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Why Rural Residents Do Not Migrate: The Hidden Welfare Costs of Rural-Urban Migration

Kaixing Huang Hao Hou Xianling Long *

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Abstract

A persistent puzzle in developing economies is why rural households remain in low-productivity agricultural sectors despite the substantial income gaps with non-agricultural opportunities. While existing studies attribute this gap to market frictions, institutional barriers, and differences in human capital, this paper shifts the focus to household-level welfare trade-offs, specifically, the non-pecuniary welfare losses borne by family members left behind when working-age individuals migrate. We develop a theoretical framework to show how such hidden costs affect labor reallocation and how they can be quantified empirically. Leveraging China's Grain for Green (GFG) Program–a nationwide conservation policy that induced farmland retirement in exchange for subsidies, we show that the policy led to significant increases in migration and non-agricultural labor, especially among women and younger individuals. Using revealed preference logic, we estimate that hidden migration costs amount to 10.5–12.6% of total household income for policy-induced migrants. Drawing on rich survey data, we trace these costs to two key sources: disruptions to children's education and reduced caregiving capacity for elderly household members. These findings highlight the need for policies that ease the burden of migrating with dependents, such as removing restrictions on education and healthcare access in destination areas.

Keywords: Rural-urban migration, Hidden migration cost, Grain for Green Program

JEL Codes: I31, O13, R14, R23.

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1 Introduction

Across the developing world, the transition of labor from agriculture to more productive non-agricultural sectors has been central to economic growth and poverty reduction. Yet in many rural areas, this transformation remains incomplete. Even as urban wages continue to outpace agricultural returns, rural households often persist in farming, raising important questions about the barriers that slow or distort labor reallocation (Gollin et al., 2002; Caselli, 2005; Restuccia et al., 2008; Restuccia and Rogerson, 2017). Understanding why rural residents stay in agriculture, despite seemingly strong incentives to leave, is critical for designing effective development policies.

Recent literature has explored the barriers to rural-urban migration and largely attributes persistent under-migration to a range of market frictions (Gollin et al., 2014; Adamopoulos and Restuccia, 2014; Chen, 2017; Gottlieb and Grobovšek, 2019; Adamopoulos et al., 2022). These include liquidity constraints, limited information, weak social networks, and uncertainty about job security or housing conditions in cities. Our paper shifts the focus from individual frictions to household-level welfare trade-offs. Specifically, we examine the role of hidden welfare losses experienced by family members left behind.

We begin with a conceptual model that illustrates the barriers that prevent rural individuals from migrating despite substantial urban-rural income gaps. The model incorporates both pecuniary and non-pecuniary components of utility. In the model, individuals choose between remaining in agriculture or reallocating labor to urban non-agricultural work. While urban wages are exogenously higher, migration reduces non-monetary welfare due to costs such as loss of family caregiving, children's education, and health risks associated with family separation. These hidden costs, which are modeled as reductions in non-pecuniary welfare, help explain why many rural residents opt to stay, even when migration appears financially advantageous.

Importantly, China's Grain for Green (GFG) policy provides an ideal setting for identifying these hidden migration costs. Launched in early 2000s and gradually scaled up nationwide, the program allowed rural households to retire cultivated land and convert it to forest in exchange for direct compensation. By 2014, the first round of the program had involved 124 million farmers across 25 provinces. By reducing the marginal return to agricultural labor while holding agricultural income (including subsidies) approximately constant, the policy creates an exogenous shift in labor incentives without introducing confounding income shocks. Therefore, this design isolates the role of non-monetary migration barriers in shaping labor decisions. In the conceptual model, we derive lower and upper bounds on the magnitude of hidden costs, based on the revealed preference logic. These theoretical insights inform our empirical analysis and help interpret rural labor responses and welfare outcomes throughout the paper.

We then empirically examine the impacts of the GFG policy. The analysis draws on the panel data from the National Fixed Point Survey, which tracks detailed household and individual demographics and outcomes across rural China. The dataset covers 335 villages between 2003 and 2014 and includes rich information on labor allocation, income, education, health and household composition. Crucially, the data record the timing of enrollment in the GFG program, which allows us to exploit the staggered roll-out of the policy for identification. To address potential endogeneity in household-level participation, we use the village-level enrollment as the treatment indicator. We employ the event study method to estimate the dynamic effects of the program.

Our first result shows that the GFG policy significantly altered households' land use patterns. There is a marked increase in the reforestation area at the household level. Correspondingly, agricultural planted area declined by 11.8%, which confirms that the program effectively shifted land away from cultivation to ecological restoration. The sharp increase in reforestation combined with flat pre-treatment trends also validates our use of village-level policy adoption as a proxy for household treatment status.

As the marginal return to agricultural labor declines due to land input reduction, rural residents respond by migrating. We document that individuals became significantly more likely to shift into non-agricultural work and to seek employment outside their home county or province. These changes reflect a substantial reallocation of labor in response to the policy shock. We also find pronounced gender differences in these responses: women exhibited a larger increase than men in both the likelihood of engaging in non-agricultural work and the number of days worked in non-agricultural sectors. They were also more likely to migrate longer distances, including across provincial boundaries. These patterns suggest that women, who may face a greater decline in the returns to agricultural labor and stronger incentives from urban labor markets or marriage prospects, were especially responsive to the shock of land retirement. In addition to the gender difference, we also find that migration responses vary across other individual and household characteristics. Younger individuals, those with higher education levels, and those with prior non-agricultural work experience were significantly more likely to migrate, consistent with lower entry barriers and stronger expected returns in the urban labor market. Moreover, households located closer to urban centers responded more strongly, likely due to reduced migration costs and easier access to non-farm opportunities.

We next focus on the changes in income and consumption. We find that net household income rose steadily following the policy implementation, driven primarily by growth in non-agricultural earnings, which is consistent with the observed migration response. In contrast, agricultural income, including the reforestation subsidy, remained flat, suggesting that the subsidy effectively offset the income loss from land retirement but did not generate additional gains. This confirms the income-neutral feature of the policy and that net income improvements were the result of labor reallocation rather than direct financial transfers.

In line with rising income, we observe a significant increase in total household consumption following the policy. This increase is concentrated in categories such as housing, insurance, and transportation, which indicates that households used their additional income to cover migration-related costs and invest in urban adjustment. However, spending on health and education remained largely unchanged. This muted response likely reflects the offsetting effects of increased income and reduced household involvement due to family separation.

Lastly, we provide evidence on the hidden costs of migration. Our analysis considers two dimensions: education and health. Children in households affected by the policy were more likely to become left behind and experienced a decline in educational attainment. At the same time, elderly household members faced worsening health outcomes and increased rates of attrition from the sample, likely reflecting reduced support after the departure of working-age adults. Based on the conceptual model and empirical evidence, we recover that the hidden costs of migration are equivalent to approximately 10.5–12.6% of total household income for rural individuals that did not migrate prior to the policy but chose to migrated afterward.

This paper makes several contributions. First, it is related to the expanding literature on the persistent income gap between rural and urban sectors in developing countries.[1] A prominent line of research attributes this gap to institutional distortions or policy-driven misallocations that are especially severe in agriculture. These distortions reduce the efficiency of land, labor, and capital markets, preventing resources from flowing to their most productive uses (Adamopoulos and Restuccia, 2014; Chen, 2017; Gottlieb and Grobovšek, 2019; Adamopoulos and Restuccia, 2020; Adamopoulos et al., 2022). However, market frictions alone cannot fully explain the observed persistent concentration of rural labor in low-productivity sectors. Another strand of research highlights barriers beyond formal institutions and policies that also deter rural households from migrating, including limited social networks in destination areas (Munshi, 2003; Beaman, 2012), attachment to home environments (Banerjee and Duflo, 2007; Banerjee et al., 2018), and risk aversion under uncertainty (Shrestha, 2020). Our paper contributes to the literature by shifting the focus to household-level welfare trade-offs and documenting the role of non-monetary losses borne by family members left behind. Moreover, these hidden costs may be reinforced by institutional features like China's household registration system, which limits migrants' access to public services in urban areas.

Second, this paper contributes to the literature on land conservation. In recent decades, governments and international agencies have implemented large-scale conservation programs aimed at reducing land degradation and promoting environmental restoration (Howlader, 2024). Much of the existing research has focused on the environmental benefits of these policies (Fu et al., 2019; Howlader, 2024; Rosenberg and Pratt, 2024) or their effects on household income and livelihoods (Uchida et al., 2009; Andam et al., 2010; Sims and Alix-Garcia, 2017; Howlader and Ando, 2020). Our work extends this literature by examining the broader implications for household labor allocation, migration, and welfare.

Third, this paper also connects to the literature on land expropriation and forced migration. Prior research has shown that land loss can significantly alter household behavior by affecting investment and savings decisions (Jacoby et al., 2002; Johnson et al., 2002), reshaping mobility patterns (Ma and Mu, 2020; Zhang

1. See Restuccia and Rogerson (2008); Hsieh and Klenow (2009); Restuccia and Rogerson (2017); Banerjee and Duflo (2019) for broader reviews of the literature.

and Song, 2022), influencing health outcomes Huang et al. (2024b), and eroding political trust (Sha, 2023). Exogenous shocks such as natural disasters have similarly been used to study land loss and its impact on income and education (Nakamura et al., 2022). War and conflict that displace people from their land have also been found to leave lasting effects on labor markets (Bauer et al., 2013; Sarvimäki et al., 2022). Unlike these studies, which typically treat the household as a unit of analysis, our paper highlights the consequences of household separation resulting from land retirement.

This paper proceeds as follows. Section 2 provides background on the rural-urban income gap and the Grain for Green policy. Section 3 develops the conceptual model. Section 4 describes the data and empirical strategy. Section 5 presents the empirical results. Section 6 concludes.

2 Background

2.1 Rural-urban Income Gap and Labor Allocation

Despite the substantial and widening income gap between agricultural and non-agricultural sectors in China, labor allocation patterns remain surprisingly sticky. As shown in Figure 1 Panel A, the per capita value added in non-agricultural sectors has consistently and significantly exceeded that in agriculture. In 2003, for example, non-agricultural value added per worker was already more than five times that of agriculture. Yet, as Panel B illustrates, rural households in that same year still allocated nearly half of their labor time to agricultural work.

While there is a gradual shift toward non-agricultural employment over time, the pace of structural transformation has been slow. By 2014, about 40% of rural labor time was still devoted to agriculture, even though the gap in value added between sectors had further widened. This persistent misalignment suggests that factors beyond income shape labor allocation decisions.

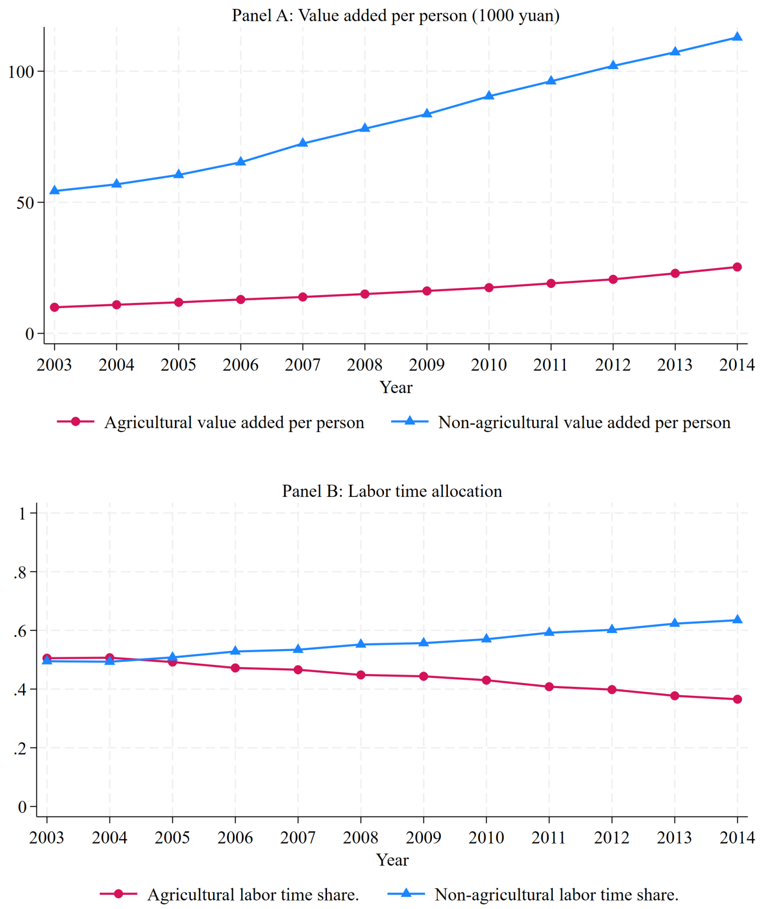

FIGURE 1 Income Gap and Labor Allocation across Sectors in China

Notes: This figure illustrates trends in income gap and labor allocation across sectors in China. Panel A shows annual per capita value added in the agricultural and non-agricultural sectors, using national-level data from the World Bank. Panel B reports the share of time rural individuals allocate to agricultural versus non-agricultural work, calculated based on data from the National Fixed Point Survey.

