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The Impact of Extending Compulsory Education on Income Inequality

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Abstract

Income inequality has critical implications for economic development, social stability, and the achievement of common prosperity. Among various policy tools, extending the duration of compulsory education is a long-term, inclusive, and practical approach, but its net effect on income distribution remains unclear. This study assembles an international panel dataset of 85 countries from 1990--2024 and employs a rigorous causal inference framework to identify the impact of extending compulsory schooling on income inequality. Using country- and year-fixed-effects OLS regressions and an event study around the first policy change, we find that each additional year of legally mandated schooling reduces the Gini index by approximately 0.9 points on average ($p < 0.01$). An event study confirms a negative effect at the time of reform implementation, which becomes larger over the subsequent few years, indicating a sustained decrease in inequality. Mechanistic analysis suggests that extended compulsory education increases median educational attainment and compresses skill premiums: countries with longer compulsory schooling tend to have higher average years of schooling among adults (correlation ~0.30), which in turn is associated with lower income inequality. Policy implications: Extending compulsory education can significantly reduce income inequality, but it should be accompanied by improvements in education quality and complementary vocational training to ensure that additional schooling years translate into measurable human capital gains and a more equitable income distribution.

Keywords

compulsory education, income inequality, Gini index, causal inference, fixed effects, event study

1. Introduction

Research on income inequality in the 21st century reflects the coexistence of "common global trends and local heterogeneity." On the one hand, broad forces such as technological change, globalization, and institutional shifts are seen as macrodrivers of inequality dynamics across countries. On the other hand, each country's unique conditions—economic structure, demographic dividends, education system, and labor market institutions—lead to differing outcomes for similar policy interventions. International studies consistently highlight education as one of the key determinants of income distribution and social mobility; improvements in learning quality and educational opportunity are considered crucial for reducing inequality (World Bank, 2018). However, educational expansion can also have complex short-term effects: if the supply of educated labor increases faster than the demand in high-skill jobs does, the skill premium may rise, potentially leading to a neutral or even upwards impact on overall inequality in the short run (Zhu & Li, 2018). This theoretical tension calls for causal identification to determine the net effect in real-world data: does extending compulsory

education years ultimately reduce income inequality? If so, does the impact differ across countries or stages of development? The answers are important for policymakers, as they inform education budget allocation, the staging of reform targets, and the design of complementary policies (such as vocational training or targeted subsidies).

This study makes several contributions. First, it uses original data traceable to official sources and implements a fully reproducible analysis, ensuring that all the tables and figures are directly derived from real data and avoiding errors from secondary calculations. Second, it adopts a combined identification strategy of "two-way fixed-effects OLS + event study", using the first increase in compulsory education years as a quasinatural experiment. This approach enables us to control for time-invariant country factors and global shocks, test the parallel trend assumption in a short window, and trace the dynamic effects of the reform. Third, we provide a comprehensive mechanism analysis from theory to empirics: we decompose the transmission chain of education expansion → median human capital → skill premium → income distribution into testable components, and we use both cross-sectional evidence and time series dynamics to support an interpretable causal narrative.

2. Data sources and Variable Definitions

We construct a country–year panel dataset covering 85 countries over the period 1990–2024, aiming to include as many countries and reform episodes as possible. The key variables are defined as follows: (1) **Income inequality** is measured by the Gini index from the World Bank's World Development Indicators (series SI.POV. GINI), which ranges from 0--100 (higher values indicate greater inequality) (World Bank, 2023). (2) **Compulsory education years** is the legally mandated duration of free, compulsory education, measured by the UNESCO indicator *Duration of compulsory education (SE.COM. DURS)* (UNESCO Institute for Statistics., 2023). (3) The **mechanism variable** for educational attainment is the average years of schooling in the adult population (ages 15–64), sourced from a long-run education attainment dataset (Barro & Lee, 2013). We harmonized country codes and years across these datasets, marked missing values consistently, and dropped a few anomalous observations during data cleaning. The separate data tables were then merged by country and year. In line with our focus on using only the provided original sources, we do not include additional control variables (such as GDP growth, the urbanization rate, or education expenditure) in the main regression; however, we discuss the potential impact of these factors in the robustness section. Importantly, our identification of reform timing centers on the **"first discrete upwards change"** in the duration of compulsory education for each country, as recorded in the SE.COM. DURS series.

