Sugarcoated Lives, Bitter Truths: Child Labor In Kenya's Sugarcane Industry

Linh Khanh Pham | Supervisor: Professor Jiaying Gu

ABSTRACT

This paper studies the issue of child labour through an integrated economic and philosophical lens. Using household panel data from Kenya, it models the relationship between poverty, child labour, and educational deprivation in the context of shocks to the sugarcane sector, in order to identify how economic disruptions reinforce this cyclical structure and motivate policy intervention. Philosophically, the paper argues that child labour cannot be adequately justified as a voluntary choice. As such, the paper highlights the need for policy interventions that address the underlying structures that sustain intergenerational deprivation.

METHODOLOGY

Data Panel

I. Long-run Analysis: Kenya Demographic and Health Survey for six years: 1993, 1998, 2003, 2008, 2014, and 2022.
II. Immediate Behavioural Analysis: Kenya Continuous Household Survey 2020-2022 and annual sugarcane production and area harvested data.

State Variables & Conceptual Economic Model

POVERTY equation $P_{t+1} = a_{PP}\,P_t + a_{LP}\,L_t + a_{EP}\,E_t + \gamma_P\,S_t + u^P_{t+1}.$

EDUCATION equation $E_{t+1} = a_{PE}\,P_t + a_{LE}\,L_t + a_{EE}\,E_t + \gamma_E\,S_t + u^E_{t+1},$

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The equations can be conceptually represented in matrix form:

$$X_t = \begin{bmatrix} P_t \\ E_t \\ L_t \end{bmatrix} \quad A = \begin{pmatrix} a_{PP} & a_{EP} & a_{LP} \\ a_{PE} & a_{EE} & a_{LE} \\ a_{PL} & a_{EL} & a_{LL} \end{pmatrix} \quad \Gamma = \begin{pmatrix} \gamma_P \\ \gamma_E \\ \gamma_L \end{pmatrix}$$

where a_ij denotes the effect of state variable i at time t on state variable j at time t+1; that is, the first subscript identifies the explanatory (lagged) variable and the second subscript identifies the dependent (current) variable.

Long-run Structural Analysis

Bayesian Estimation Strategy

For each parameter θ_i:

$$\theta_i \sim N(\mu_i, \sigma_i^2)$$

where μ_i and σ_i are obtained from previous empirical studies.
The posterior distribution is obtained as:

$$p(\theta|X) \propto p(X|\theta)p(\theta)$$

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Robustness Checks

- Re-estimated models using Diffuse and Informative priors.

Bayesian Multilevel Regression

- P, E: Gaussian; L: zero-inflated beta
- Covariates: Lagged outcomes, household & urban characteristics
- Random intercept: Birth cohort
- Estimation: Hamiltonian Monte Carlo (4 chains; 4,000 iterations; 1,000 warmup)
- Diagnostics: $\hat{R}$, effective sample size, posterior predictive checks

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where Yct denotes the outcome variable of interest (poverty, education deprivation, or child labour) in county c at time t.
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μc denotes county fixed effects, λt denotes year fixed effects, and εct is the error term.

Identification Strategy
Shift-share Instrumental Variables

$$Z_{ct} = \text{Exposure}_c \times \text{SugarPrice}_t,$$

$IV = Production \times SugarPrice$

$IV = AreaHarvested \times SugarPrice$

Estimation Method - Two-Stage Least Squares (2SLS)

First Stage: $S_{ct} = \pi_0 + \pi_1 Z_{ct} + \mu_c + \lambda_t + \nu_{ct},$ sugarcane exposure is predicted using the interaction between county-level sugarcane exposure and world sugar prices

Second Stage: $Y_{ct} = \beta_0 + \beta_1 \widehat{S}_{ct} + \mathbf{X}'_{ct}\gamma + \mu_c + \lambda_t + \varepsilon_{ct},$ the effect of the predicted sugarcane exposure on the outcome variables

RESULTS

Eigenstructure Analysis

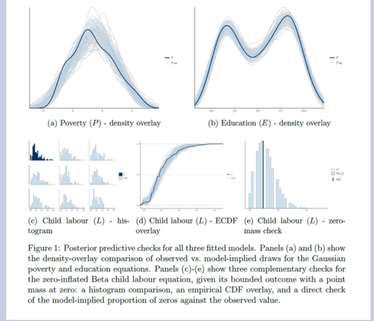
$$\hat{A} = \begin{pmatrix} 0.49 & 0.11 & -0.34 \\ 0.12 & 0.51 & -0.02 \\ -0.08 & 0.002 & 0.21 \end{pmatrix}$$

