Determinants of Migration:

Cotton Strikes and Income Shocks in Mali*

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ABSTRACT

How does a transitory income shock affect household migration decisions in low-income countries? This work studies how income losses from a cotton strike that affected Malian districts differentially changed agricultural household migration choices. The short duration and geographic specificity of the strike allows us to cleanly identify the long-run impact of a sudden change in household income on migration choices.We show that a drop in income precipitated by the strike reduced household migration rates by approximately 32% over a six-year period. Robustness checks and a randomized inference placebo test corroborate the validity of the result. Our results demonstrate how not having cash-on-hand is a binding constraint to labor migration for a poor population, which has implications for the design of economic development policies that seek to reduce migration rates.

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In popular perception and development policies, push factors—such as low income and poverty—are seen as the primary determinants of migration. However, economic studies find a much more complex relationship between income, wealth, and migration. A fall in household income will sometimes increase migration; at other times, decrease migration. Wealth levels mediate the effect of a change in income on migration. While a negative income shock may constrain poor households with limited cash on hand from migrating, the same shock may serve to induce wealthier households to move (McKenzie and Rapoport 2007; Clemens 2014; Dao et al. 2018).[1] In the case of low-income countries, poor households potentially stand to gain the most from relocating to more economically vibrant areas, and therefore even a small reduction in the local returns to labor may make the difference between achieving subsistence or not. The same households also face binding constraints to their mobility, and may be unable to afford the up-front costs of migration or bear the risks of a migrant failing to find a job and remit money (Munshi and Rosenzweig 2016; Cai 2018). Understanding the conditional relationship between local productivity, income, and migration remains an open research question and policy concern. Despite the extensive theory regarding the push and pull factors correlated with migration, there remains a need for well-identified empirical evidence of how changes in income affect migration patterns.

Our primary question is whether a transitory negative shock to agrarian household income will induce or constrain household migration outcomes in a low-income country. An agricultural income shock creates confounding effects: lower income in the current period increases the relative value of relocating, even for seasonal or temporary work, to a location with higher wages, which should lead to more migration. Yet lower agricultural income may also lead to less migration by reducing the capacity for households to pay up-front migration costs. These confounding effects present significant challenges to understanding the causal connection between household agricultural income and migration patterns, and to policy makers who seek to develop programs that affect migration choices.

Empirical work studying migration in agrarian societies has typically used variation in weather patterns to instrument for agricultural income. Fluctuations in temperature and rainfall, and larger events such as hurricanes and floods, cause income shocks for agrarian households, which can help identify the income elasticity of migration. For example, Munshi (2003) demonstrates that periods of low rainfall in Mexico led to a subsequent higher incidence of household migration, and Kleemans and Magruder (2017) show a similar positive correlation between rainfall shocks and migration in Indonesia. In contrast, Grace et al. (2018) find that over a twenty-year period negative rainfall shocks reduce migration in households in Mali.[2] In terms of larger events, Gröger and Zylberberg (2016) find that households in Vietnam cope with typhoon strikes through labor migration, and Missirian and Schlenker (2017) also find an increase in migration as a result of large weather shocks. In the context of the United States negative weather events such as the Dust Bowl of the 1930s and the Great Mississippi Flood of 1927 increased migration from impacted areas (Hornbeck 2012; Hornbeck and Naidu 2014).

In many instances, however, it is a reasonable concern that weather shocks might produce spillover effects that go beyond agricultural income, thereby complicating the identification of the income-to-migration nexus. Large natural disasters do significantly more than alter agricultural productivity: a hurricane or typhoon destroys household assets and limits other forms of economic activity. Migration is also the outcome of forward looking dynamic optimization choices, and even small fluctuations in current weather patterns can change long-run future expectations. For example, a period of low rainfall may lead households to expect a longer-term reduction in agricultural productivity, which induces migration over a number of years, even if that specific shock had little effect on agricultural incomes. In addition, studies exploiting weather shocks may be capturing a more general equilibrium response to natural disasters from price and asset changes, rather than migration responses to a change in household agricultural income.

To better understand how a change in household income affects migration we conduct an event study of a Malian farmers' strike in the year 2000 that reduced the local returns to labor and household income among a subset of farmers. We use this strike to identify the degree to which a change in income ultimately induces or constrains migration. This event offers two advantages over the existing literature in identifying the relationship between income and migration. First, the strike produced relatively limited spillovers, allowing us to focus on income as a mechanism, without concern for other general equilibrium effects. During the strike households maintained their current assets and were capable of pursuing other forms of economic activity, something less feasible in the case of a hurricane. Second, households correctly understood that the income shock was transitory, and that local returns to labor would return to their previous levels in subsequent periods.

We demonstrate that the income shock in 2000 reduced household migration by approximately 32% from 2001 to 2006 for households affected by the strike. These households, facing a tighter budget constraint, were unable to afford to send out migrants, despite the relatively high expected returns to doing so. Our results corroborate other work on low-income countries showing the degree to which migration costs limit mobility (Bryan, Chowdhury, and Mobarak 2014; Bazzi 2017). We find that the strike produced long-term effects: suggesting that lower migration in one year disrupted migration plans and networks, limiting migration for households affected by the strike over a substantial period of time. A randomized inference placebo test shows that the results are robust to alternate timing and unlikely to have been caused by any event other than the cotton strike.

1 | Theoretical Framework and Context

We consider the choice to engage in seasonal, temporary, or even long-term economic migration as a forward looking dynamic problem (Kennan and Walker 2013). Agents weigh the present value of continuing to earn the local returns of their labor against the expected value of moving and working elsewhere, less the upfront costs, risks, and social and psychological toll of migration. Large regional productivity gaps, common in agrarian, low-income countries, generate a form of spatial arbitrage: a worker moving from a low- to high-productivity area stands to significantly improve upon their wages, and can return with, or remit, this income (Gollin, Lagakos, and Waugh 2014).

However, there are many reasons why households may choose not to migrate, even when productivity gaps are large. Individuals may lack the appropriate human capital to take advantage of higher average wages elsewhere (Young 2013). Moreover, households may lack sufficient information about wages elsewhere to motivate a move, or the cash on hand to finance a migration and compensate for a failed job search (Bryan, Chowdhury, and Mobarak 2014). Poor households living near subsistence levels may rely heavily on local networks, which limits their ability to seek work elsewhere (Munshi and Rosenzweig 2016; Morten 2019). This is how an increase in the local return to labor and household income can lead poorer households to migrate—by loosening these constraints—while also reducing the spatial productivity gap, reducing the propensity for wealthier households to migrate.