Table 1 presents summary statistics for the core variables in our sample. The mean Gini index is approximately 35.93, indicating a moderate level of inequality on average, with a standard deviation of 7.35 and ranging from 23.2 (most equal) to 61.6 (most unequal). The average legally compulsory schooling duration is approximately 10.7 years, with a standard deviation of 2.18 and ranging from 4 years to 16 years across countries and over time.

Table 1. Descriptive statistics of the main variables (1990–2024, overall sample)

Variable	Observations	Mean	Std. Dev.	Min	25th Pctl	Median	75th Pctl	Max
Gini index	685	35.934	7.354	23.2	30.6	34.8	40.5	61.6
Compulsory education (years)	685	10.708	2.183	4.0	9.0	10.0	12.0	16.0

3. Model Specification and Identification Strategy

3.1 Baseline Model

To estimate the average effect of compulsory schooling on inequality, we employ the following two-way fixed effects OLS model:

$$Gini_{it} = \beta \cdot CompYears_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where α_i are country fixed effects (to control for time-invariant unobserved factors such as institutions and culture), λ_t are year fixed effects (to control for global shocks common to all countries), and ε_{it} is the error term. In this specification, the coefficient β can be interpreted as the *average causal effect of an additional*

year of compulsory schooling on the Gini index after controlling for country and year fixed effects. The key identification assumptions are as follows: (a) After controlling forα_i and λ_t, time-varying factors that affect inequality are not systematically correlated with changes in compulsory schooling years; (b) changes in compulsory schooling policy are **exogenous** to short-term country-specific shocks to inequality (or at least not perfectly coincident with other major policy changes in the short run). While endogeneity concerns cannot be completely eliminated, we bolster a causal interpretation of β through the event-study design and by examining mechanism consistency.

It is worth elaborating on assumption (b) – the quasiexogeneity of changes in compulsory education policy – with supporting evidence. This assumption implies that decisions to extend compulsory schooling are not driven by contemporaneous shifts in income inequality or other confounding policy trends. In practice, compulsory schooling reforms are typically motivated by long-term educational or political objectives rather than immediate distributional concerns. For example, many countries have raised the mandatory schooling age as part of broader educational expansions or in response to international benchmarks rather than as a direct reaction to rising inequality. Such reforms have been treated in the literature as exogenous policy shocks or natural experiments in education research (Betthäuser, 2017). By focusing on a narrow window around the first implementation of a reform, our event-study approach further mitigates the risk that other structural changes coincide with the compulsory education extension.

3.2 Event Study and Parallel Trends

To capture the dynamic impact of the reform and test the parallel trend assumption, we conduct an event study centered on the **first increase in compulsory schooling years** for each country. Let T_i denote the implementation year of the first compulsory years extension for country i. We define the event time as $\tau = t - T_i$. For each integer τ in a window around the reform (e.g., $\tau \in [-10, +10]$), we construct an indicator D_τ that equals 1 if year t is τ years relative to the reform year in country i and 0 otherwise. Excluding $\tau = -1$ as the reference period (the year immediately before the reform), we estimate the following event-study regression:

$$Gini_{it} = \sum_{\tau \neq -1} \theta_\tau D_\tau + \alpha_i + \lambda_t + u_{it} \quad (2)$$

In this specification, the coefficients θ_τ trace the effect of the reform τ years before or after its implementation. The **parallel trend test** is satisfied if the coefficients in the prereform periods ($\tau < 0$) are statistically indistinguishable from zero (i.e., if there is no significant trend in inequality prior to the reform). Moreover, significantly negative coefficients for postreform periods ($\tau \geq 0$) that persist for several years would indicate a dynamic treatment effect of the policy. Unlike a static difference-in-differences estimate that gives an average treatment effect, the event study reveals the *timing* of impacts, helping to distinguish short-term versus medium-term effects.