$$\rho(\hat{A}) = \max_i |\lambda_i| = 0.65 < 1.$$

Asymptotically Stable

Table 4: Posterior Estimates for the Three Bayesian Panel Regressions

	Poverty (P) *Gaussian*	Education (E) *Gaussian*	Child Labour (L) *Zero-Inflated Beta*
Intercept	−1.13 [−1.68, −0.59]*	2.98 [1.81, 4.09]*	−1.86 [−2.68, −1.05]*
P_{lag}	**0.49** [0.35, 0.63]*	0.12 [−0.02, 0.26]	**−0.68** [−0.91, −0.46]*
E_{lag}	**0.11** [0.05, 0.18]*	**0.51** [0.40, 0.63]*	0.02 [−0.06, 0.10]
L_{lag}	−0.34 [−0.69, 0.01]	−0.02 [−0.12, 0.08]	**1.82** [1.14, 2.47]*
Dependency ratio	−0.23 [−0.47, 0.01]	−0.12 [−0.48, 0.23]	**−0.78** [−1.20, −0.38]*
Female head	**1.58** [0.70, 2.44]*	**−1.31** [−2.41, −0.19]*	**−1.63** [−2.86, −0.40]*
Urban	0.71 [−0.10, 1.47]	1.35 [−0.02, 2.70]	−0.22 [−1.27, 0.83]
Hyperparameters			
sd(Intercept) [cohort]	0.11 [0.00, 0.26]	1.90 [1.32, 2.71]	0.10 [0.00, 0.26]
σ (residual)	0.29 [0.24, 0.35]	0.40 [0.34, 0.49]	–
ϕ (precision)	–	–	73.02 [49.39, 101.50]
zi (zero-inflation)	–	–	0.06 [0.02, 0.11]
Observations	86	86	86
Cohorts (levels)	21	21	21
Max $\hat{R}$	< 1.01	< 1.01	< 1.01



(a) Poverty (P) - density overlay (b) Education (E) - density overlay (c) Child labour (L) - histogram (d) Child labour (L) - ECDF overlay (e) Child labour (L) - zero-mass check

Figure 1: Posterior predictive checks for all three fitted models. Panels (a) and (b) show the density-overlay comparison of observed vs. model-implied draws for the Gaussian poverty and education equations. Panels (c)-(e) show three complementary checks for the zero-inflated Beta child labour equation, given its bounded outcome with a point mass at zero: a histogram comparison, an empirical CDF overlay, and a direct check of the model-implied proportion of zeros against the observed value.

Instrument Validity | First-stage Result

Exogeneity of shares (Exclusion Restriction)

Relevance of shifts

Using only 15 active sugarcane-producing counties, the F-statistic is reported as follows:
AreaHarvested × SugarPrice: F = 5.43
Production × SugarPrice: F = 9.77

Second-stage Result

Outcome	2SLS Estimate	AR 95% CI	p-value at zero
Poverty (P)	−0.065	Unbounded	0.413
Education (E_{avg})	0.189	Unbounded	0.330
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Taken at face value, this table would suggest a positive association between sugarcane exposure and educational deprivation and a negative association with agricultural child labour, both significant under AR inference. However, this table does not survive restriction to the honest sample above and should not be read as evidence of an effect in either direction.

PHILOSOPHICAL ANALYSIS

Social Reproduction Theory & the Persistence of Child Labour

Child labour reproduces intergenerational poverty and limited opportunities. Households trade children's education for short-term income, while firms benefit from cheap labour. This reduces children's human capital and future bargaining power, making them more likely to face low-wage, limited opportunities as adults—and potentially passing the same constraints to the next generation.

Normative Argument

International Children's Rights Framework

Child Labour as a Rights Violation: Interest Theory

- UN Convention on the Rights of the Child, Article 32: Children have a right to protection from economic exploitation and work that harms their health, development, or education.
- Interest Theory of Rights (Raz): A right exists when an individual's well-being provides sufficient reason to impose duties on others.
- Application: Children's interests in education, healthy development, and bodily integrity are sufficiently fundamental to impose protective duties on states and employers.
- Parental hardship does not override this right: Short-term household income cannot justify depriving children of education or sacrificing their future well-being.

Distributive Justice

Difference Principle (Rawls)

1. Each person has an equal claim to a fully adequate scheme of equal basic rights and liberties, which scheme is compatible with the same scheme for all; and in this scheme the equal political liberties, and only those liberties, are to be guaranteed their fair value.
2. Social and economic inequalities are to satisfy two conditions: (a) They are to be attached to positions and offices open to all under conditions of fair equality of opportunity; and (b) they are to be to the greatest benefit of the least advantaged members of society.

Child labour may increase short-term household welfare, but it undermines fair opportunity and future capabilities. Under Rawls's priority ordering, poverty cannot justify sacrificing children's basic rights and opportunities.

ACKNOWLEDGEMENT

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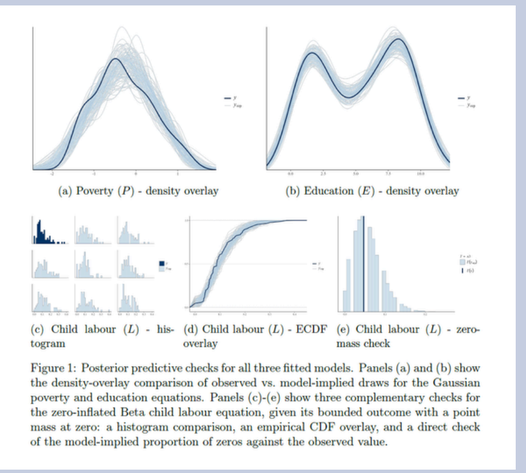

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