2.2 Grain for Green Programs in China

China launched one of the world's largest Grain for Green Programs in 1999. The program was initiated in response to severe flooding during the 1998 rainy season in the Yangtze, Pearl, and Songhua River basins, with the aim of curbing soil erosion. The program primarily targeted cropland with a slope of 25 degrees or more, but other croplands suffering from severe soil erosion or consistently low grain yields were also included. Although the government actively promoted the program, farmers retained the voluntary right to participate. The government monitored and evaluated whether the program had been implemented on the designated land for conversion.

Farmers owning these croplands were subsidized to reallocate all or part of their sloped land to plant grass or trees while retaining ownership of the converted land. Considering both the policy costs of the program and farmers' incentives, the central government mandates that subsidies must cover the resulting loss of agricultural income for farmers. The subsidies were provided in the form of in-kind grain allocations, cash payments, and free seedlings. For example, the subsidy standard is 2250 kilograms of grain per hectare annually for regions in the Yangtze River Basin and southern areas, and 1500 kilograms of grain per hectare annually for regions in the Yellow River Basin and northern areas, roughly equivalent to the grain output in these areas. The duration of subsidies varies: grassland restoration subsidies are for 2 years, economic forest subsidies are for 5 years, and ecological forest subsidies are for 8 years.

The program was carried out in two major rounds. The first round began in 1999 and lasted for 15 years, until 2014. During this period, 9.3 million hectares of farmland were retired and converted into forests or grasslands, 17.5 million hectares of barren mountains and lands were afforested, and 3.1 million hectares of hillsides were closed for afforestation. By 2014, the central government had invested 405.7 billion yuan in the first round of the program, involving 124 million farmers from 2422 counties in 25 provinces. In 2015, China launched a new round of the program with the aim of returning approximately 2.8 million hectares of sloped cropland and severely desertified cropland to forests and grasslands by 2020.[2] Given the more complex policy environment in the second round of the program and the lack of microdata, our empirical study focuses on the first round.[3]

The program was gradually rolled out across provinces, counties, and villages. At the provincial level, it was first launched in the three western provinces of Sichuan, Gansu, and Guizhou in 1999, expanded to include 13 provinces along the upper Yangtze and middle reaches of the Yellow River in 2000, and further extended to 25 provinces by 2002. Although the program swiftly covered most provinces, its actual implementation in villages within each province lagged significantly due to

2. Data are derived from *China's Grain for Green Program: Twenty Years (1999-2019).*

3. The land titling reform rolled out across China from 2009 to 2019, which is very later than the GFG policy, so it did not confound the GFG policy impacts.

high execution costs and complex procedures, with substantial variations observed across regions. This roll out of the program across counties and villages will be detailed in the next section.

3 Conceptual Framework

3.1 Utility

We develop a representative household model to guide the empirical identification of the hidden costs of rural-urban migration in a developing economy. The household maximizes utility defined over consumption (C) and non-monetary welfare (H), with an initial land endowment $L_0 > 0$ and labor endowment normalized to unity. The utility function takes the form:

$$U(C, H) = u(C) + \phi(H), \tag{1}$$

where $u(C)$ represents utility from consumption, and $\phi(H)$ captures utility from non-pecuniary components of household welfare. The function $u(\cdot)$ is strictly increasing and concave ($u' > 0$, $u'' < 0$), reflecting diminishing marginal utility of consumption. The function $\phi(\cdot)$ is also increasing and concave ($\phi' > 0$, $\phi'' \leq 0$), representing diminishing marginal returns to non-monetary household welfare.

3.2 Production

The household can engage in agricultural production using land (L) and agricultural labor (N_a), with a Cobb-Douglas production function $Y_a = AL^{\alpha}N_a^{1-\alpha}$, where $\alpha \in (0, 1)$ denotes the elasticity of output with respect to land, and A denotes agricultural productivity. Alternatively, labor can be allocated to urban wage employment (N_m), which earns an exogenously given wage w_m. Labor allocation satisfies $N_a + N_m = 1$. Land markets are imperfect, so land can only be used in agriculture. This specification captures the fundamental dual-sector production facing rural households.

3.3 Hidden Costs of Migration

Migration decisions affect non-monetary welfare through the function:

$$H = \begin{cases} \bar{H} & \text{when } N_m = 0 \\ \bar{H} - c & \text{when } N_m = 1 \end{cases}, \tag{2}$$

where $\bar{H}$ denotes baseline welfare in the absence of migration, and $c > 0$ represents the hidden cost of migration. The cost c captures a range of non-monetary welfare losses associated with migration, including reduced educational quality for children, diminished caregiving for family members and related health risks, the loss of social support networks, and psychological costs of displacement. These costs are incurred when labor is reallocated to urban employment, i.e., when $N_m = 1$. The migration choice is modeled as binary, $N_m = 0$ (no migration) or $N_m = 1$ (full migration).

3.4 Policy Shock: Grain for Green

We introduce an exogenous policy intervention with two components: land reduction and monetary compensation. The Grain for Green policy retires a portion ΔL of land ($0 \leq \Delta L \leq L_0$), leaving the household with $L = L_0 - \Delta L$. To offset the income loss, the policy provides compensation (T):

$$T = A \cdot (L_0^\alpha - (L_0 - \Delta L)^\alpha), \tag{3}$$

which is designed to exactly offsets the agricultural income loss under pre-policy labor allocation. This compensation design makes the policy income-neutral for agricultural workers but creates labor surplus by reducing the marginal product of agricultural labor. The policy thus provides exogenous variation that induces migration without income effects.

3.5 Household Optimization

The household chooses whether or not to migrate by solving:

$$\max_{N_m \in \{0,1\}} U(C, H) \quad \text{subject to} \quad C = Y_a + w_m N_m + T, \tag{4}$$

3.5.1 Pre-Policy Equilibrium

Before the policy implementation ($T = 0$, $L = L_0$), utility without migration is:

$$U_0^{\text{stay}} = u(AL_0^\alpha) + \phi(\bar{H}), \tag{5}$$

while utility with migration is:

$$U_0^{\text{mig}} = u(w_m) + \phi(\bar{H} - c). \tag{6}$$

The household remains in rural if $U_0^{\text{stay}} \geq U_0^{\text{mig}}$, implying:

$$u(AL_0^\alpha) - u(w_m) \geq \phi(\bar{H} - c) - \phi(\bar{H}). \tag{7}$$

The right-hand side is negative since $c > 0$ and ϕ is increasing, while the left may be negative when $w_m > AL_0^\alpha$. Persistent rural residence despite urban wage premiums suggests substantial hidden costs c.

3.5.2 Post-Policy Equilibrium

After the policy, utility without migration becomes:

$$\begin{aligned} U_1^{\text{stay}} &= u(A(L_0 - \Delta L)^\alpha + T) + \phi(\bar{H}) \\ &= u(AL_0^\alpha) + \phi(\bar{H}), \end{aligned} \tag{8}$$

since T exactly compensates agricultural income loss. Utility with migration is:

$$U_1^{\text{mig}} = u(w_m + T) + \phi(\bar{H} - c). \tag{9}$$

Migration occurs iff $U_1^{\text{mig}} \geq U_1^{\text{stay}}$, yielding:

$$u(w_m + T) - u(AL_0^\alpha) \geq \phi(\bar{H}) - \phi(\bar{H} - c). \tag{10}$$

3.6 Identification of Hidden Costs

Proposition 1. *(Lower Bound on Migration Costs) For individuals who did not migrate prior to policy, the hidden cost c satisfies:*

$$c \geq \frac{u(w_m) - u(AL_0^\alpha)}{\phi'(\bar{H} - c)}. \tag{11}$$

Proof. By the Mean Value Theorem, $\exists \tilde{H} \in (\bar{H} - c, \bar{H})$ such that:

$$\phi(\bar{H}) - \phi(\bar{H} - c) = \phi'(\tilde{H}) \cdot c. \tag{12}$$

Thus $\phi'(\tilde{H}) \cdot c \geq u(w_m) - u(AL_0^\alpha) \equiv \Delta u$. Since $\phi' > 0$ and $\phi'' \leq 0$, $\phi'(\tilde{H}) \leq \phi'(\bar{H} - c)$, we have:

$$c \geq \frac{\Delta u}{\phi'(\tilde{H})} \geq \frac{\Delta u}{\phi'(\bar{H} - c)}. \tag{13}$$

The exact bound follows from inverting $\phi(\bar{H}) - \phi(\bar{H} - c) \geq \Delta u$ via the inverse function theorem. □

Proposition 2. *(Upper Bound on Migration Costs) Similarly, for individuals who migrated after the policy, the hidden cost c satisfies:*

$$c \leq \frac{u(w_m + T) - u(AL_0^\alpha)}{\phi'(\bar{H})}. \tag{14}$$

3.7 Model Implications

The model yields three key predictions regarding the hidden costs of migration. First, migrants reveal lower hidden costs than non-migrants, other things equal. Second, non-migrants implicitly indicate that their hidden migration costs exceed the utility-equivalent value of income gains enjoyed by migrants. Third, the migration responses induced by the Grain for Green program among previously non-migrating rural households allow us to identify bounds on these hidden costs. Specifically, the utility gain from the urban-rural income gap without subsidies, defined as $\Delta u = u(w_m) - u(AL_0^\alpha)$, provides a lower bound on the hidden migration costs $\phi(\bar{H}) - \phi(\bar{H} - c)$. Meanwhile, the utility gain from the income gap with policy subsidies $\Delta u = u(w_m + T) - u(AL_0^\alpha)$ provides an upper bound.

The policy's dual design is crucial for identifying these hidden migration costs. The agricultural land retirement creates labor surplus that lowers the opportunity cost of migration, while monetary compensation eliminates the income effect. This combination isolates the role of hidden costs in migration decisions. The model further suggests that the persistence of rural residency even after such policies thus highlights substantial unobserved migration barriers beyond income considerations. Recognizing these hidden costs carries important implications for designing development policies aimed at promoting efficient labor reallocation and reducing rural-urban inequality.

4 Data and Method

4.1 Data

Our analysis relies on micro-level data from the National Fixed Point Survey (NFP), a panel survey conducted by the Research Center of Rural Economy in China. NFP villages were selected for national representativeness based on various factors such as region, income, cropping pattern, and population. Within each village, a random sample of households was selected, typically ranging from 50 to 100 households, depending on village size. If a sample household permanently relocated, it was replaced by a randomly selected new household within the same village, receiving a new household ID.[4] The NFP data contains more than 19 thousand households in each year from about 350 villages; a small number of sample villages disappeared during the urbanization process, while in certain years, additional sample villages were added. Figure 2 presents the counties where the sample villages are located. The NFP data, widely employed in the literature (Kinnan et al., 2018; Chari et al., 2021; Huang and You, 2025; Huang et al., 2024a), has been demonstrated to be of high quality (Benjamin et al., 2005).

4. The dataset constitutes an unbalanced panel, with 99.6% of the sample households having data for at least two years, and 91.2% having data for at least 5 years.