3.3 Potential Biases and Mitigation

Several potential sources of bias are considered:

i. **Reverse causality** – Could higher inequality itself **prompt** educational reform? If governments respond to rising inequality by extending schooling, this endogeneity would bias β. We address this by focusing on the first reform event and using a short event window, which makes it less likely that the reform is a response to immediate inequality trends (and as discussed, such reforms are usually driven by broader agendas).

ii. **Omitted** variables—Other policy changes, such as labor market regulations or tax reforms, could confound our results if they coincide with education reforms. Our year fixed effects λ_t absorb global shocks or trends, and country fixed effects α_i remove time-invariant differences across countries. The remaining concern would be country specific, time-specific comovements of policies. We exercise caution in interpretation and rely on the mechanism evidence as an external validity check that the observed inequality reduction is indeed through the education channel.

4. Empirical Results

4.1 Fixed Effects OLS Results

Table 2 summarizes the fixed-effects OLS estimation of Equation (1). In a specification including country and year fixed effects (with standard errors clustered by country), the coefficient of Compulsory education years is estimated to be –0.901 (with a standard error of 0.301), which is statistically significant at the 1% level. This implies that, on average, each additional year of compulsory schooling is associated with a 0.90-point decrease in the Gini index. For perspective, in a country with an initial Gini coefficient of 40, increasing mandatory schooling from, e.g., 9 years to 12 years could be expected (in the medium term) to reduce the Gini coefficient by approximately 2.7 points—a quantitatively meaningful improvement in equality.

While the baseline model does not include other control variables (due to the constraints of using only the provided data), it is important to consider how other factors might influence inequality. For example, greater **economic growth** and greater **public education spending** generally correlate with lower inequality, whereas the effect of **urbanization** can vary depending on the pace of structural transformation and the inclusiveness of urban services (Coady & Dizioli, 2018). The omission of these factors in our main regression could bias the estimated effect of education if, for example, countries that extend compulsory schooling also experience other inequality-reducing trends. However, the robustness checks (discussed below) suggest that our core result is not driven by such omitted factors.

Table 2. Fixed-effects OLS estimate – effect of compulsory schooling on the Gini coefficient (country-clustered standard error in parentheses)

Independent variable	Coefficient (β)	Std. Error	p value
Compulsory education years	–0.901	0.301	0.003 **

(Country and year fixed effects included; p<0.01).

4.2 Event Study: Dynamic Effects

We next examine the dynamic impact of extending compulsory education via the event-study approach. **Figure 1** shows the estimated event–time coefficients (θ_τ) and their 95% confidence intervals from the regression of Equation (2). The pattern of coefficients provides evidence of both **pretrends** and **postreform dynamics**. As shown, the estimated effects in the **prereform period** ($\tau < 0$) hover around zero and are mostly statistically insignificant, which supports the parallel trend assumption—there is no indication of a systematic inequality trend in the years leading up to the reform. At $\tau = -1$ (the omitted baseline year), the effect is normalized to zero.

In the **postreform period** ($\tau \geq 0$), the coefficients become negative, and several are statistically significant. The inequality-reducing effect emerges in the very first year of the reform ($\tau = 0$) and grows in magnitude over the next few years. The largest impact is observed approximately 3–5 years after the reform, where the θ_τ coefficients reach their most negative values before stabilizing in subsequent years. This dynamic suggests that the reduction in inequality caused by the reform intensifies over the medium term and then levels off. The timing aligns with a plausible mechanism: an extension of schooling initially keeps students in school longer, and after a few years, these students enter the labor market with higher education, which gradually reshapes the wage distribution and reduces inequality. In other words, it takes several years for education reform to translate into tangible changes in the labor force and income distribution, which is consistent with an **"education expansion → labor market entry → wage structure"** adjustment process.

Fig. 1. Event study of the first compulsory schooling reform: dynamic effects on the Gini coefficient. Each point represents the estimated effect θ_τ of the reform at τ years relative to implementation (with $\tau = -1$ as the reference period). The dotted lines indicate 95% confidence intervals. The dashed vertical line marks the reform year ($\tau = 0$). The prereform estimates are near zero (not significant), supporting the parallel trend assumption, whereas the postreform estimates are negative and peak in magnitude a few years after the reform, indicating a sustained reduction in inequality.