The ability to make the initial investment required for labor migration, whether for a single season of work, or over many years, mediates migration patterns (Dustmann 1997; Dustmann and Görlach 2016). Members of households who can finance the upfront costs of a move may receive a higher return to their labor by working elsewhere. Younger individuals from poorer households may rely more on migration networks and their subsequent earnings in higher-productivity areas to return and start their own households, their own businesses or farms, and to marry. In Muslim majority societies, such as Mali, migration can provide a method for young men to generate sufficient wealth in order to afford the bride prices necessary to get married. [3] Because labor migration typically occurs early in a person's lifecycle, and relies on preexisting migrant networks to find places to live and work, the entire system can be surprisingly fragile. If a household cannot afford to send one of their members in one year, they may miss their window of opportunity to migrate; low migration rates in one year can cascade into lower migration in subsequent years as the migration network becomes sparse (Fafchamps and Shilpi 2008; Stark and Jakubek 2013; Comola and Mendola 2015; Bertoli and Ruyssen 2018; Giulietti, Wahba, and Zenou 2018).

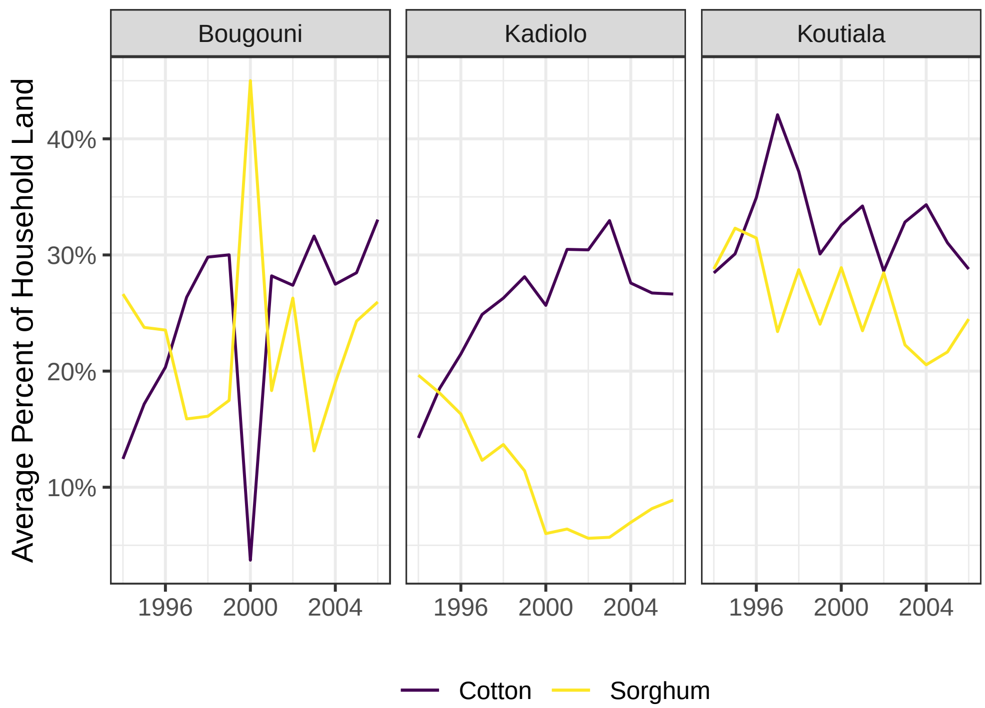
To provide empirical evidence on how a change in the marginal productivity of labor and household income affects migration patterns among low-income agrarian households, we study the effects of a cotton strike in Mali. Mali is the largest producer of cotton in Africa, and the southern region of Sikasso is the hub of cotton production in Mali. In the early 2000s all aspects of cotton production, harvest, and sale in Mali were controlled by the *Compagnie Malienne pour le developpement du textile* (CMDT), a vertically-integrated quasi-state-owned enterprise. Each season Malian cotton farmers were forced to enter into a binding futures contract with the CMDT in return for access to seeds, fertilizer, and other inputs (Theriault and Sterns 2012, 949). CMDT had a complete monopsony on cotton buying. During the 2000s in Mali there was effectively no market for cotton that existed outside of the CMDT's control, which owned all of the cotton ginning factories in Mali and exported over 98% of all cotton fiber produced domestically (Michel et al. 2000). It was also illegal for farmers to sell their cotton to anyone other than the CMDT. [4]

In late 1999, the CMDT declared that it would offer farmers 150-160 West African Francs (CFA) per kilogram cotton for the following year's harvest, a reduction from 185 CFA in the previous season (Serra 2012, 6). The national cotton farmers' union called for a strike in response, boycotting growing cotton rather than accept the lower price. The national strike was, however, not maintained, because dissension among the upper ranks of union leadership led to widespread capitulation to the CMDT. While union leaders in the district (*cercle*) of Bougouni formed a Crisis Committee in April of 2000 to maintain the strike and demand higher prices, conflict with the leadership in the districts of Kadiolo and Koutiala prevented those districts from joining the Crisis Committee.[5] Households in Bougouni were prevented from growing cotton by the Crisis Committee: cotton plants were ripped out of the fields and any farmers attempting to break the strike were threatened with the expropriation of their land (Roy 2010, 388).

The Crisis Committee's demands were initially ignored by the CMDT, but ultimately the President of Mali acquiesced in June 2000, increasing the purchase price of cotton for all farmers in the whole country (Roy 2012). The timing of this delay is crucial, as cotton is planted in southern Mali from May to June, and then harvested from October through April of the following year. A farmer who misses the planting season must wait for the next year to sow cotton. By the time the Crisis Committee's demands had been met it was too late in the year to plant cotton in holdout areas. As a result, cotton production in Bougouni was practically nonexistent for that season. Without a cash crop, access to credit, and other agricultural inputs, household incomes fell dramatically in temporarily non-cotton producing areas. These households maintained agricultural cropping areas, but switched cotton land to sorghum, a less lucrative staple crop with similar high labor requirements as cotton (Laris and Foltz 2014).

This crop switching behavior is shown in Figure 1 as the fraction of household land devoted to growing sorghum almost perfectly reflects the fraction of land used to grow cotton. For context on the potential income effects of this switch, a hectare of cotton produces more than twice the profit ($300/ha - $400/ha) as a hectare of sorghum ($120/ha - $150/ha). In addition, the access to credit and fertilizer only available to those who grew cotton for CMDT was often used by farmers to increase yields on other crops: such as maize and horticultural cash crops (Laris and Foltz 2014). Thus not growing cotton reduced income across the full agricultural enterprise.