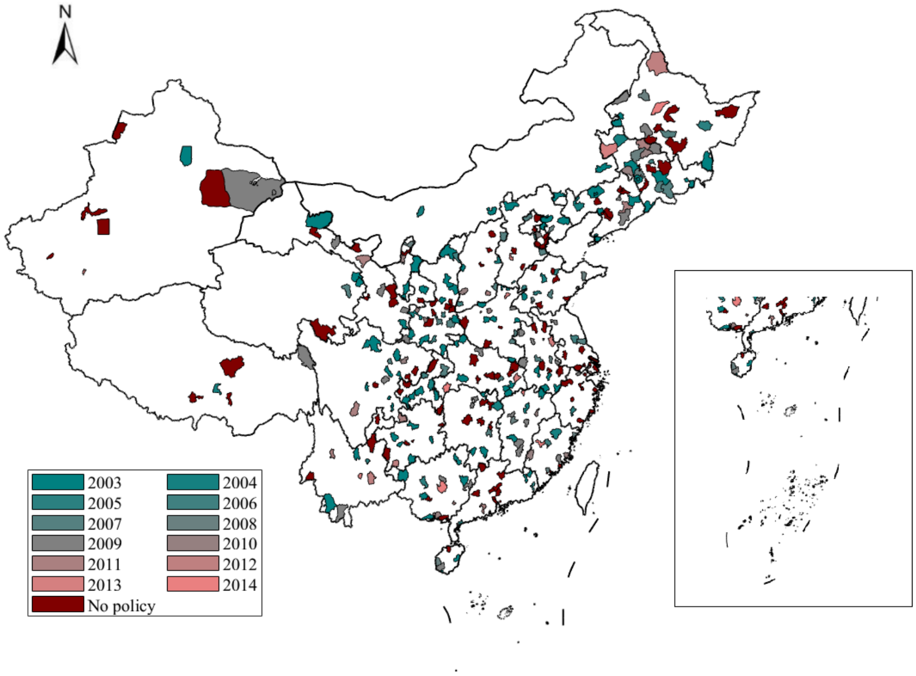

FIGURE 2 The Roll-out of the Grain for Green Program

Notes: This figure presents the geographic distribution of the NFP counties and the roll-out of the Grain for Green program across these counties. As each NFP county contains only one NFP village, the county-level year of the adoption of the Grain for Green program is defined by the village-level year of the program adoption.

We use data from annual waves of the survey from 2003 to 2014 for 335 villages. Waves before 2003 are excluded as individual level data on labor allocation and other variables of interest are not included in the survey before that. Data after 2014 are excluded to avoid the confounding effects of the second round of the Grain for Green program. The final sample used for our analysis includes 19,157 households in each year on average.

The NFP data are particularly well-suited for our analysis for three reasons. First, the dataset provides a large, nationally representative sample spanning the key years of the first round of the Grain for Green program, enabling us to uncover the long-run effect of the national program. Second, it offers rich panel data at both the individual and household levels, including information on labor allocation, income, education, marital status, health, and family composition, which are used to construct the key variables used in this study. Third, and most importantly, the dataset contains detailed information on the timing and extent of the Grain for Green enrollment at both the village and household levels (if enrolled), including the specific area of farmland retired. Table 1 presents the summary statistics for the key variables.

TABLE 1 Summary Statistics of Key Variables

Variable	N	Mean	SD
Panel A. Household-year level			
Reforestation area (mu)	229,983	0.05	0.67
Total net income[a] (Yuan)	229,983	28,532	31,334
Non-agricultural income (Yuan)	229,983	9,055	15,213
Agricultural income (Yuan)	229,983	7,450	12,108
Medical expenditure (Yuan)	229,983	918	3857
Consumption (Yuan)	229,983	18,072	26,885
Panel B. Individual-year level			
Age	816,326	37.74	20.19
Male	816,326	0.52	0.50
Health status[b]	816,326	3.25	1.04
Non-agricultural work days	816,326	91.89	129.51
Agricultural work days	816,326	55.16	91.35
Years of schooling	816,326	6.22	3.72
Work location[c]	816,326	0.52	1.05
Left-behind child[d]	135,262	0.10	0.29

Notes: All monetary values are expressed in constant 2010 yuan. The sample size for left-behind children is smaller due to missing values. [a] Agricultural and non-agricultural income do not sum to total net income, as the total net income also includes operational income that is not classified as either agricultural or non-agricultural in the survey. [b] Health status is a categorical variable defined as follows: 4 = excellent, 3 = good, 2 = moderate, 1 = poor, and 0 = unable to work. [c] Work location is an exclusive category variable, where 0 indicates work within the home villages, 1 indicates work within the home counties but outside home villages, 2 indicates work within the home province but outside home counties, 3 indicates work within the country but outside home provinces, and 4 indicates work out of country. [d] Left-behind child is a binary variable that takes the value of 1 when a child (under age 16) living in the home villages but none of his or her working age (20–60) family members working within home county.

Figure 3 presents the rollout of the Grain for Green program across the NFP villages. We find that 26.5% of villages had initiated the program before 2003, consistent with the timeline discussed in Section 2. The share of participating villages increased gradually over time, reaching 68.6% by 2014. In contrast, household-level participation remained relatively low, gradually rising from 4.84% in 2003 to 9.84% in 2014. This staggered rollout across villages provides plausibly exogenous variation that we leverage to evaluate the program's effects.

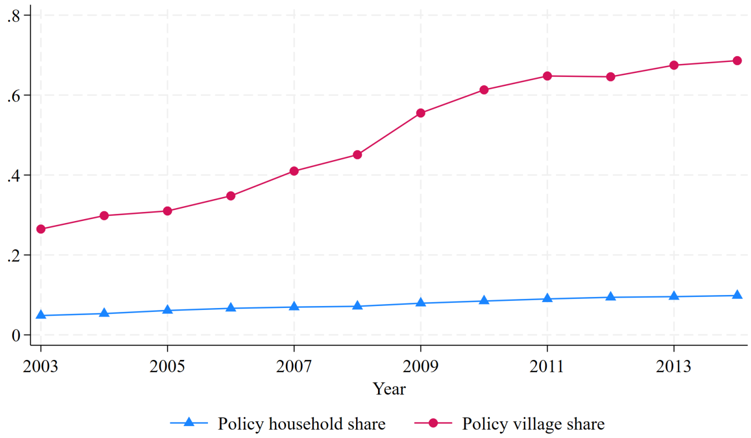

FIGURE 3 Enrollment Shares in the Grain for Green Program

Notes: This figure displays the share of villages and households enrolled in the Grain for Green program, calculated based on field survey data from NFP. The data before 2003 are not available.

4.2 Methods

We estimate the effects of the Grain for Green program using an event-study regression. The specification is as follows:

$$Y_{iv,t} = \sum_{k=-5,k\neq-1}^{11} \beta_k D_{v,t+k} + \theta_i + \theta_t + \epsilon_{iv,t} \tag{15}$$

where $Y_{iv,t}$ denotes the outcome variable for household i in village v and year t. The key outcome variables examined in this study include the area of farmland converted to forest, as well as measures of household income, welfare, labor allocation, and migration. The explanatory variables $D_{v,t+k}$ are event-time indicators equal to one if year t is k years from the policy adoption year in village v, and zero otherwise. We omit the indicator for $k = -1$ as the reference period.

The coefficients β_k for $k \geq 0$ capture the dynamic treatment effects in the years following the policy. The coefficients β_k for $k < 0$ serve as a test for pre-trends and provide evidence on the plausibility of the identification strategy. The post-treatment period spans up to 11 years, corresponding to the time between the earliest policy adoption in our sample (2003) and the final year of the sample (2014). To avoid sparse pre-treatment data, observations more than five years before treatment are excluded from the analysis.

The household fixed effects θ_i control for time-invariant household-specific characteristics, while year fixed effects θ_t are included to account for common shocks across all households in a given year. The $\epsilon_{iv,t}$ denotes the residual term. The standard errors are clustered at the village-by-year level to account for potential correlation within villages over time. In robustness test, we re-estimate the model with additional time-varying household controls, including the age and education of the household head and household size.

A key concern with voluntary participation is that households who choose to enroll in the program may differ systematically from those who do not, introducing potential selection bias. To address this, we define treatment at the village level rather than the household level, thereby avoiding concerns about endogenous household-level participation. This aggregation strategy allows us to identify an intention-to-treat (ITT) effect. The village-level policy year is defined as the calendar year in which the first resident of the village is recorded as participating in the Grain for Green program.

5 Results

This section presents our empirical findings. We begin by examining the impact of the Grain for Green Program on land use in Section 5.1. We then document rural households' migration responses to the policy in Section 5.2. Section 5.3 estimates the program's effects on household income and consumption. We then turn to the hidden costs of migration in Section 5.4, focusing on non-pecuniary welfare outcomes such as educational attainment and health status of family members. Section 5.5 explores heterogeneity in the program's effects across different subpopulations. Finally, we assess the robustness of our results through a series of checks in Section 5.6.

5.1 Impact on Land Use

We first examine changes in land use, which represent the most immediate and direct consequence of the Grain for Green Program. Panel A of Figure 4 shows a significant increase in household reforestation area following the implementation of the policy, with the effect reaching approximately 0.3 mu per household. This result indicates that households in treated villages responded to the program by reallocating land toward ecological uses. Importantly, the sharp increase beginning in the policy year and the flat pre-treatment trends support the validity of using village-level policy adoption as a proxy for household-level treatment, as household responses are tightly aligned with village-level program roll-out.

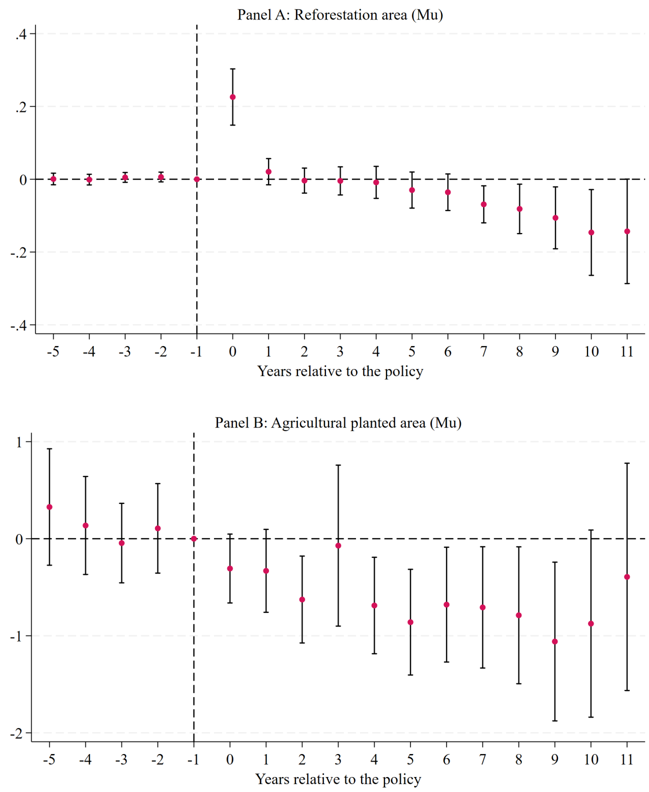

FIGURE 4 The Impacts on Land Use

Notes: This figure presents the effects of the GFG policy on household reforestation area and agricultural planted area. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Panel B displays a corresponding decline in agricultural planted area, consistent with land being retired from cultivation. On average, the reduction in agricultural planted area amounts to approximately 1.2 mu per household, representing about

11.8% of a household's pre-policy agricultural land area.[5] The persistence of these effects suggests that the program induced long-term shifts in land use, which, as we show in subsequent sections, carry lasting consequences for household income and welfare.

5.2 Migration Response

Having shown that the Grain for Green Program led to substantial land retirement, we next examine how rural households adjusted their labor allocation in response, with a particular focus on both sectoral and geographical labor reallocation. Panel A of Figure 5 shows that the policy increased the likelihood of individuals engaging in non-agricultural work, and Panel B demonstrates a corresponding rise in the number of non-agricultural work days. These results suggest that land retirement prompted rural households to reallocate labor away from agricultural activities toward non-agricultural employment.