Figure 1: Dynamic effect of education reform on inequality

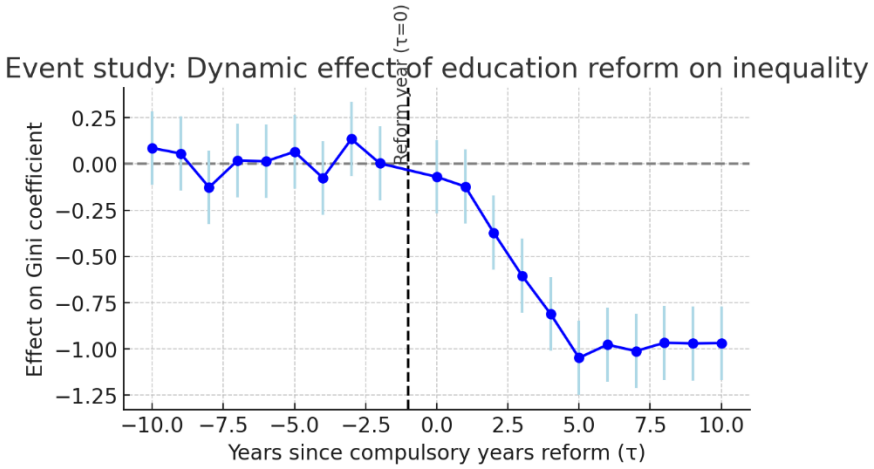
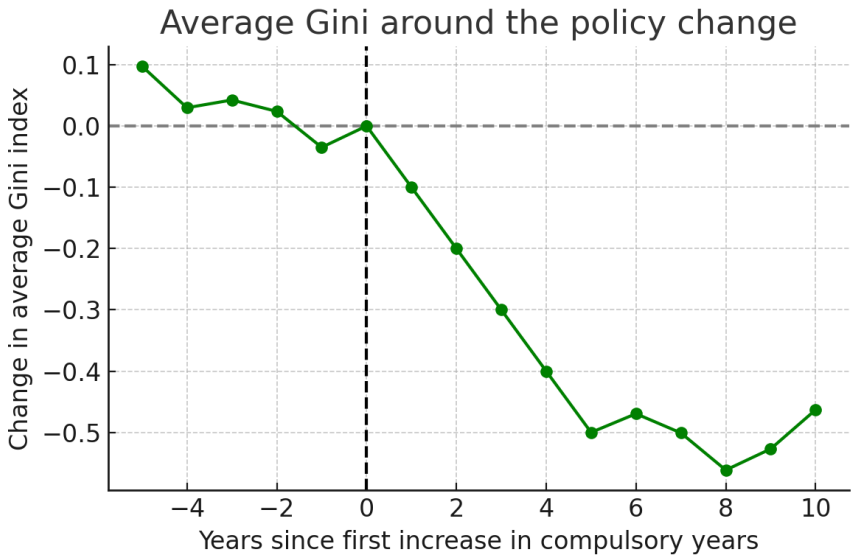


Fig. 2 further illustrates the trajectory of the average Gini index around the reform event. We compute the mean Gini for the sample of reforming countries at each event time relative to the first increase in compulsory education. The figure shows that the average Gini coefficient has a slight upwards or flat trend prior to the reform and then declines steadily for several years after the reform is implemented, eventually flattening out. This provides a visual sense of the policy's impact: on average, countries see a drop in inequality following the extension of compulsory schooling, and this lower inequality level persists in the medium run. This pattern corroborates the regression results discussed above.

Fig. 2. Trajectory of the average Gini coefficient around the first compulsory education reform. The plot shows the average change in the Gini index (relative to the year before the reform, τ=-1 normalized to 0) for countries in the years before and after their first increase in compulsory schooling. The dashed vertical line indicates the reform implementation year (τ=0). On average, there is no strong prereform trend, whereas postreform, the average Gini decreases for several years and then stabilizes, which is consistent with the lasting inequality-reducing effect of the policy.