Figure 1: Land usage by crop and district



Lines represent the average percent of household land devoted to growing cotton and sorghum in each district for each year. Where cotton is a lucrative cash crop that requires significant inputs, sorghum is a staple crop that primarily requires labor. We can see how households substitute between these two crops, especially in Bougouni during the strike in 2000 as their usage perfectly mirrors each other.

The exogeneity of the strike to household- and village-level characteristics rests on two points. First, the emergence of the Crisis Committee in Bougouni, and not Kadiolo and Koutiala, was due to leadership conflicts among elite farmers whose concerns were unrelated to needs or concerns of poor households that are in our data. The idiosyncratic political geography caused by elite personality disputes dictated whether households were permitted to grow cotton. Households located in Bougouni were effectively forced to participate in maintaining the strike, because of choices by their unelected leaders rather than by their own volition. Second, the timing of the president's intervention accounts for the inability of Bougouni farmers to grow cotton that year. Had the Crisis Committee's demands been met earlier then the Bougouni farmers would have grown cotton that year. Indeed, our data shows that all farmers residing in holdout areas in 2000 returned to growing cotton the following year.

2 | Data

We draw survey data from Mali's *Institut d'Economie Rurale's Suivie Evaluation Permanente* (SEP) data collection process, which surveyed rural farming households located in three administrative districts within the Sikasso region: Bougouni, Kadiolo, and Koutiala. When the SEP started in 1994, with the idea of creating a permanent panel of farmers, they chose four or five villages in each of the three districts. The villages were chosen to be representative of the agroecological zones of the districts. Within each village, they stratified farm households by three levels of farm machinery ownership and pulled a random sample of farmers within each strata. While we do not have exact numbers, there was some, but low levels of attrition of households, with the biggest attrition due to the exit of villages due to the exit of an enumerator. Each village in the SEP had it's own enumerator who were recruited elsewhere but typically lived in the village during the agricultural season. In the stratified random sample data set available to us, there are a total of 109 households surveyed yearly from 1994 to 2006, 33 in Bougouni, 32 in Kadiolo, and 44 in Koutiala. The households are situated within twelve village association groups, four in each district, and each village association comprises between seven to twelve surveyed households. Repeated sampling over twelve years provides a long-run picture of household characteristics and migration patterns, giving us a lengthy before-and-after period to study the effect of a transitory income shock.

Cotton is the major cash crop for these households, with approximately 90% of them growing some cotton in any year. Non-nuclear households are the norm in all districts in Sikasso, with an average household consisting of 20 members. Migration is also common, as approximately 15% of household members are recorded as being migrants in any given year. Surveys record household members as being either "temporary" or "permanent" migrants. We find, however, that some members listed as permanent migrants will return over the course of the survey, and conversely other household members listed as temporary migrants will not return over this twelve year period. Therefore, we aggregate both categories into a singular "migrant" category.

Table 1 compares household characteristics between households affected and unaffected by the strike prior to 2000. There is no statistically significant difference in the average number of migrants prior to the strike between households located in Kadiolo and Koutiala (control) and those in Bougouni (treatment). Households in Kadiolo and Koutiala have more members on average, more agricultural land, income, and have more livestock. We use farm size and the number of crops planted in a year to connote different types of farming that households pursue; literacy levels and livestock are highly correlated with assets and so allow

Table 1: Household Average Characteristics Pre-Strike (1994–1999)

	Control	Treatment	Diff
Number of households	33	76	
Number of migrants	3.32	3.76	-0.440
	(4.35)	(4.64)	(0.407)
N household members	19.4	16.3	3.02**
	(10.9)	(7.3)	(.917)
Literacy (%)	0.10	0.09	0.01
	(0.13)	(0.13)	(0.01)
Size of Farm (ac.)	10.6	8.59	1.97**
	(5.48)	(9.59)	(0.64)
Number of Crops	6.20	6.48	-0.28
	(1.99)	(1.38)	(0.17)
Cotton Production (kg.)	3191	1920	1271***
	(3178)	(1780)	(262)
Agricultural Income (000 CFA)	1131	840	291***
	927	646	(78.7)
Livestock (TLU)	10.8	4.85	5.94***
	(11.0)	(5.9)	(1.00)

Note: Standard deviation reported in parentheses, with stars corresponding to T-test significance levels.

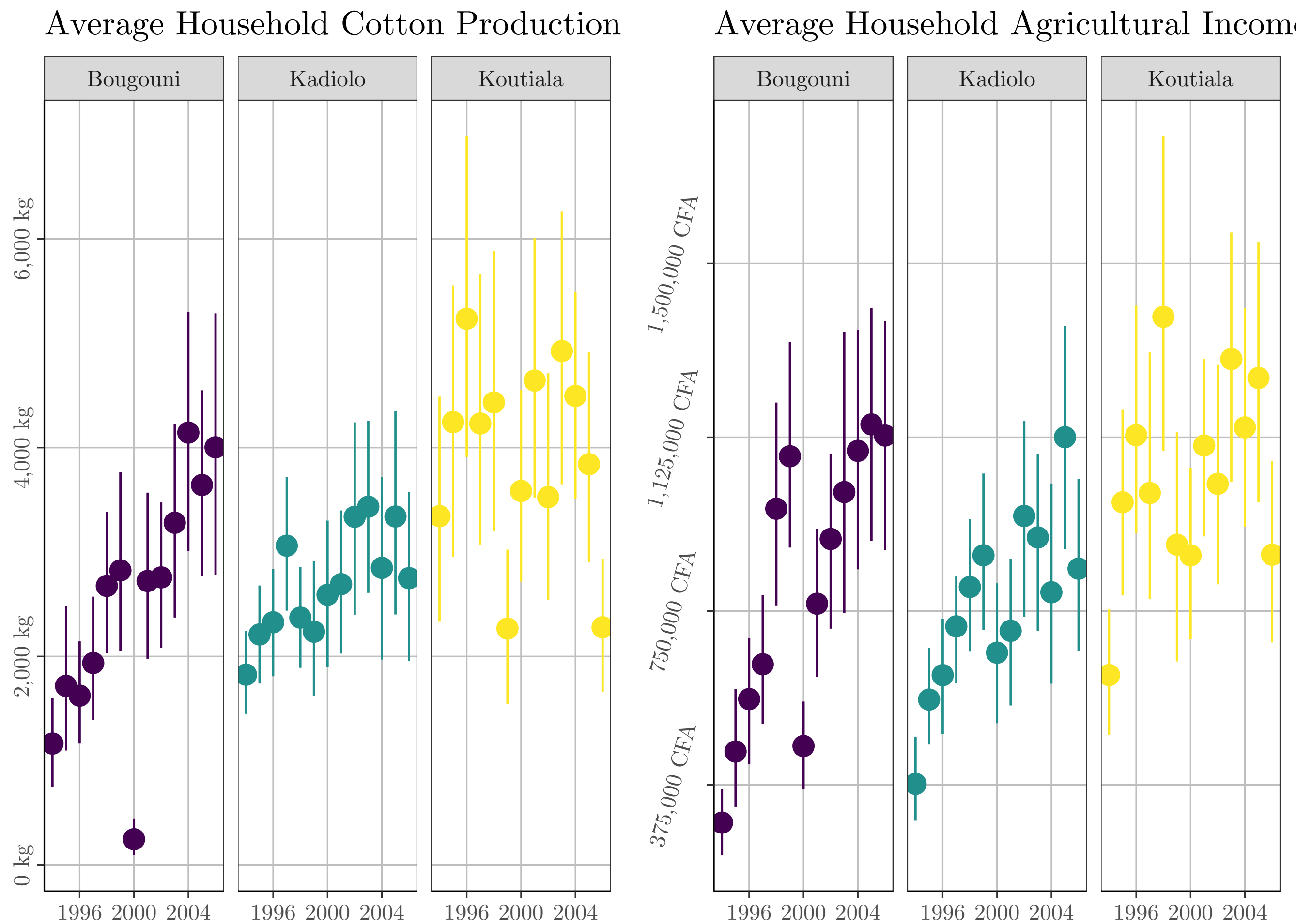
for us to control for households of different wealth levels. Household size is likely to be positively correlated with migration, and is included as a necessary control.