Panels C and D further examine migration patterns and show that individuals were increasingly likely to seek employment outside their home county and province. The likelihood of working within the county declined after the policy, as did the likelihood of working within the same province. These results indicate that the shift toward non-agricultural work was accompanied by geographic labor mobility, with many rural residents migrating to distant locations–often across provincial boundaries–to access better-paying non-farm jobs.

The impacts of the Grain for Green policy on migration vary significantly by gender and age. Figure 6 illustrates that women experienced a substantially larger increase in both the probability of participating in non-agricultural work and the number of non-agricultural work days compared to men. Women also show a higher propensity to migrate beyond the county or even to other provinces. These results highlight that the Grain for Green program not only triggered a sectoral shift in rural labor supply, but also had important implications for gender roles in the household and local labor market participation.

5. The area of retired agricultural land exceeds the reported reforestation area, possibly because some households withdrew land from cultivation without fully converting it to forest, particularly in cases where program monitoring was weak.

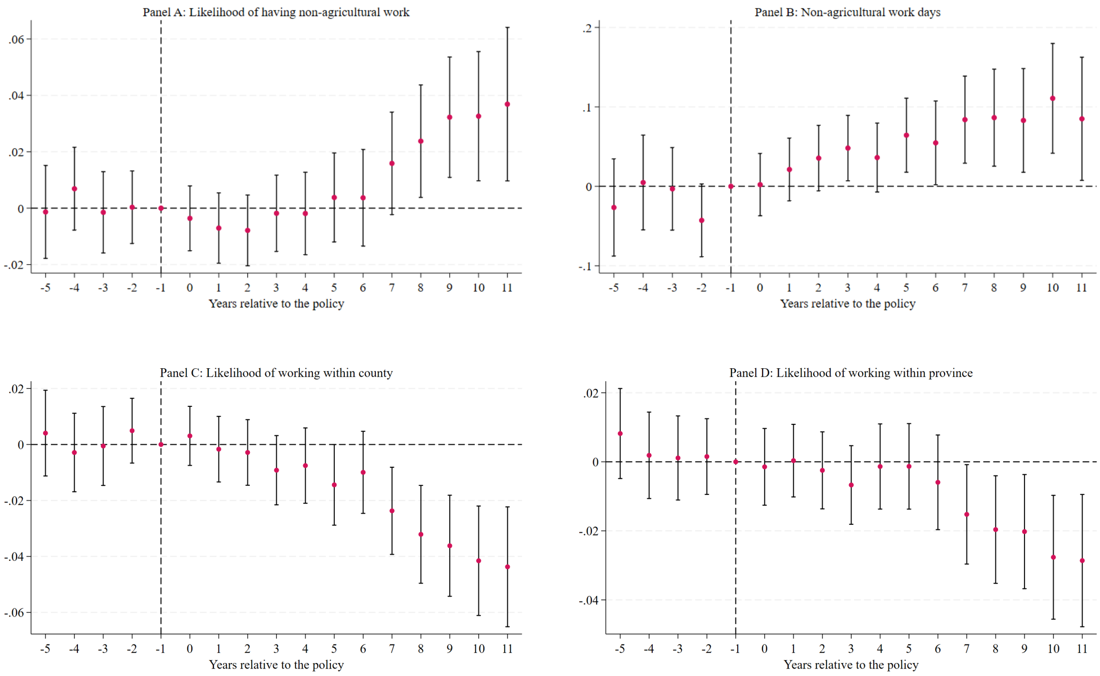

FIGURE 5 The Impacts on Migration

Notes: This figure presents the effects of the GFG policy on individual labor reallocation across sectors and geographic locations. In Panel A, the dependent variable is a binary indicator equal to 1 if the individual earns positive non-agricultural income. In Panel B, the dependent variable is number of non-agricultural (off-farm) work days and the estimates are based on pseudo-Poisson regression that captures the percentage changes in the dependent variable. In Panel C, the dependent variable is a binary indicate equal to 1 if the individual working within home county and 0 otherwise. In Panel D, the dependent variable is a binary indicate equal to 1 if the individual working within home province and 0 otherwise. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Several factors may explain this gender heterogeneity. First, prior to the policy, migration was already male-dominated: among households with at least one migrant before 2003, 65% of migrants were male and only 35% were female. This pre-policy pattern implies a larger productivity gap between agricultural and non-agricultural work for men relative to women. In terms of the model, men are more likely to migrate prior to the policy because their $u(w_m) - u(AL_0^\alpha)$ is larger. Accordingly, the smaller post-policy response among men reflects a lower marginal effect of the policy, as many men with strong non-agricultural potential had already exited agriculture. However, this explanation alone does not fully account for the observed gender differences. Even when we restrict the sample to households with no prior migration, women still show a stronger labor reallocation response than men (Panels E and F). One plausible explanation is that women have lower agricultural productivity, so when land is reduced due to reforestation, they are the first to exit agriculture in a merit-based household labor allocation. We provide supporting evidence in Section 5.5, where we show that households with lower agricultural productivity are more likely to migrate. Additionally, urban marriage markets may offer stronger incentives for women to relocate, further amplifying the gendered impact of the policy (Koh et al., 2025).

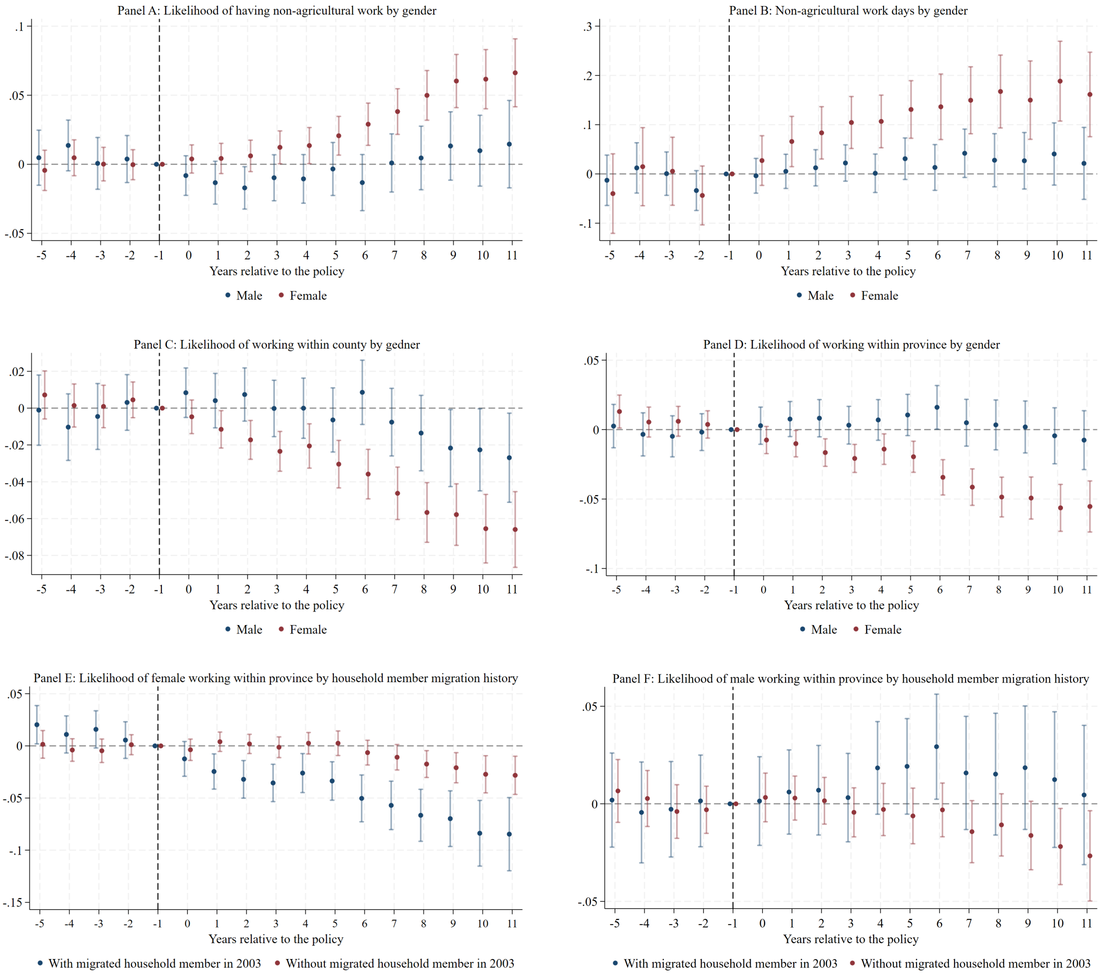

FIGURE 6 Migration Response by Gender

Notes: This figure presents the gender-specific effects of the GFG policy on labor reallocation across sectors and geographic locations. The dependent variables correspond to those in Figure 5: the likelihood of engaging in non-agricultural work (Panel A), number of non-agricultural work days (Panel B), and the likelihood of working within the same county (Panel C) or within the same province (Panel D). Panels E and F further examine heterogeneity by household migration history, showing the likelihood of working within the province separately for females (Panel E) and males (Panel F). The indicator for household migration history equals 1 if any household member had migrated beyond the county level as of 2003. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Figure 7 examines heterogeneity in migration among women by age group. The results show that younger women aged 18–45 are significantly more likely to shift into non-agricultural work and increase their non-agricultural work days following the policy, as seen in Panels A and B. Panels C and D further indicate that this group is also more likely to migrate, with a substantial decline in the likelihood of working within their home county or even within their home province. In contrast, older women those over age 45 exhibit smaller response in either labor reallocation or migration. These patterns suggest that younger people are more flexible and responsive to labor market opportunities created by the policy, likely due to higher mobility and stronger incentives to seek long-term income outside of agriculture, and the added potential to participate in urban marriage markets.

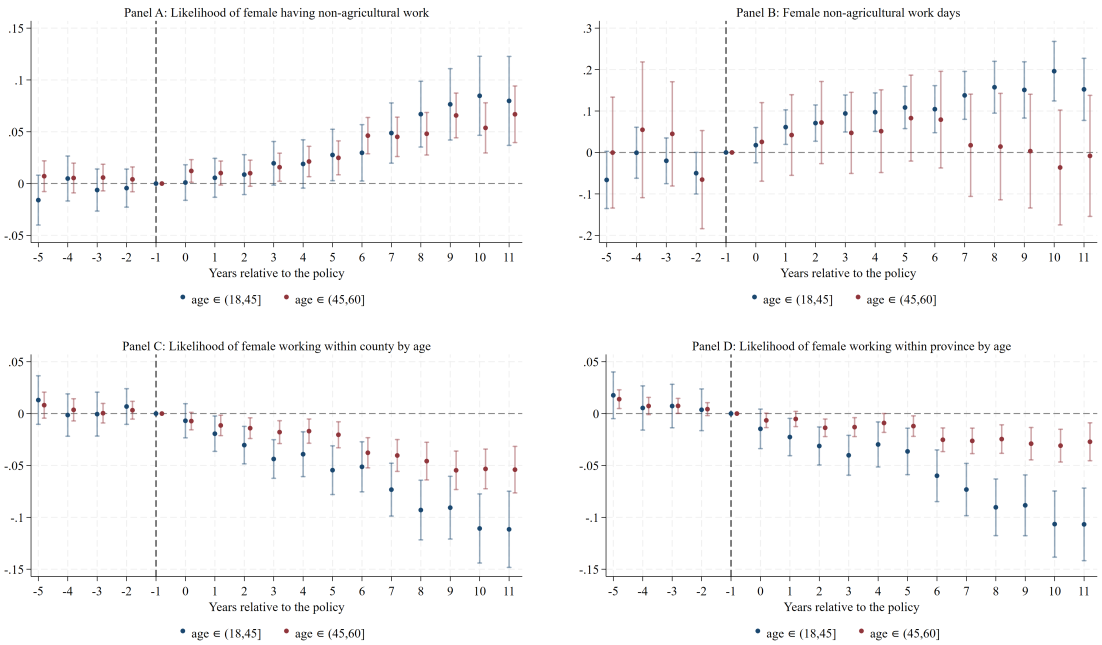

FIGURE 7 Migration Response by Age

Notes: This figure presents the age-specific effects of the GFG policy on labor reallocation across sectors and geographic locations. We classify working-age individuals into two groups based on their age: those aged 18–45 and those aged 46–60. The dependent variables correspond to those in Figure 5: the likelihood of engaging in non-agricultural work (Panel A), number of non-agricultural work days (Panel B), and the likelihood of working within the same county (Panel C) or within the same province (Panel D). The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

5.3 Income and Consumption

To assess the economic implications of the migration response, this section examines the extent to which policy-induced migration improved household income and consumption.