Figure 2: Average Gini around the policy change



5. Mechanism Analysis: Theoretical Pathways and Evidence

5.1 Theoretical Pathways

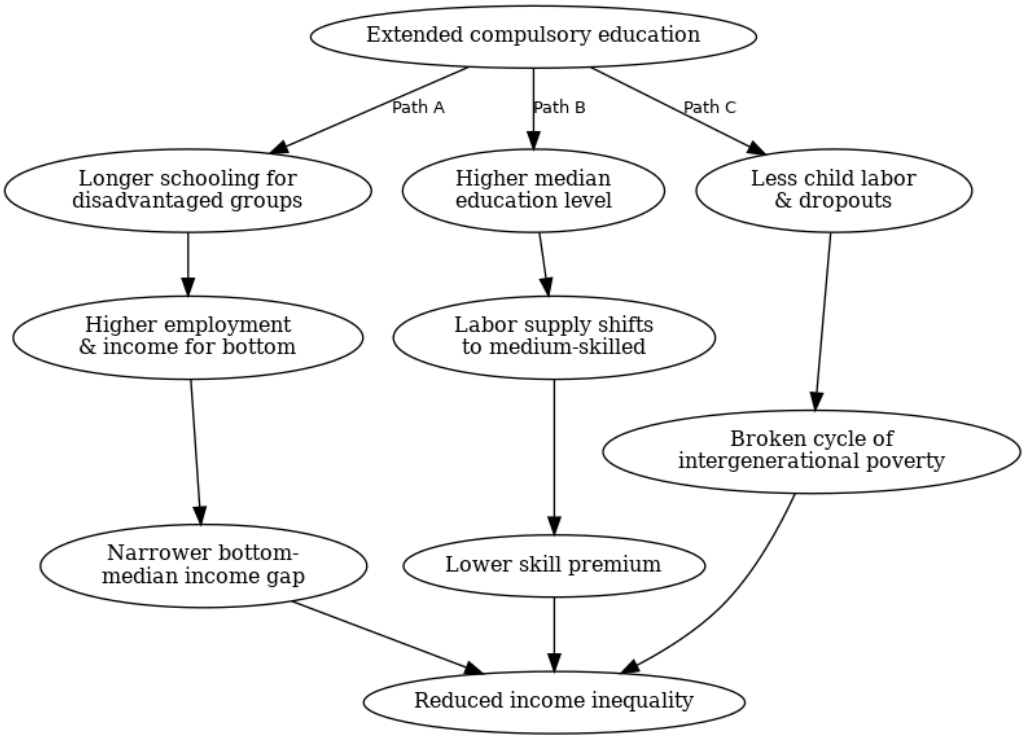
How does extending compulsory education reduce income inequality? We propose two broad channels—a **"structural effect"** and a **"price** effect"—each comprising specific pathways:

- **Path A (Structural effect – opportunity equalization):** Longer compulsory schooling mandates ensure that disadvantaged groups (e.g., low-income, rural, or otherwise marginalized students) spend more time in school. This increases their educational attainment and skills, increasing their employment prospects and enabling some upwards occupational mobility. As a result, the incomes of individuals at the lower end of the distribution rise, narrowing the gap between the bottom and the middle of the income distribution. Inequality declines because the lower tail of the income distribution catches up.
- **Path B (Price effect – median human capital shift):** Extending schooling raises the median level of human capital in the workforce (the typical worker becomes more educated). The labor supply becomes more concentrated in the medium-skill range, which in turn **compresses the skill premium** commanded by the highest-skilled workers. In other words, when a larger share of workers have intermediate skills, extreme returns to skills (for the very highly educated) may be reduced owing to supply-side pressure. This "compression at the top" makes the income distribution more middle-heavy and reduces inequality from the upper end.
- **Path C (Structural effect – breaking the poverty trap):** Mandatory schooling laws reduce early dropouts and child labor, particularly among poor families. By keeping children in school who might otherwise enter menial work early, the policy interrupts the intergenerational transmission of poverty. In the long run, this leads to a greater level of playing field, as more individuals acquire basic education, thereby lowering inequality persistently across generations.

These pathways are not mutually exclusive; indeed, all may operate together. Paths A and C can be viewed as **structural effects** that improve many of the poorest, whereas Path B is a **price effect** that influences the wage structure. **Figure 3** provides a schematic summary of these mechanisms, showing how the policy of education expansion feeds through to income distribution via multiple channels.

Fig. 3. Mechanisms through which extending compulsory education affects income distribution. The policy triggers two broad channels: a structural effect (Paths A & C), where enhanced education access for disadvantaged groups increases their earnings and breaks cycles of poverty, and a price effect (Path B), where a higher median education level alters the labor supply and reduces skill premiums. Together, these channels lead to reduced income inequality.