The agricultural response to the cotton strike in Bougouni is seen in figure 2, which shows average cotton production and agricultural income by district over time. The impact of the strike is immediately visible as both cotton production and agricultural income collapse in Bougouni in 2000 and not in the other two districts. After the strike in 2000, cotton production and agricultural income return to their previous levels in Bougouni. The distribution of the percentage of household land used to grow cotton in each year is shown in the appendix in figure A1, illustrating the similarity in farming practices between districts in all years except 2000. In addition, the figure shows that the percentage of land used to grow cotton in Bougouni in 2000 goes to zero.

3 | Empirical Specification

We use a difference-in-differences approach to estimate the impact the strike and resultant income shock on migration. We code all households in Bougouni after 2000 as having been affected by this shock, and use the households located in Kadiolo and Koutiala districts as controls. A key assumption of this methodology is that

Figure 2: Effect of the strike on Bougouni



Points represents average yearly household averages by district with lines representing a bootstrapped 95% confidence interval of the mean. The resultant drop in cotton production and agricultural income due to the strike in the year 2000 is evident in Bougouni.

there are parallel pre-trends. To investigate parallel pre-trends, whether household migration patterns were substantially similar in Bougouni from those in Kadiolo and Koutiala prior to the strike in 2000, we regress pre-strike household migration on a year fixed effect interacted with an indicator variable for a household being located in Bougouni.

$$\text{migration}_{it} = \alpha + \beta\left(\mathbb{1}\{i \in \text{Bougouni}\} \times t_{1994:1999}\right) + \epsilon_{it} \tag{1}$$

The results of the pre-trend test are shown in Table 2 with linear and non-linear specifications. None of the treatment-year parameters are statistically significant, suggesting similar migration levels in Bougouni as Kadiolo and Koutalia prior to the strike. An F-test fails to reject the null hypothesis that the parameters are jointly zero.

Table 2: Test of Pre-Strike Migration Trends in Bougouni

	Linear	Poisson	Neg. Binomial
Intercept	3.32***	1.20***	1.20***
	(0.22)	(0.06)	(0.06)
Bougouni × 1994	−0.65	−0.22	−0.22
	(0.79)	(0.29)	(0.29)
Bougouni × 1995	−0.25	−0.08	−0.08
	(0.90)	(0.29)	(0.29)
Bougouni × 1996	0.55	0.15	0.15
	(0.85)	(0.22)	(0.22)
Bougouni × 1997	1.21	0.31	0.31
	(0.87)	(0.20)	(0.20)
Bougouni × 1998	0.95	0.25	0.25
	(0.86)	(0.21)	(0.21)
Bougouni × 1999	1.18	0.30	0.30
	(1.29)	(0.29)	(0.29)
Overdispersion parameter			0.95***
			(0.08)
Adj. R^2	0.00		
Pseudo R^2		0.01	0.00
N	577	577	577

Note: Robust standard errors in parentheses. Model is estimated using a linear, poisson, and negative binomial specification.

To determine how the strike and the resultant income shock affected migration we regress the number of migrants recorded for each household i in village j in years $t \in \{1995, \ldots, 1999, 2001, \ldots, 2006\}$ using the specification shown in Equation 2. We omit the year 2000 as the events that year constitute the entire shock; however, our results are robust to its inclusion.

$$\text{migration}_{ijt} = \tau\delta_{it} + \gamma\mathbf{x}_{it} + \theta_i + \varphi_t + \rho_{jt} + \epsilon_{it} \tag{2}$$

We represent the post-strike period with an indicator variable δ_{it}, which is coded as 1 for households in villages located in Bougouni after the year 2000, and 0 otherwise. We add a vector of household covariates, denoted $\mathbf{x}$, including the number of household members, farm size, number of crops planted, number of livestock in tropical livestock units (TLU), and average household literacy. To control for unobserved household characteristics that may drive migration we use a household-level fixed effect θ. Year fixed effects (φ) and village-level time trends (ρ) are also included.

We estimate Equation 2 using both a linear and non-linear specifications. The Poisson count model helps to account for potential non-linearities due to migrants being indivisible, which could bias the linear model. Due to the small number of clusters we estimate p-values for each parameter with the wild subcluster bootstrap. Motivated by the recent work by MacKinnon and Webb (2018) we cluster the bootstrap residuals at the household level to avoid either over- or under-rejecting the null hypothesis, given the small number of villages at which to cluster. MacKinnon and Webb (2018) provide a discussion of the drawbacks of the wild cluster bootstrap with few treated clusters, as would be the case if we used districts. They instead propose the sub-cluster, in our case household level, bootstrap as a superior method in the case of few clusters and few treated clusters. The score bootstrap proposed in Kline and Santos (2012) is used for the non-linear models.