Income. Figure 8 presents the impacts on household income. Panel A shows a steady increase in net total income following policy implementation. Panel B reveals that this rise was primarily driven by growth in non-agricultural income, which suggests that households responded to land retirement by reallocating labor to off-farm activities, consistent with the observed rise in migration. On average, non-agricultural income increased by about 41% per year and total net income increased by 12.6% per year. In contrast, Panel C shows insignificant change in agricultural income, which includes the reforestation subsidy. This implies that the government compensation effectively offset the income loss from reduced agricultural production.

Based on the revealed preference logic in our conceptual model, we can recover bounds on the hidden costs of migration for rural households that had no prior migration before the policy shock but chose to migrate afterward. Intuitively, their decision to migrate after the policy implies that the resulting increase in total net income–including the reforestation subsidy–must exceed their monetized hidden migration costs. Given that total net income rose by approximately 12.6%, this serves as an upper bound: the hidden cost must be no greater than 12.6% of income per year. Similarly, the fact that these households did not migrate prior to the policy suggests that the rural-urban income gap excluding the subsidy was insufficient to outweigh the hidden costs at the time. Since the reforestation subsidy accounts for approximately 2.1% of total income, this implies a lower bound of 10.5% of income. For households that chose not to migrate even after the policy shock, the hidden cost is plausibly greater than 12.6% of household income, all else equal. For those who migrated prior to the policy without receiving the subsidy, the hidden cost is likely below 10.5%. Together, these bounds provide an empirically grounded estimate of the non-pecuniary barriers that deter labor mobility.

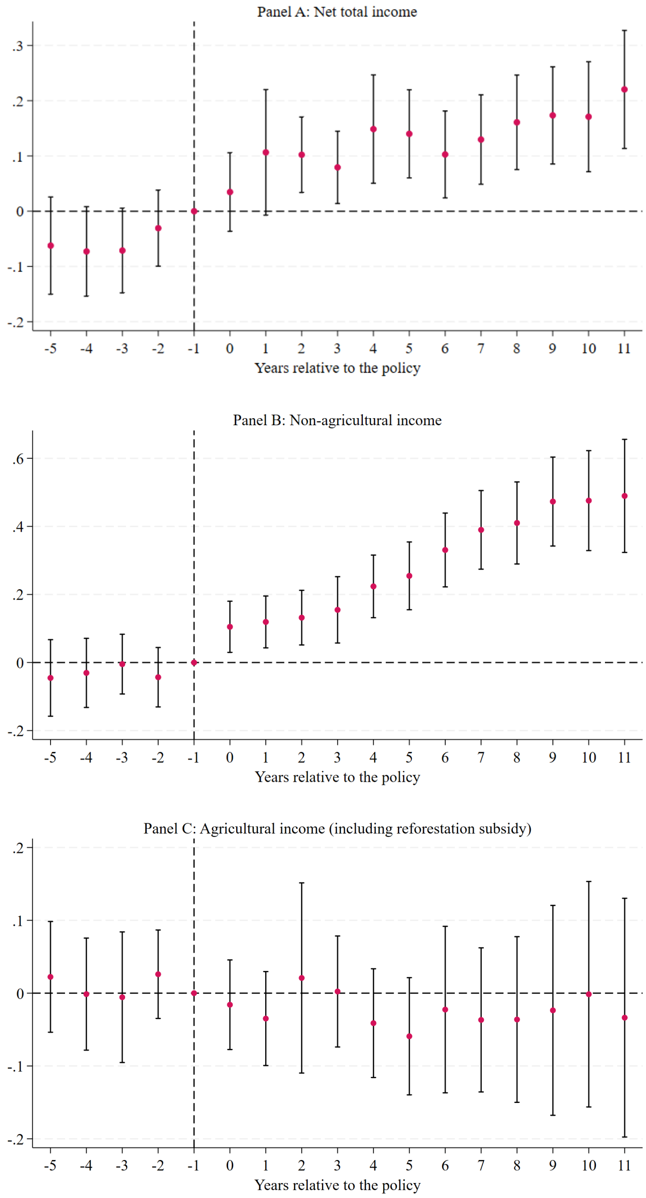

FIGURE 8 The Impacts on Income

Notes: This figure presents the effects of the GFG policy on net total income (Panel A), non-agricultural income (Panel B) and agricultural income (Panel C). Net total income is defined as total household income including reforestation subsidies minus agricultural production cost. Agricultural income is defined as income from cultivated crops (including food crops and cash crops), also including reforestation subsidies, net of production costs. All estimates are based on pseudo-Poisson regression that captures the percentage changes in the dependent variable. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Consumption. We next examine how the Grain for Green policy affected household consumption patterns, as shown in Figure 9. Total household consumption increased significantly after the policy implementation (Panel A), reflecting the rise in household income associated with migration to non-agricultural employment. This overall increase was concentrated in specific consumption categories. Specifically, households significantly increased spending on housing (Panel B), insurance (Panel C), and transportation and communication (Panel D). Increased housing expenditure may reflect improved living conditions or relocation costs associated with migration, while higher insurance spending indicates greater investment in financial security and risk management, likely driven by reduced reliance on traditional social networks. Similarly, increased transportation and communication expenditures suggest greater mobility and connectivity as households adjusted to urban employment opportunities. Overall, these consumption shifts align with the migration response.

In contrast, medical expenditures (Panel E) and education-related expenditures (Panel F) do not show significant changes at the household level. These muted effects likely reflect the interplay of opposing forces. On one hand, rising total income from migration could increase household capacity to invest in health and education, creating an upward pressure on spending. On the other hand, family separation due to migration–particularly the absence of working-age adults–may reduce the direct involvement in and financial prioritization of children's education and family members' healthcare. Migrants themselves often cannot directly influence these expenditures once they leave, and caregiving responsibilities are shifted to remaining household members, often the elderly, who may have limited awareness of such needs. As a result, the potential income-driven gains in these welfare-enhancing categories may be offset by reduced intra-household coordination and care. These findings highlight that while the policy boosts overall consumption, the benefits do not uniformly translate into better outcomes for family welfare.

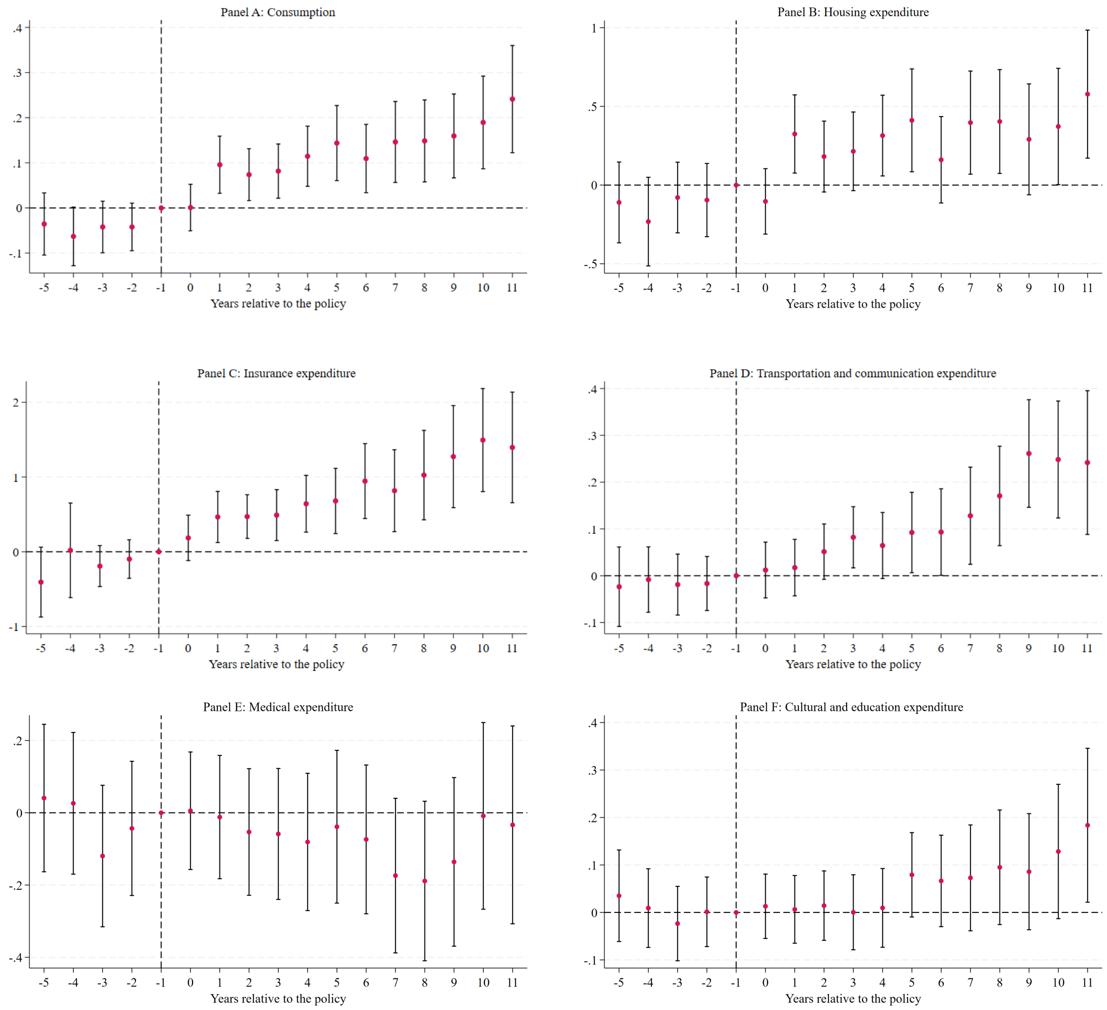

FIGURE 9 The Impacts on Consumption

Notes: This figure presents the effects of the Grain for Green policy on household total consumption (Panel A), housing expenditure (Panel B), insurance expenditure (Panel C), transportation and communication expenditure (Panel D), medical expenditure (Panel E), and cultural and education expenditure (Panel F). All estimates are based on pseudo-Poisson regression that captures the percentage changes in the dependent variable. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

5.4 Hidden Costs of Migration

Although the Grain for Green policy induced migration and improved household income and consumption, many rural residents chose not to migrate voluntarily prior to the policy implementation. This reluctance likely reflects significant hidden welfare costs of migration, which may outweigh the potential economic benefits for many households. In earlier section 5.3, we provided empirical estimates of the magnitude of these hidden costs. In this section, we explore their underlying sources. These non-pecuniary costs arise primarily from disruptions in household arrangements. We specifically examine two critical dimensions of these hidden costs: children's educational outcomes and the health status of household members, particularly among the elderly.

Education. Panels A and B of Figure 10 show the policy's effects on school-age children's years of schooling and the likelihood of being left behind. Panel A indicates a significant decline in educational attainment among children aged 6 to 18, and Panel B reveals an increase in the probability that children under 16 are left behind, that is, living in households where no working-age adult resides within the county. These results suggest that as adults migrate in response to land retirement, children faced reduced parental involvement, which adversely affected their schooling.

Migrant parents often choose to leave their children behind rather than bring them along due to barriers like the *hukou* (household registration) system that restricts access to local public education and prevents migrant children from taking the college entrance exam in the destination city, poor living conditions in cities (Banerjee and Duflo, 2007; Banerjee et al., 2018), and the availability of caregiving from extended family members in the home village. On average, the likelihood of being left behind increased by 3.6 percentage points per year. During our sample period (2003–2014), left-behind children accounted for 9.45% of the rural child population in China, indicating that the effects are not only statistically but also economically significant.

Panels C and D examine the heterogeneity by household structure, focusing on the presence of elderly family members. Panel D shows that households with elderly members are more likely to leave children behind, reflecting a common practice in rural China where grandparents care for children when parents migrate for work. Panel C further shows that children in such households experience a slightly smaller reduction in years of schooling, likely because grandparents help maintain educational routines and provide basic supervision, partially offsetting the negative effects of parental absence.