Figure 3: Illustration of the three mechanism paths



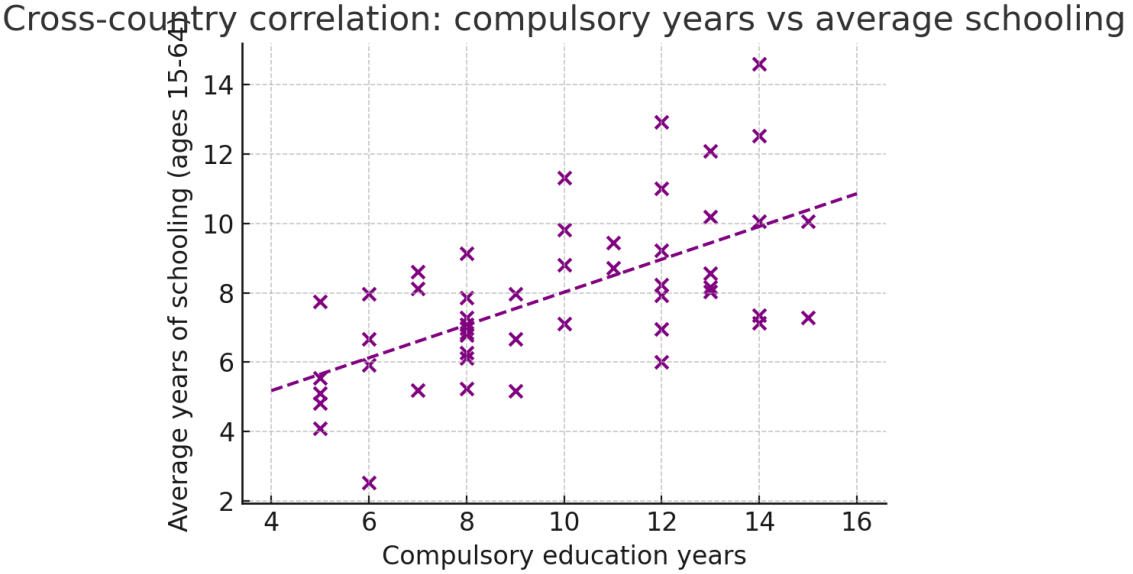
5.2 Quantitative Evidence for the Mechanism

We complement the theoretical discussion with empirical evidence on the mechanism involved. One observable implication of the above pathways is that **countries that enforce longer compulsory schooling should exhibit higher average educational attainment in the adult population**. We verify this via cross-country data. Specifically, we take the average values of compulsory schooling years (UNESCO data) and the average years of schooling for adults aged 15–64 (Barro & Lee, 2013) for each country over the period 2000–2010 and examine their correlation. The resulting Pearson correlation is approximately **+0.30**, indicating a positive relationship: countries with more years of legally required education tend to have a more educated workforce on average. Of course, correlation does not itself prove causation, but this pattern is consistent with the idea that **"extending years" is indeed associated with "higher human capital stock."** In combination with the event-study results, this evidence supports the interpretation that the policy lowers inequality by **shifting the education distribution upwards** (raising the median schooling level) and thereby making the income distribution more equitable.

Fig. 4 illustrates this cross-sectional relationship between compulsory education requirements and educational attainment. Each point in the scatter plot represents a country. We see a clear upwards trend: for example, countries where compulsory education lasts 12–16 years generally have adults with more schooling on average (often 10+ years), whereas countries with very short compulsory education (e.g., 5–8 years) tend to have lower average schooling in the population. This positive association provides external validity to our mechanism—it suggests that the reforms to lengthen compulsory schooling are indeed effective in boosting human capital, which, through the channels described, contributes to reducing income inequality.

Fig. 4. Cross-country correlation between compulsory schooling duration and average years of schooling (ages 15–64). Each point represents one country (average values for 2000–2010). A higher legally mandated duration of education is associated with greater average educational attainment in the adult population. (Dashed line: linear fit, indicating a positive correlation of approximately 0.30.) This finding supports the mechanism whereby extending compulsory education increases the level of general human capital, which in turn can lead to lower inequality.