4 | Results

In the results presented in table 3 we show that the income shock produced by the strike in Bougouni reduced household migration in the period following the strike from 2001 to 2006. The first column is a linear specification with household and year fixed effects, and a village level time trend, while the second column has added household covariates. We find that households affected by the strike sent approximately 1.5 fewer migrants in the following years than households in the control group. With an average of 4.2 migrants per household in unaffected areas, this amounts to over a 30% reduction in the number of migrants per household. The number of household members is naturally positively correlated with the number of migrants in each household, but other household covariates do not exhibit a statistically significant correlation with migration. A household's risk portfolio, measured by the number of types of crops they plant, their human capital, as measured by literacy, and their buffer stocks, as measured by livestock do not have a significant correlation with migration. The size of the household farm is correlated with migration, but with a very small magnitude. Columns (3) and (4) replicate the first two models using a Poisson model, providing an estimate of the strike that is broadly consistent with the results found in the linear model. After calculating the marginal effects, the Poisson model provides an estimate of the strike as having decreased migration by affected households by approximately -23%.

Table 3: Impact of the Strike on the Number of Migrants by Household

Dependent variable: Migrants (N)	Linear	Linear	Poisson	Poisson
Treatment ($\hat{\tau}$)	-1.452^{**}	-1.569^{**}	-0.260^{*}	-0.318^{**}
	[0.049]	[0.019]	[0.074]	[0.036]
Control avg. number migrants	4.23			
Size of farm (ac.)		-0.018		-0.008^{**}
		[0.111]		[0.046]
Number of crops		0.032		0.020
		[0.517]		[0.142]
Literacy (%)		-0.371		-0.146
		[0.466]		[0.620]
Livestock (TLU)		-0.020		-0.008
		[0.642]		[0.231]
Household members (N)		0.123^{**}		
		[0.041]		
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
R^2	0.31	0.35	0.40	0.40
Observations	1049	873	1049	873

Note: P-values in brackets are estimated using a wild subcluster bootstrap distribution with 10,000 replications, with residuals randomized at the household level using a 6-point weight with support on $\left\{-\sqrt{\frac{3}{2}}, -\sqrt{\frac{2}{2}}, -\sqrt{\frac{1}{2}}, \sqrt{\frac{1}{2}}, \sqrt{\frac{2}{2}}, \sqrt{\frac{3}{2}}\right\}$ with uniform probability as suggested by Webb (2014). The logged value of the number of household members is included as the offset in the Poisson specification in models 3-4. R^2 and Pseudo-R^2 values reported. For the results with the year 2000 included see table A1, and with cluster robust standard errors see table A2.

We next investigate whether the strike had any effect on other household outcomes beyond its effect on migration. In short, the strike does not appear to have a long-run impact on overall household agricultural income. In table 4 we show no statistically significant change in household wealth as measured by livestock holdings, or the production of sorghum and or millet—all staple crops in Sikasso. There does appear to be a statistically significant negative impact on cotton production, suggesting the potential for long-run damage to cotton farming in Bougouni from the strike. Household wealth and household savings, as measured by yearly agricultural income and livestock, respectively, appear to have suffered no significant long-term effects from the strike. The impact of the strike appears to be confined to limiting the ability for households to fund labor migration: households who could not grow cotton in 2000 were unable to afford either the immediate costs or the risks of migration.

Table 4: Impact of the Strike on Other Household Outcomes

	Ag. Income	Livestock TLU	Cotton Prod	Sorghum Prod	Maize Prod	Millet Prod
Treatment ($\hat{\gamma}$)	−328.09	0.16	−1629.80*	586.39	−1795.00	84.31
	[0.23]	[0.88]	[0.07]	[0.44]	[0.26]	[0.82]
Size of farm (ac.)	14.85	−0.00	34.18***	30.75***	20.58	13.16
	(8.75)	(0.03)	(12.66)	(11.78)	(14.39)	(8.44)
Number of crops	−1.67	0.14				
	(21.91)	(0.12)				
Literacy (%)	−192.48	1.27	−705.76	−442.91	−139.20	−235.38
	(220.76)	(1.73)	(689.77)	(641.93)	(784.08)	(459.78)
Livestock (TLU)	10.89		61.47***	22.30	15.30	−10.75
	(6.43)		(14.67)	(13.65)	(16.67)	(9.78)
Household members (N)	10.18	0.43***	−18.16	−41.20**	54.50**	29.09**
	(7.66)	(0.05)	(20.12)	(18.72)	(22.87)	(13.41)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.38	0.33	0.28	0.12	0.27	0.05
Observations	873	873	873	873	873	873

Note: P-values in brackets estimated using a wild subcluster bootstrap distribution with 10,000 replications, with residuals randomized at the household level using a 6-point weight. Clustered standard errors at the village level in parentheses.

5 | Robustness Checks

To test the robustness of our findings we first estimate our basic models with alternative assumptions on data inclusion and the standard errors. We then conduct a placebo test using randomized inference methods to test our causal mechanism. As shown below, all of our key results are robust to these alternative scenarios.

As an initial robustness check we include the year 2000 in our estimate of equation 2, with results in table A1 in the appendix. The magnitude of the point estimates is smaller, but the statistical significance of our results remains unchanged: households in Bougouni show a marked decrease in migration rates following 2000 relative to those in Kadiolo and Koutiala. Estimates of the same equation but with cluster-robust standard errors are also provided in the appendix in table A2. This more conventional clustering process for the standard errors does not change our basic inference.

It remains possible, however, that there may be other unobserved factors affecting migration patterns in Bougouni, and our identification of the strike as causal to this change is instead merely coincidental. To further test the robustness of our results, we implement a randomization inference test to verify that it was the income shock produced by the strike that reduced household migration (Chung, Romano, et al. 2013; Young 2019). Following the suggestions in the literature, we randomly assign a year for a *placebo* strike to have occurred in, and then randomly assign participation in this placebo strike at either the district level, among four villages (as in the case of actual strike), or randomly among households. We use the interaction between the placebo year and placebo strike participation as the placebo difference-in-differences parameter, equivalent to τ from Equation 2. We then re-run our linear regression model 2,000 times to form a distribution for the t-statistic of this placebo effect.