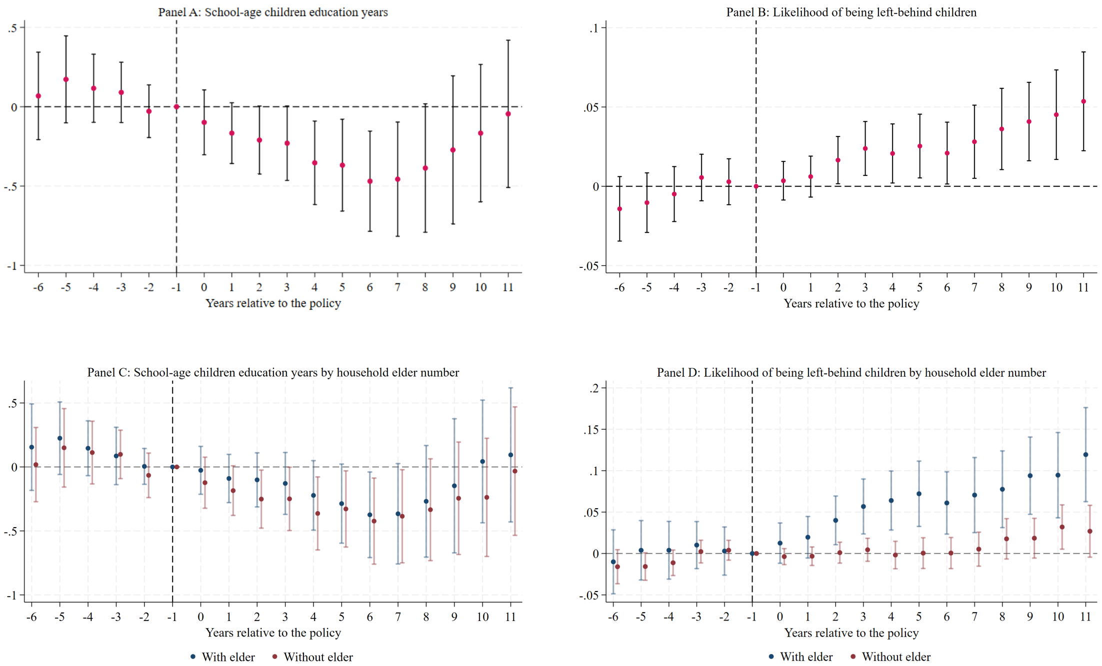

FIGURE 10 The Impacts on Education

Notes: This figure presents the effects of the GFG policy on children's education. Panel A shows the impact on years of education for school-age children, defined as those aged 6 to 18. Panel B reports the effect on the likelihood of being a left-behind child, defined as a child under age 16 whose household has no working-age members (aged 20 to 60) residing within the county. Panels C and D examine heterogeneity by the presence of elderly members in the household. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Since reduced educational outcomes represent a significant hidden cost of migration, it is important to examine whether such concerns had discouraged rural people from migrating. A natural test is to compare migration patterns between households with and without children. The results in Figure 11 indeed show differences consistent with this consideration. Women in households with children were significantly less likely to engage in non-agricultural employment (Panel A) compared to those without children. Panels C and D further demonstrate that these women were also less likely to migrate beyond their home county or province. These patterns strongly suggest that caregiving responsibilities, especially the potential negative impact on children's education, limited female labor mobility even in the presence of large rural-urban income gaps.

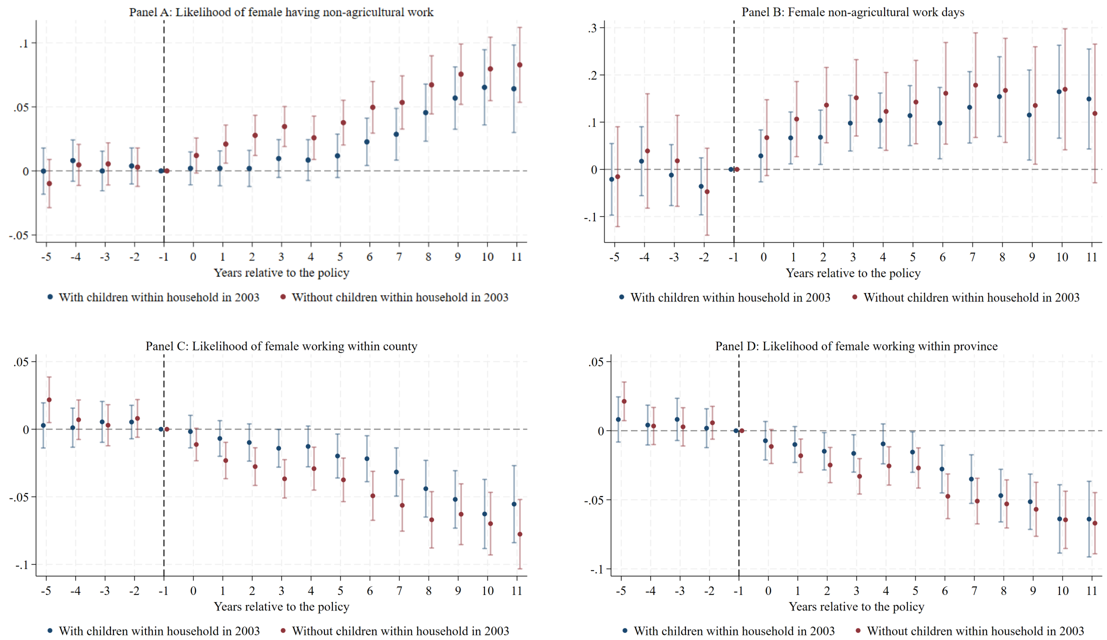

FIGURE 11 Migration Response by the Presence of Children

Notes: This figure presents the heterogeneous effects of the GFG policy on migration by household composition. Households are classified into two groups based on whether they had at least one child in 2003, where a child is defined as an individual under age 18. The dependent variables correspond to those in Figure 5. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Health. Another important dimension of household welfare is health. Figure 12 presents the effects on individual health outcomes. Panel A shows that self-reported health status deteriorated after policy implementation, with declines observed for both middle-aged (18–45) and older (45+) individuals. The negative impact is more pronounced among the elderly, consistent with increased caregiving burdens and reduced household support resulting from adult labor reallocation. Panel B provides supporting evidence from elderly attribution patterns. We observe an increase in the probability that elderly individuals drop out of the sample in the years following policy adoption. This rise in attrition, which potentially reflects mortality, underscores the vulnerabilities of older adults in households.

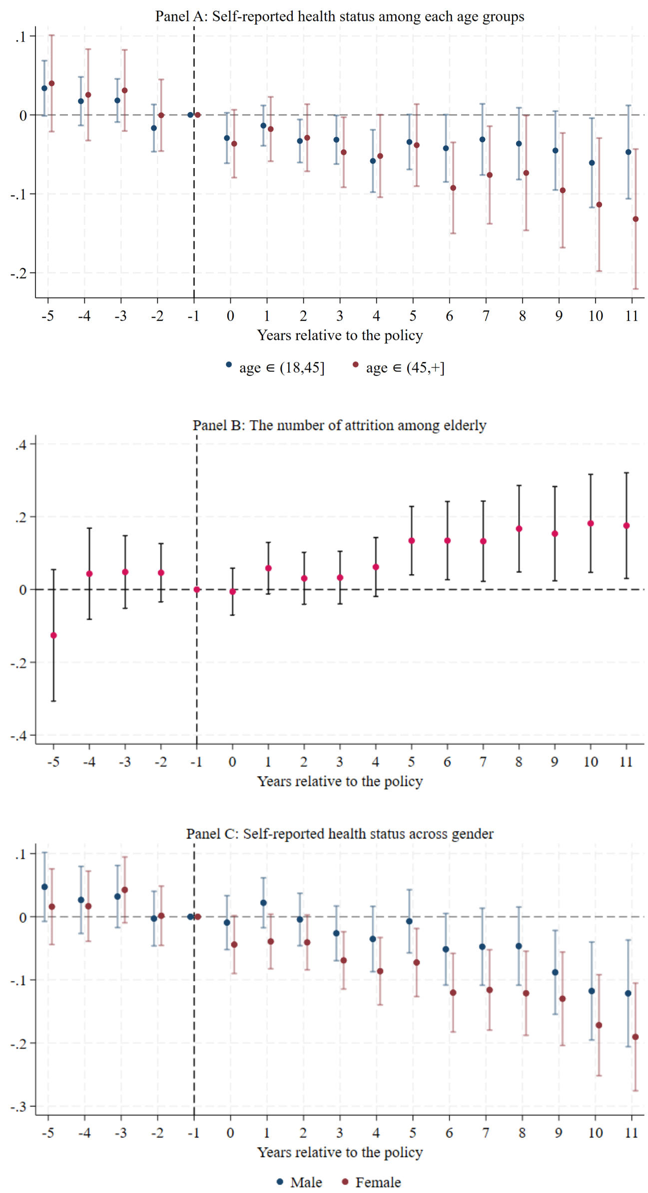

FIGURE 12 The Impacts on Health

Notes: This figure presents the effect of the GFG policy on individual health outcomes. Panel A shows the impact on self-reported health status by age group. Panel B reports the effect on elderly attrition within households, and the analysis is based on a subsample of households that had at least one elderly member in 2003, where elderly individuals are defined as those aged over 60. To construct this measure, we first identify the initial year of appearance for each individual i and create a balanced panel from the initial year to 2014. The dependent variable $Attribution_{it}$ is defined as 1 if individual i is missing from the survey in year t, and 0 otherwise. Panel C shows the effects by gender among working-age individuals. The dependent variable in Panels A and C is the self-reported health status, coded as: 4 = excellent, 3 = good, 2 = moderate, 1 = poor, and 0 = unable to work. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Panel C reveals gender differences in health impacts. While both men and women experienced declines in self-reported health status, the negative effect is larger for women. As we have shown previously, women are more likely than men to migrate in response to the Grain for Green program. The migration process itself may be physically and psychologically demanding, particularly for female migrants, who are often employed in informal or low-wage service-sector jobs in urban areas. Additionally, institutional barriers in China's healthcare system may further exacerbate the health burden. Rural migrants frequently face restrictions in accessing public healthcare services outside their registered home province due to the *hukou* system. In many cases, their health insurance coverage does not transfer across provinces. These constraints may lead to delayed treatment, underutilization of healthcare, and heightened health risks, especially for female migrants with fewer financial and social resources to navigate the system.

The adverse impacts on education and health outcomes documented above may help explain why rural households do not voluntarily migrate in pursuit of higher income in the absence of policy interventions. Bryan et al. (2014) find that even in conditions of extreme poverty and hunger, households in Bangladesh are reluctant to migrate, despite being provided with detailed information about higher urban wages. Prior literature attributes this to several factors, including market frictions, institutional barriers, limited social networks in destination areas, the comforts of home, and risk aversion in the face of uncertainty. Our findings offer an additional explanation: the potential welfare costs of leaving family members behind, especially elderly parents and school-age children, may act as a powerful deterrent to migration. These concerns are likely amplified by institutional barriers such as China's *hukou* system, which limits access to public services, including education and healthcare, for migrants living outside their registered locality.

5.5 Heterogeneity

In this section, we examine heterogeneity across work experience, education level, home location, and agricultural productivity.

Heterogeneity by Work Experience. Figure 13 highlights how prior non-agricultural work experience influences migration responses. As shown in Panels A and B, women with pre-policy non-agricultural work experience are more likely to engage in non-agricultural employment following the policy shock. Additionally, as illustrated in Panels C and D, these women are more likely to migrate beyond their home county or province. These patterns suggest that previous migration or work experience lowers the barriers to future migration, possibly by reducing information frictions, building social networks in destination areas, or increasing confidence in off-farm employment opportunities.

