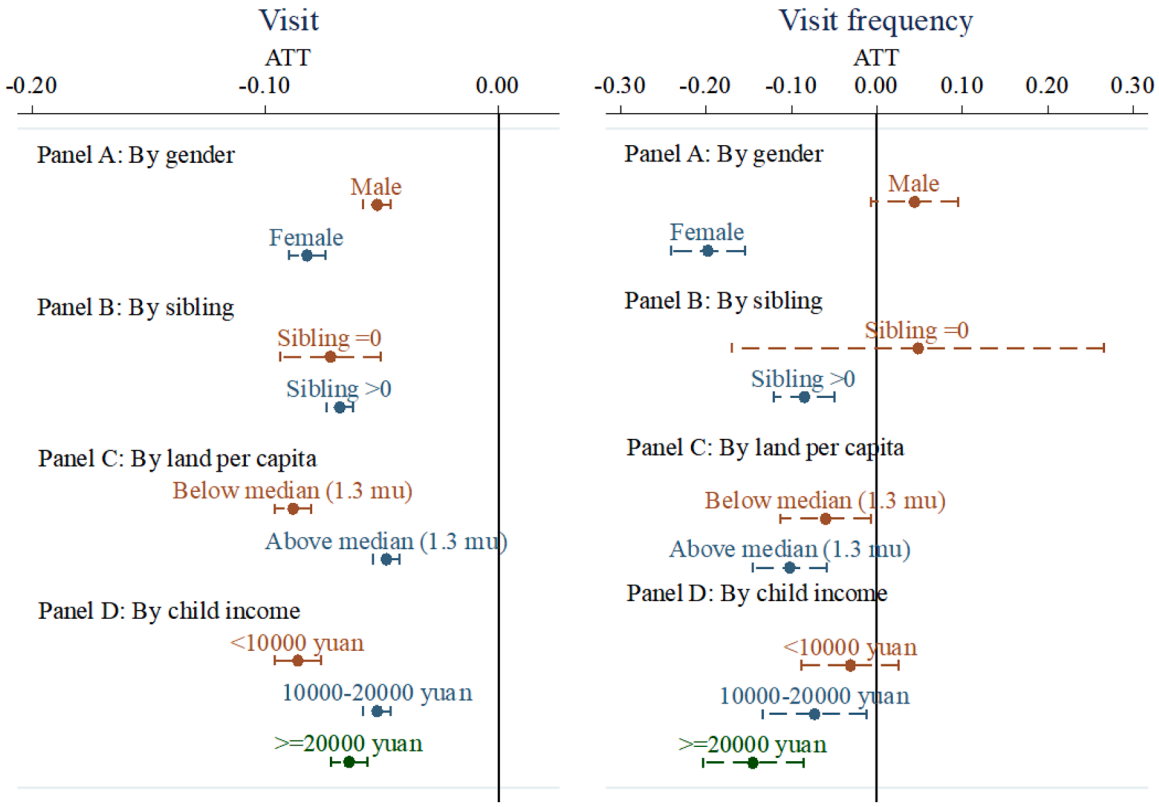

Fig. 5. Heterogeneity analysis: Time transfers
Note: The points represent the estimated ATT, and the capped spikes represent the 95 % confidence intervals. 1 yuan = 0.155 dollars (2011). 1 mu=0.067 hectare.

Finally, considering that children's income serves as the foundation for providing pecuniary transfers, we partition the sample into three groups: children with annual income lower than 10,000 yuan, children with annual income between 10,000 yuan and 20,000 yuan, and children with annual income higher than 20,000 yuan. We find that compared with the other two groups, children with income higher than 20,000 yuan tend to provide more pecuniary transfers and fewer time transfers in terms of visit frequency.

6. Conclusions

This research investigates the motives behind intergenerational transfers from children to parents in the context of the land titling program in rural China. The endogenous switching model is employed to alleviate the potential endogeneity problem arising from selection bias. The estimated ATTs indicate that for children whose parents receive land titling, land titling has significantly increased their pecuniary transfers while decreasing their time transfers. Mechanism analysis reveals one potential pathway: the land titling program results in higher parental income by incentivizing parents to rent out their land and engage in off-farm employment. This is consistent with the exchange motive. Heterogeneity analysis further reveals that both sons and daughters lean towards exchange motives and the effects of land titling on intergenerational transfer are pronounced among children without siblings, those from parental households with lower land per capita, and those with higher income.

The findings have important implications for policy design, especially in light of global population ageing trends and widespread land titling practices in many developing countries. First, there's an imperative for institutional enhancements to clarify and stabilize property rights. Beyond addressing land misallocation in agricultural production, land titling programs can help increase peasants' income including property-based and off-farm income, potentially stimulating pecuniary transfers from children and alleviating strains on public resources. Second, governments should extend additional support, such as various assistance programs and pension schemes, for elderly individuals who lack sufficient assets for sustainable livelihoods. Finally, it is essential to acknowledge that while land titling may reduce time transfers, it could also have adverse effects on the mental health of the elderly. This aspect warrants consideration when governments contemplate land titling as a policy tool to influence transfers from children to parents.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. There's no financial/personal interest or belief that could affect their objectivity.

All authors have approved the final version of the manuscript being submitted. This paper is the authors' original work, and it hasn't received prior publication and isn't under consideration for publication elsewhere.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2024.07.015.

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