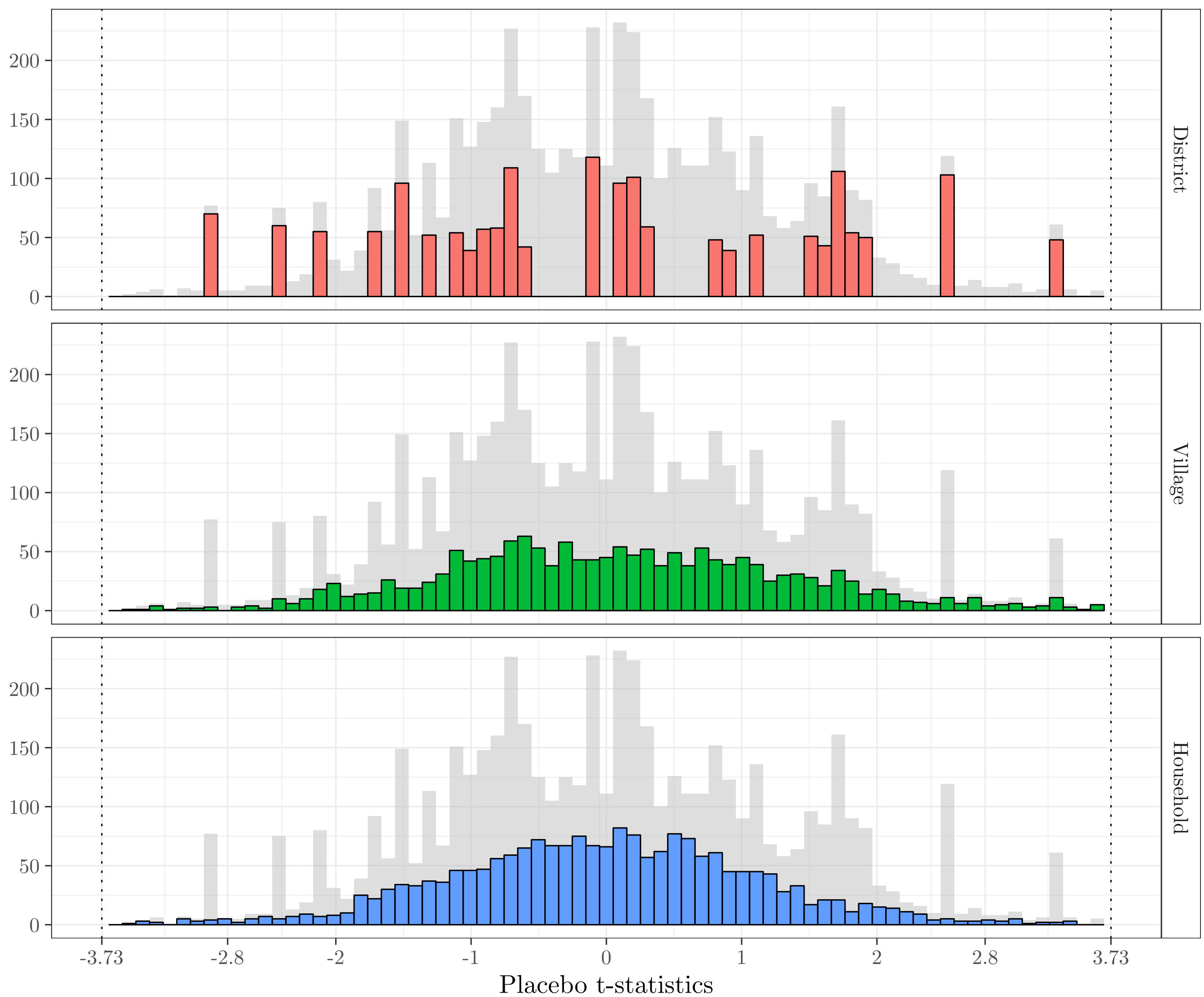
Figure 3 shows the placebo distribution of t-statistics from our randomization inference. The dashed lines represent the t-statistic of -3.73 estimated in the linear specification with covariates (model 2) in table A2 when standard errors are clustered at the village level ($G = 12$). Following Young (2019) we conduct a randomization-t test, comparing the likelihood of a squared t-statistic from the placebo distribution equaling or exceeding the squared t-statistic from our regression. The estimation produces a p-value of less than 0.001 for the likelihood of observing a result equivalent to magnitude of the one in our regression. And furthermore, despite concerns of over-rejecting the null hypothesis when the number of clusters is small, as is the case in our sample, we only find a significant t-statistic 4% of the time in the placebo distribution. Overall, these randomization inference placebo tests suggest that the effect we find is entirely due to the cotton strike happening in Bougouni in 2000, and not some other, unobserved event. The placebo test confirms that no other combination of location and timing can produce a similar result.

6 | Discussion

Our results presented so far provide strong evidence that the temporary reduction in cash on hand caused by the strike reduced migration. Such a finding, suggests that we might see differential effects by levels of household wealth. Our data, which provide a long time series necessary for understanding dynamic processes are not well suited to estimating heterogeneity in cross-section, due to low numbers of households. We nonetheless set out, within the limits of our data to estimate how these effects on migration change with household wealth levels.

Given our hypothesis that a temporary reduction in cash on hand proves a more binding constraint to migration than an inducement to move, despite the relative increase in the returns to labor elsewhere, we would expect the effect of the strike to be attenuated among households with higher levels of wealth. We therefore estimate an interaction between household wealth before the strike and the strike itself, using the

Figure 3: Placebo t-statistic estimates



The dashed line at $\hat{\tau} = \{-3.73, 3.73\}$ represents the t-statistic for our estimated effect of the strike on household migration found with our linear difference-in-differences specification in table 3 (model 2). Each histogram shows the distribution of t-statistics for 2000 random combinations of placebo years and placebo treatment assignment at the household, village, or district level.

number of livestock a household owns to proxy for wealth levels. Households are coded as poor if their livestock holdings are in the bottom 30% percentile of the livestock ownership distribution in 1999.

$$\text{migration}_{ijt} = \tau\,(\delta_{it} \times \text{poor}_{i1999}) + \gamma \mathbf{x}_{it} + \theta_i + \varphi_t + \rho_{jt} + \epsilon_{it} \tag{3}$$

We recover a point estimate of the effect of the strike on migration patterns for poor households approximately 60% greater than non-poor households. However, we fail to reject equality between the estimates for poor and non-poor households in Bougouni. The results are presented in table A3 in the appendix. This is suggestive evidence that even within relatively similar agrarian households in southern Mali there was a divergent migration response to changes in the marginal productivity of labor and income by wealth levels. While these data afford us the ability to follow migration patterns in the same households every year over a decade—not as snapshot in a pre- and post-strike period—our ability to isolate household level heterogeneity is limited by our relatively small number of unique households.

7 | Conclusion

In this work we demonstrate that an unanticipated and transitory income shock caused by the cotton strike in Bougouni changed household migration patterns. Despite the transitory nature of the shock, it led those households that were affected by the strike to send fewer migrants over the following five years. We argue that this drop in the relative number of migrants is the result of a binding income constraint, where households lacked the cash on hand to afford the upfront costs and risks of labor migration. Our results provide causal evidence to corroborate results in the literature that find upfront costs to migration for agricultural households in Mali constitute a significant constraint to migration (Grace et al. 2018).

This work demonstrates a number of methodological improvements over the existing literature on the effects of income on migration. First, our use of a randomized inference placebo test is able to rule out other location and timing effects. Second, by using an event with a transitory localized shock and a long time series post event, we are able to show effects commonly missed in the literature. We show that even when the income shock produces no immediate general equilibrium spillovers, it can lead to long-lasting effects, likely due to the path dependent nature of migration networks. The evidence presented here of a long-lasting effect suggests that a smaller number of migrants in one year limits the reach of migrant networks, making future migration more difficult.