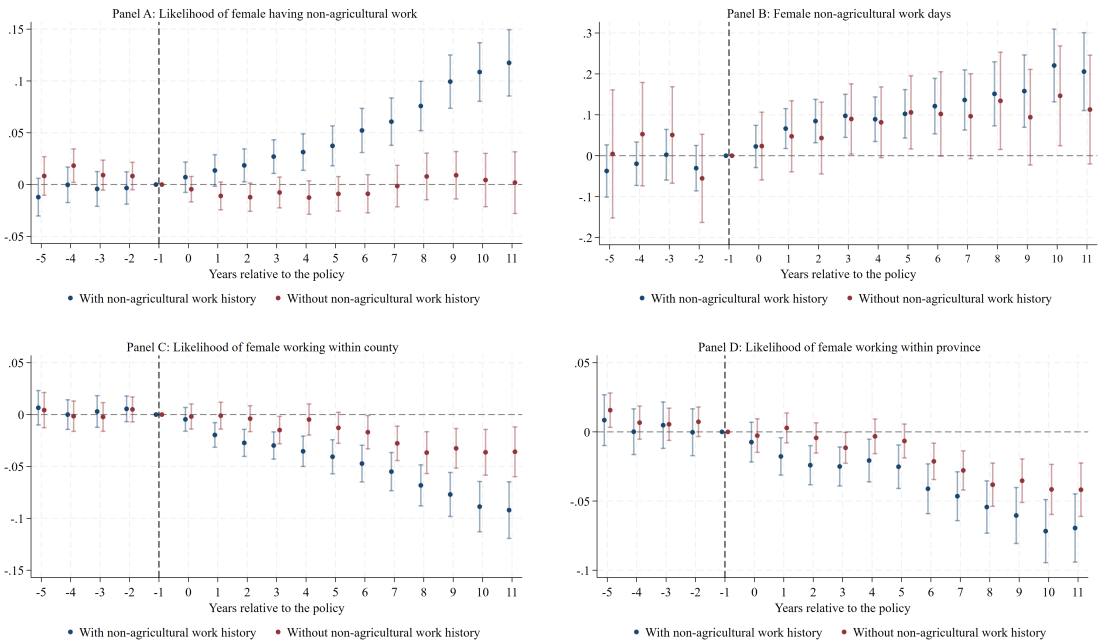

FIGURE 13 Heterogeneous Female Migration Response by Work Experience

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, disaggregated by prior work experience. Prior non-agricultural work experience is defined as a binary variable equal to 1 if the individual had any non-agricultural work history before 2003. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Heterogeneity by Education Level. Figure 14 examines heterogeneity by education level and show that education is another strong predictor of migration. Women with above-average education are substantially more likely to migrate in response to land retirement. Moreover, they are more likely to migrate further. These results suggest that education enhances labor market adaptability and access to higher-return opportunities in distant urban areas, which implies the unequal distribution of policy responses across human capital levels.

Moreover, Figure A.1 examines heterogeneity in migration responses by household political status. The results show that women from non-official households, those without a member serving as a village government official, were significantly more likely to migrate out of their home province following the GFG policy. In contrast, female migration from official households remained relatively limited. This suggests that stronger local institutional ties may reduce mobility, either due to better access to local resources or higher social and political costs associated with leaving.

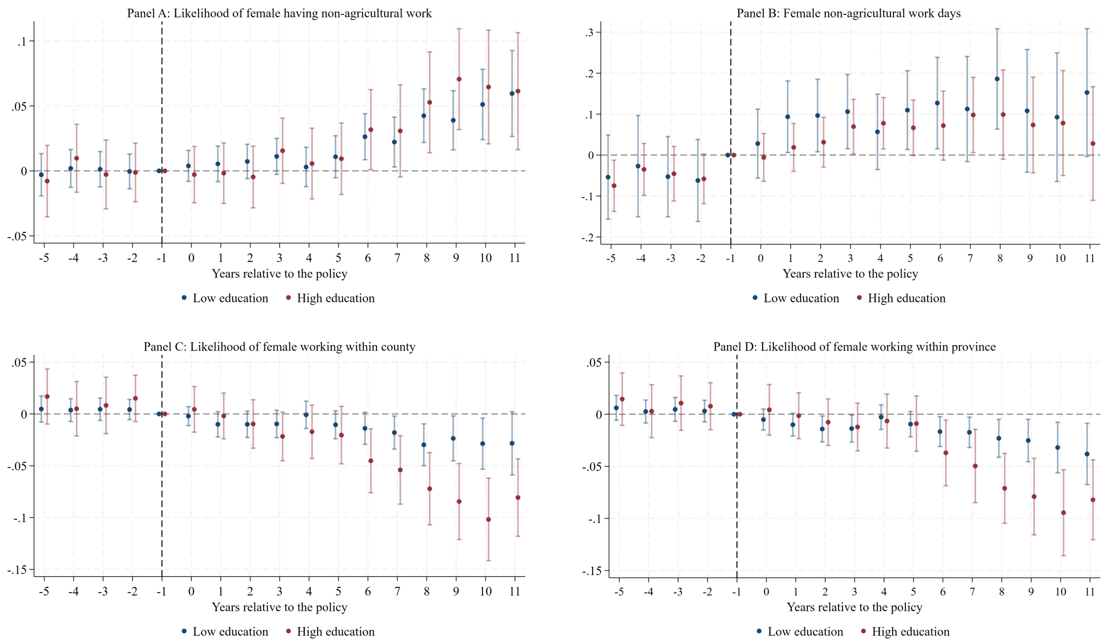

FIGURE 14 Heterogeneous Female Migration Response by Education Level

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, disaggregated by education level. Education level is classified based on whether an individual's years of schooling in 2003 exceed six years, which corresponds to the sample mean. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Heterogeneity by Home Location. Women's migration responses to the Grain for Green policy differed by their home location, specifically, whether they lived in suburban or non-suburban villages. Panel A of Figure 15 shows that women from suburban villages were more likely to shift into non-agricultural employment following the policy. This stronger response may be attributed to their proximity to urban labor markets and lower costs of accessing off-farm work opportunities.

Migration distance also varied by home location, as shown in Panels C and

D. Women from suburban villages were more likely to leave their home county but tended to remain within the same province, suggesting shorter-distance migration. In contrast, women from non-suburban villages were relatively more likely to engage in long-distance, cross-provincial migration. This pattern may reflect differences in spatial access to employment opportunities: suburban women often live near city centers just beyond county borders, whereas women in more remote villages must travel farther–often across provincial lines–to reach viable non-agricultural jobs.

Additionally, Figure A.2 explores heterogeneity by the industrial structure of the home province. The migration response was notably stronger in provinces with a lower share of the service sector in GDP. This indicates that female residents in less service-oriented regions were more likely to seek opportunities elsewhere, particularly in provinces with a stronger service economy. These patterns suggest that the availability of suitable non-agricultural jobs at the destination plays a critical role in shaping migration decisions following land retirement.

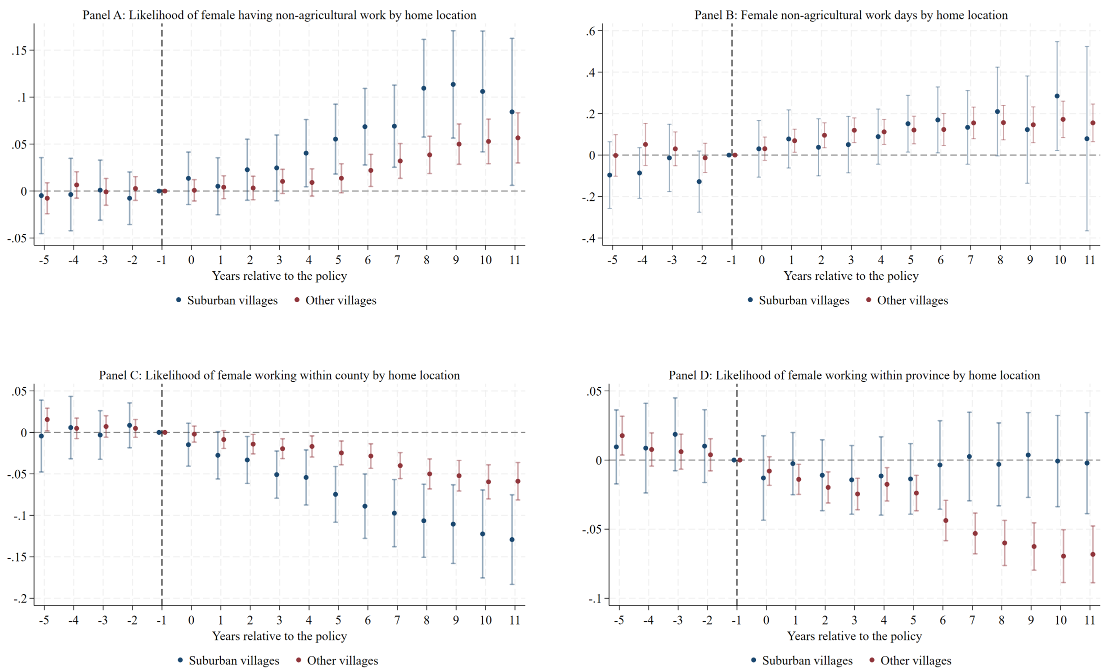

FIGURE 15 Heterogeneous Female Migration Response by Home Location

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, disaggregated by home locations: whether the individual's home is was located in a suburban village in 2003. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

Heterogeneity by Agricultural Productivity. Figure 16 explores heterogeneity based on agricultural productivity. Panel A shows that households with lower pre-policy agricultural productivity retired significantly more land for reforestation, which indicates that the policy primarily displaced less productive agricultural land. In turn, these households exhibited a stronger migration response among women. As shown in Panel C, women from lower-productivity households were more likely to migrate out of their home county.

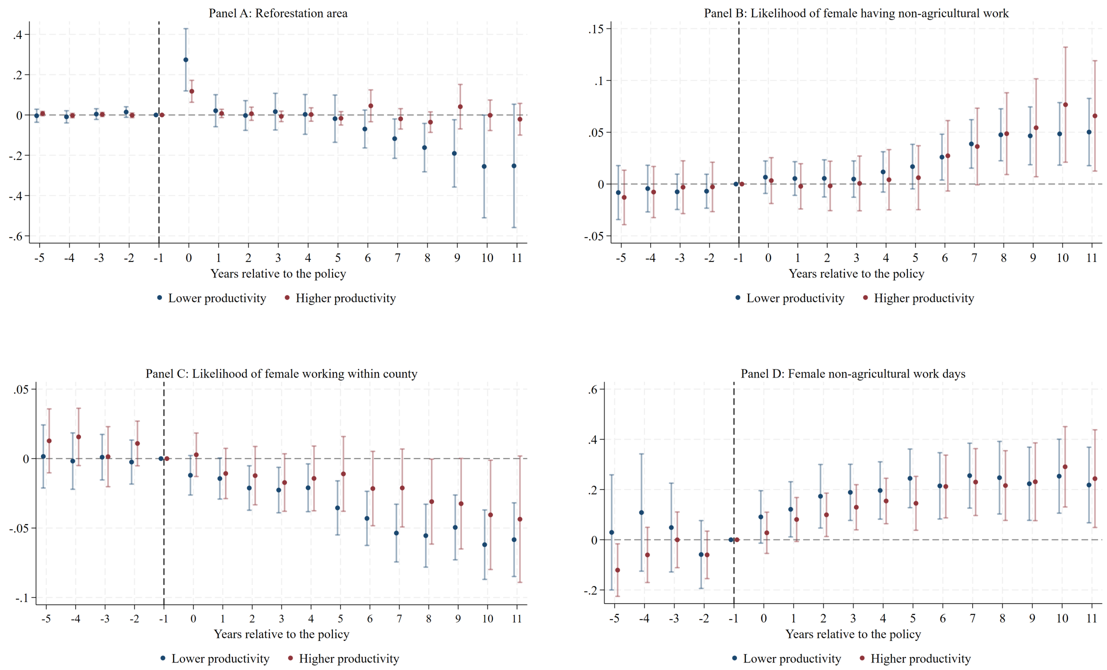

FIGURE 16 Heterogeneous Female Migration Response by Agricultural Productivity

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, based on agricultural productivity. Households are classified into the lowest and highest 20% within each village according to their agricultural output per mu in the year 2000–prior to the start of the policy–to avoid endogeneity. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

This greater migration response among lower-productivity households may also translate into larger welfare impacts. Figure A.3 examines heterogeneity in the effects of the GFG policy on household health and education outcomes based on initial agricultural productivity. Self-reported health status declined significantly among individuals from lower-productivity households, while no significant change is observed for those from higher-productivity households. Similarly, there is a marked decline in educational attainment among school-age children in lower-productivity households, whereas children in higher-productivity households experienced no comparable reduction.