Our result that lower incomes can reduce migration in an agrarian economy has important ramifications for policy makers running programs that seek to reduce emigration through economic aid and development. One prominent example is the 2015 European Union Emergency Trust Fund for Africa, established in response to concerns over increasing numbers of African migrants entering Europe.[6] The Fund's explicit strategy for reducing migration is to encourage local economic development, premised on the belief that poverty is the root cause of migration, and that projects that increase local income levels will reduce migration. Our research highlights a case in West Africa, a key zone for this type of project, where migration is an increasing function of household income, likely due to capital constraints. Policies that seek to reduce migration through economic development and wealth creation may produce important benefits, but may achieve the opposite of their desired effect on migration.

Notes

1. See Abramitzky, Boustan, and Eriksson (2013) and Angelucci (2015) for cases where migration is both decreasing and increasing following a positive shock to household wealth, respectively.

2. Using data from the 1980s Findley (1994) similarly finds migration to be non-increasing in Mali despite heavy drought pressure.

3. For more on the economics of bride prices see: Anderson (2007).

4. There existed a very small local black market for cotton outside the CMDT monopsony, where the cotton lint was purchased by artisanal threadmakers and weavers. Due to the difficulty of artisanal cotton ginning, threadmaking, and weaving this market remained tiny.

5. Roy (2012, 366, 379, 388) identifies the idiosyncratic personality conflicts between union leadership in Koutiala and the other areas in Sikasso as responsible for the fractured response within the farmers' union. Union leadership in Mali is not democratically elected and typically held by the wealthiest farmers and elite members of society, who rarely represent the interests of the rank and file.

6. The fund is designed "to address the root causes of instability, forced displacement and irregular migration and to contribute to better migration management." See: the EU Emergency Trust Fund for Africa factsheet at `https://ec.europa.eu/trustfundforafrica/sites/euetfa/files/eu_emergency_trust_fund_for_africa_18-12-2017.pdf`. Clemens and Postel (2018) argue that such attempts have not been successful at deterring or reducing migration in the developing world.

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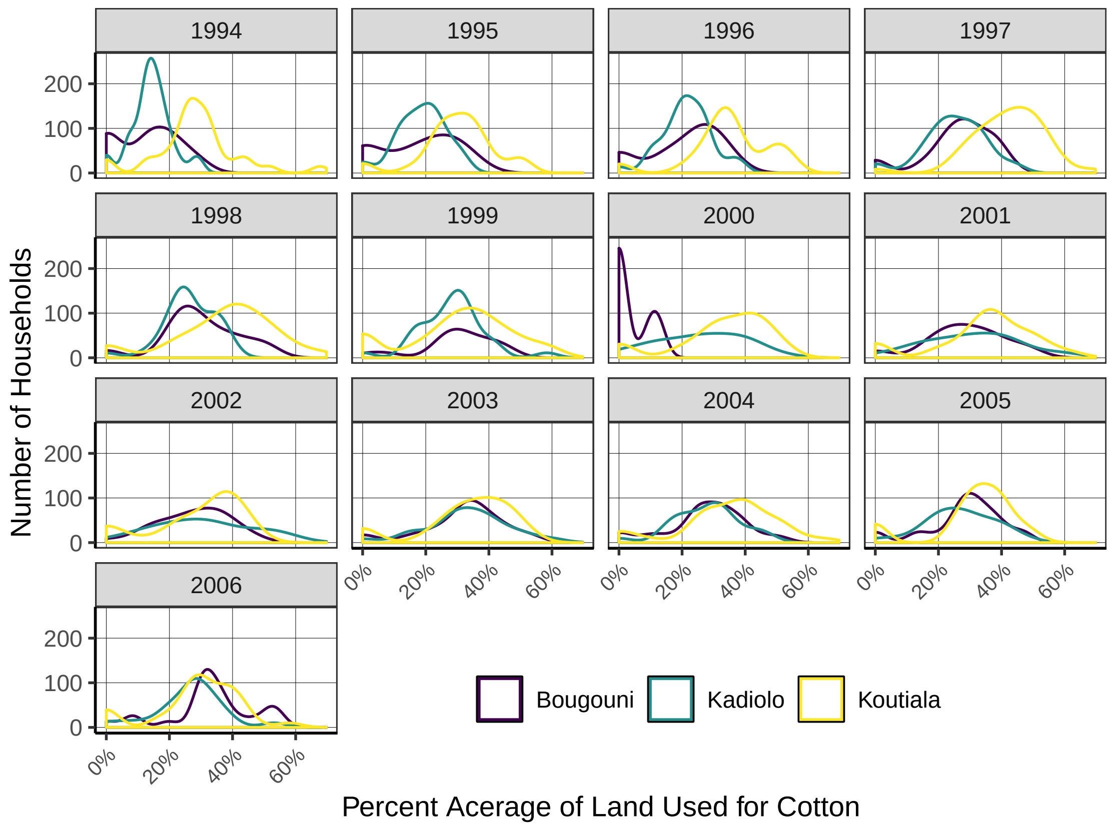
A | Tables and Figures

Figure A1: Percentage of land used for growing cotton



Cotton comprises a significant percentage of land usage for all households in all districts — on average 28.3% of all farmland is used to grow cotton. The strike in Bougouni is easily seen in 2000 as the percentage of land used for cotton production collapses towards zero.

Table A1: Impact of the Strike on the Number of Migrants by Household, including the year 2000

Dependent variable: Migrants (N)	Linear Model	Linear Model	Poisson	Poisson
Treatment ($\hat{\gamma}$)	-1.290^{**}	-1.331^{**}	-0.222^{*}	-0.251^{*}
	[0.04]	[0.01]	[0.09]	[0.06]
Size of farm (ac.)		-0.019^{*}		-0.008
		[0.08]		[0.07]
Number of crops		0.034		0.021
		[0.52]		[0.14]
Literacy (%)		-0.192		-0.085
		[0.72]		[0.76]
Livestock (TLU)		-0.016		-0.006
		[0.70]		[0.26]
Household Members (N)		0.120^{*}		
		[0.04]		
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
R^2	0.30	0.34	0.40	0.40
Observations	1128	951	1128	951

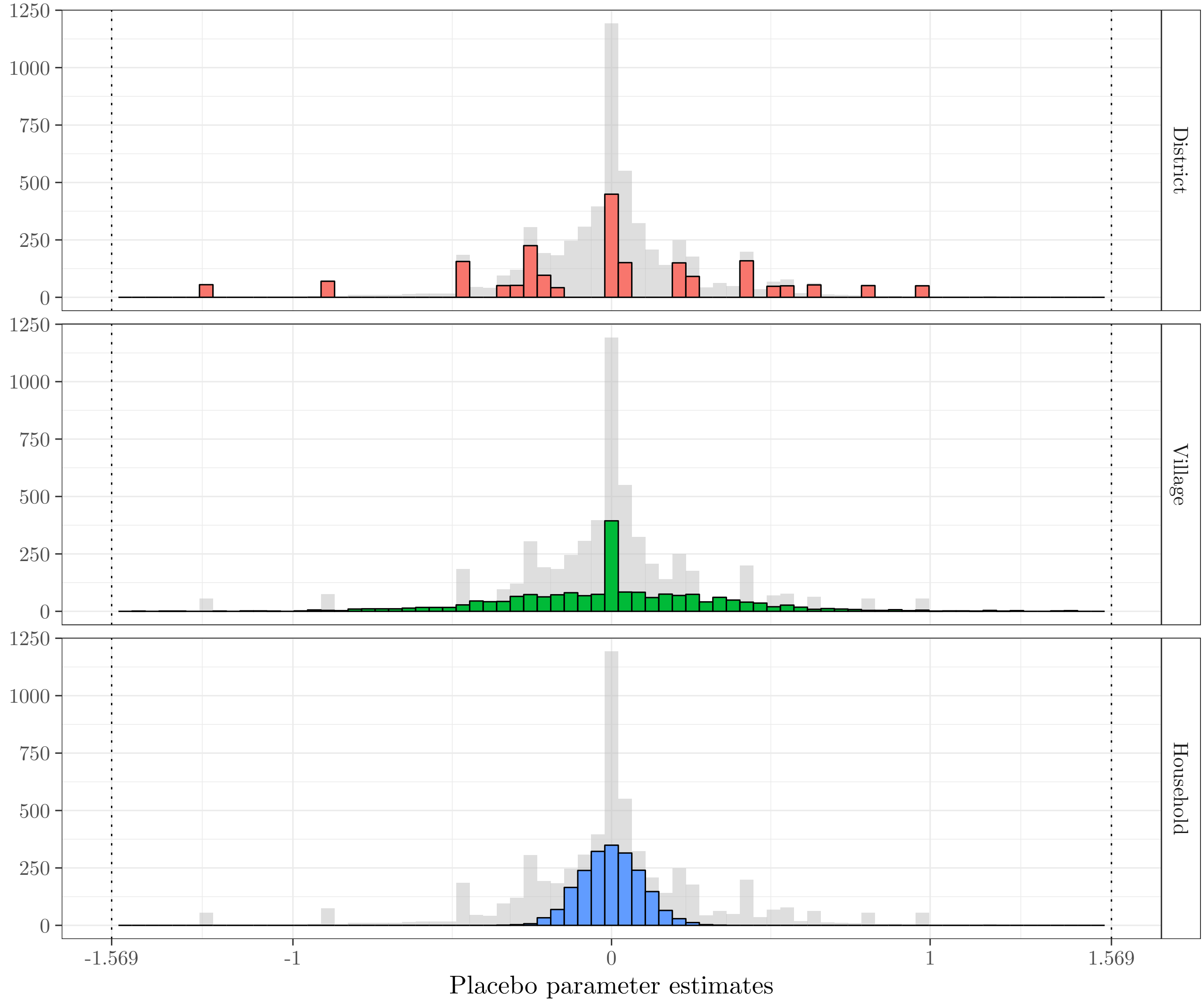
Note: P-values in brackets are estimated using a wild subcluster bootstrap distribution with 10,000 replications, with residuals randomized at the household level using a 6-point weight with support on $\left\{-\sqrt{\frac{3}{2}}, -\sqrt{\frac{2}{2}}, -\sqrt{\frac{1}{2}}, \sqrt{\frac{1}{2}}, \sqrt{\frac{2}{2}}, \sqrt{\frac{3}{2}}\right\}$ with uniform probability as suggested by Webb (2014). R^2 and Pseudo-R^2 values reported. The logged value of the number of household members is included as the offset in the Poisson specification in models 3-4.

Table A2: Impact of the Strike on the Number of Migrants by Household

Dependent variable: Migrants (N)				
	Linear	Linear	Poisson	Poisson
Treatment ($\hat{\gamma}$)	-1.452^{***}	-1.569^{***}	-0.260^{**}	-0.318^{**}
	(0.484)	(0.420)	(0.128)	(0.133)
Control avg. number migrants	4.23			
Size of farm (ac.)		-0.018^{**}		-0.008^{**}
		(0.008)		(0.004)
Number of crops		0.032		0.020^{*}
		(0.045)		(0.011)
Literacy (%)		−0.371		−0.146
		(0.464)		(0.284)
Livestock (TLU)		−0.020		−0.008
		(0.039)		(0.005)
Household Members (N)		0.123^{**}		
		(0.052)		
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Time Trend	Yes	Yes	Yes	Yes
R^2	0.31	0.35	0.40	0.40
Observations	1049	873	1049	873

Note: Standard errors in parentheses estimated using cluster robust standard errors at the village level ($G = 12$). The logged value of the number of household members is included as the offset in the Poisson specification in models 3-4.

Figure A2: Placebo parameter estimates



The dashed line at $\hat{\tau} = \{-1.569, 1.569\}$ represents our estimate for $\hat{\tau}$: the effect of the actual strike on household migration found with our linear difference-in-differences specification in table 3 (model 2). Each histogram shows the distribution of point estimates for 2000 random combinations of placebo years and placebo treatment assignment at the household, village, or district level.

Table A3: Heterogeneity of the Impact of the Strike on the Number of Migrants by Household

Dependent variable: Migrants (N)		
	Linear Model	Linear Model
Treatment ($\hat{\gamma}$) × Poor in 1999=0	-1.22^{*}	-1.25^{**}
	(0.57)	(0.53)
Treatment ($\hat{\gamma}$) × Poor in 1999=1	-2.03^{***}	-1.93^{***}
	(0.49)	(0.41)
Size of farm (ac.)		-0.02^{**}
		(0.01)
Number of crops		0.04
		(0.04)
Literacy (%)		−0.03
		(0.45)
Household members (N)		0.11^{**}
		(0.04)
Household FE	Yes	Yes
Year FE	Yes	Yes
Time Trend	Yes	Yes
R^2	0.31	0.36
Observations	1049	1049

Note: Standard errors in parentheses estimated using cluster robust standard errors at the village level ($G = 12$).