5.6 Robustness Test

To assess the reliability of our main findings, we conduct a series of robustness checks using alternative estimation strategies and additional controls, as shown in Figure 17. First, we apply the method of Callaway and Sant'Anna (2021) to address concerns about heterogeneity in treatment effects and the potential bias in a difference-in-differences setting with staggered treatment adoption. Second, we augment our baseline specifications with time-varying household-level covariates including household size, and the education and age of the household head. Across all specifications, the estimated effects on land use, labor reallocation, migration, and child education remain robust in both magnitude and significance, reinforcing the validity of our empirical conclusions.

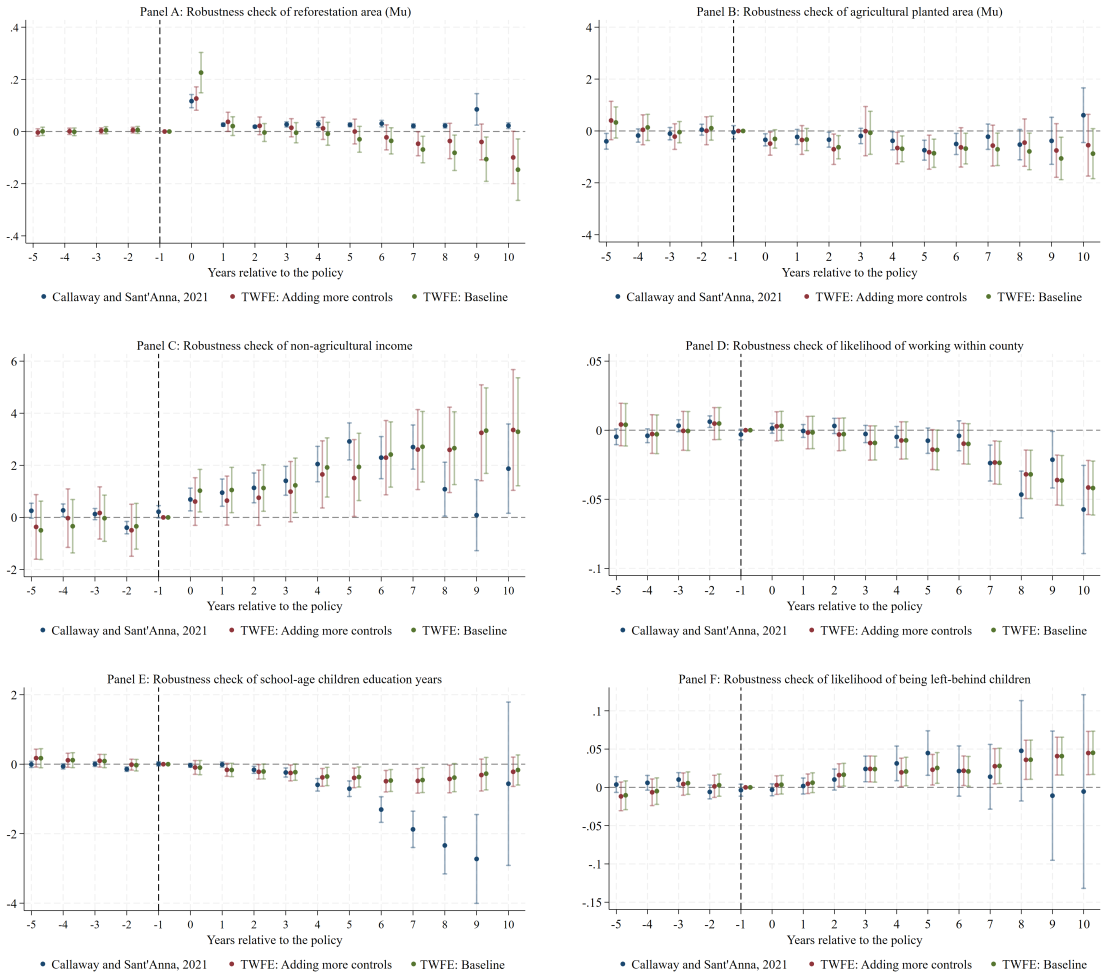

FIGURE 17 Robustness Tests

Notes: This figure presents the robustness checks for the estimated effects of the GFG policy on the key outcome variables including reforestation area (Panel A), agricultural planted area (Panel B), non-agricultural income (Panel C), likelihood of working within county (Panel D), school-age children education years (Panel E), and likelihood of being left-behind children (Panel F). First, we apply the method proposed by Callaway and Sant'Anna (2021) to address the potential bias in the presence of staggered treatment timing or treatment effect heterogeneity. Second, we include additional household-level covariates, such as household size, household head's education, and age, to control for time-varying household characteristics. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

6 Conclusion

This paper investigates why rural households in developing economies, despite facing large income gaps between agricultural and non-agricultural sectors, often choose not to migrate. While existing research has emphasized individual-level frictions, such as financial constraints, information frictions, and weak social networks, we shift the focus to household-level welfare trade-offs, particularly the hidden welfare costs associated with family separation. These non-pecuniary losses, borne by family members left behind, can significantly deter migration even when economic returns are high. To quantify these costs, we leverage China's Grain for Green (GFG) Program, a nationwide ecological compensation policy that induced farmland retirement in exchange for subsidies.

The GFG program provides a quasi-natural experiment: it reduces the marginal return to agricultural labor while keeping household income levels stable through compensation. This unique policy setting allows us to isolate the role of non-monetary barriers in household labor reallocation. Combining a conceptual model with rich household panel data, we show that the policy led to significant increases in non-agricultural employment and migration, especially among women and younger individuals. Household income rose by about 12.6%, entirely driven by non-farm earnings. Using revealed preference logic and the subsidy rates, we estimate the hidden costs of migration to be equivalent to 10.5–12.6% of household income for policy-induced migrants. We trace these costs primarily to disruptions in children's education and elderly care. These results highlight that economic incentives alone may be insufficient to promote efficient labor reallocation when migration imposes substantial family-level costs.

The policy implications are clear: to promote inclusive rural-urban transformation, development strategies should go beyond income support and address the institutional barriers that prevent families from migrating together. This includes reforms to the household registration (*hukou*) system, improved portability of health insurance, and better access to schooling for migrant children. Reducing these frictions can lower the hidden costs of migration and allow more rural households to benefit from higher returns in the non-agricultural economy.

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A Online Appendix

A.1 Additional Heterogeneity Analysis for Migration

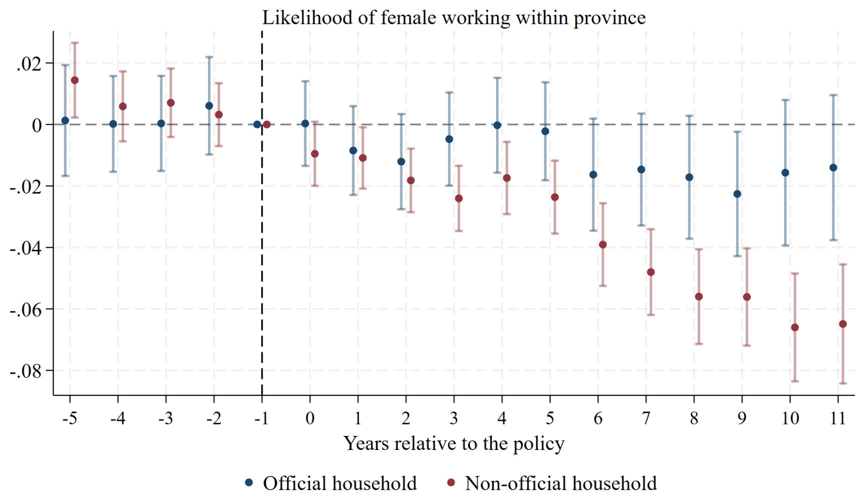

FIGURE A.1 Heterogeneous Migration Response by the Presence of Village Cadres in Household

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, based on whether the household includes at least one member serving as a village government official. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

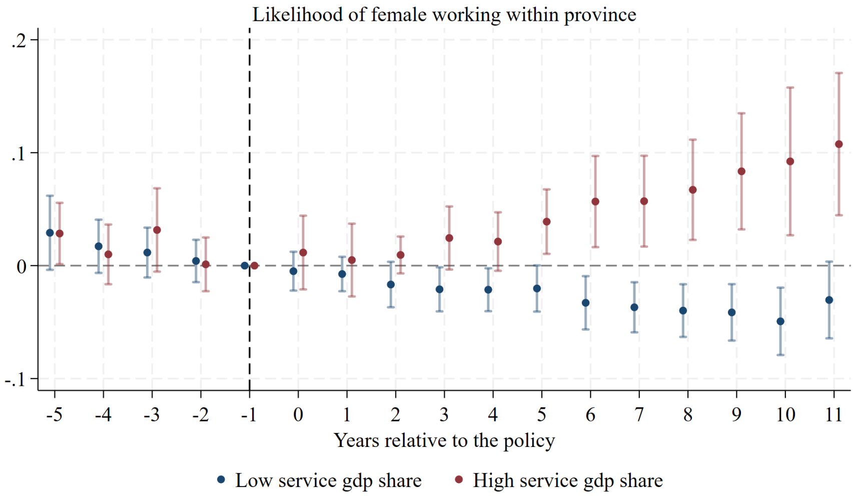

FIGURE A.2 Heterogeneous Migration Response by Share of Service Sector

Notes: This figure presents the heterogeneous effects of the GFG policy on female migration, based on the share of the service sector in the home province's GDP. Provinces are classified into two groups: the top 10% and bottom 10% in terms of service sector share. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.

A.2 Additional Heterogeneity Analysis for Education and Health Impacts

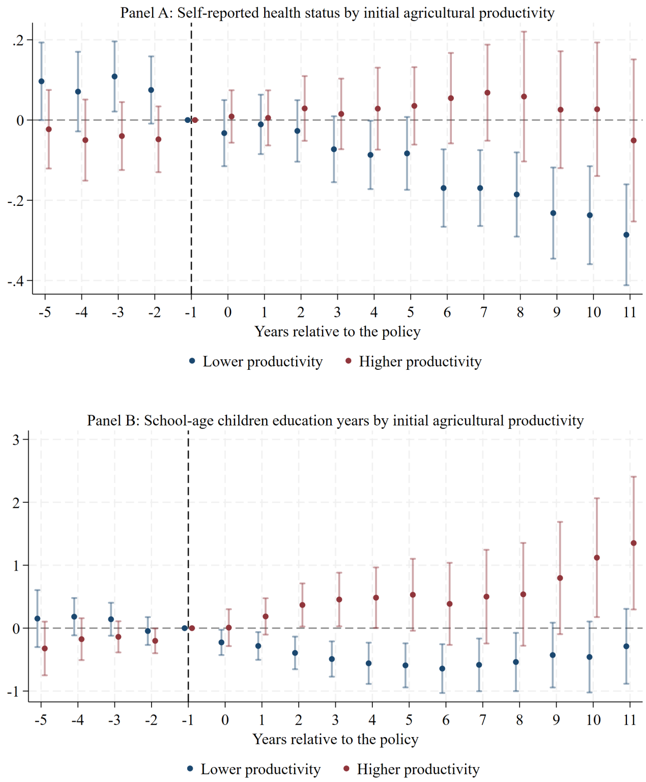

FIGURE A.3 Heterogeneous Health and Education Impacts by Agricultural Productivity

Notes: This figure presents the heterogeneous effects of the GFG policy on education of school-age children and individual health status, by agricultural productivity. Households are classified into the lowest and highest 20% within each village according to their agricultural output per mu in the year 2000–prior to the start of the policy–to avoid endogeneity. The vertical bars represent 95% confidence intervals, with standard errors clustered at the village-by-year level.