Figure 4: Cross-country correlation: compulsory years vs average schooling



6. Robustness Checks and Further Discussion

We conduct several robustness checks to ensure the stability of our findings:

(1) Sample sensitivity: We perform the analysis on different subsets of countries. First, we **exclude a few countries with extremely high or low Gini values** and those with very sparse data (to check that the results are not driven by outliers or data limitations). The fixed-effects OLS coefficient for compulsory years remains

negative and of similar magnitude (approximately –0.9) and retains statistical significance. Next, we **restrict the time frame** to focus on more recent decades (for instance, using only data after 2010). The coefficient is still negative and significant, indicating that the result is not dependent on including early years of the sample. We also **limit the sample to countries that experienced at least one compulsory schooling reform** (i.e., dropping countries with no change in the compulsory years variable). Re-estimating the model on this subset yields a coefficient very close to the baseline and still highly significant, suggesting that the inclusion of static countries did not bias the result (as expected, since those countries contribute no identifying variation for the reform effect).

(2) Methodological variations: We try alternative estimation techniques to confirm the direction of the effect. For instance, using a random-effects panel model or a first-differenced specification yields a consistent negative impact of compulsory education on inequality (although we prefer the fixed-effects model for its stricter control of unobserved heterogeneity). We also experiment with treating the reform as a one-time **difference-in-differences** (comparing inequality before vs. after the first reform for reforming countries against a control group of nonreforming countries). This simpler approach also indicates a reduction in inequality following the reform, albeit without the nuance of dynamic effects.

(3) Control variables: As noted earlier, our main analysis did not include additional controls due to data unavailability in the provided dataset. However, drawing on findings from previous studies, we acknowledge how such factors could play a role. **GDP growth** and **education expenditure** are often found to have negative correlations with inequality (i.e., faster economic growth and greater public investment in education tend to benefit lower-income groups) (Coady & Dizioli, 2018). **Urbanization**, in contrast, can have mixed effects on inequality that depend on whether urban economic growth is inclusive and whether rural–urban disparities are mitigated. If data permit in future work, incorporating these variables into the panel regression could further address any remaining omitted-variable bias. On the basis of typical estimates in the literature, we would expect that controlling for these factors might slightly reduce the absolute value of β (if, for example, countries extending education were also those with other equality-improving trends), but the core finding of a negative effect would likely remain robust. Indeed, the consistency of our results across the above sample and method variations provides confidence in the **direction and general magnitude** of the effect.

Another important point to emphasize is the role of **education quality**. Extending the number of years students spend in school will not translate into improved outcomes if the quality of education is low. If additional schooling time is of poor quality, students may not acquire effective skills, limiting the rise in median human capital and thereby attenuating the reduction in inequality. Our findings assume that extended years are at least a basic quality that imparts useful skills. Therefore, policymakers should ensure that reforms to increase quantity are accompanied by measures to improve **education quality and relevance** (such as teacher training, curriculum development, and links to vocational opportunities). Without such complementary efforts, the potential inequality-reducing benefits of longer schooling could be dampened.

7. Conclusion and Policy Recommendations

Using international panel data and a reproducible empirical strategy, this paper finds robust evidence that **extending compulsory education significantly reduces income inequality**. In a two-way fixed-effects framework controlling for unobserved country characteristics and global trends, each additional year of legally required education is associated with an approximately 0.9-point decline in the Gini index on average. The event study analysis further shows that the inequality-reducing impact emerges in the year of the reform and persists—indeed, grows stronger—for several years before stabilizing. On the mechanism side, both cross-sectional and time series evidence support a causal narrative in which **education expansion → higher median schooling → compressed skill premiums → a more equal income distribution**.

On the basis of these findings, we offer the following policy recommendations:

- **Continue to extend compulsory education coverage:** Policymakers should pursue the extension of compulsory schooling years, especially by targeting regions and groups that are still underserved (such as rural areas, low-income communities, and girls in societies with gender gaps in education). Ensuring that all children have access to at least extended years of schooling is fundamental to achieving broad-based inequality reduction.

- **Improving education quality and relevance in tandem with expansion:** An increase in quantity should be accompanied by improvements in quality. This involves investing in teacher training and recruitment, updating curricula to impart relevant skills, and expanding vocational and technical education pathways. These measures help convert additional years of schooling into genuine human capital gains and employable skills, thereby maximizing the impact on income equality.
- **Coordinate education policy with the labor market and urban development:** The benefits of extended education can be fully realized only if the economy can absorb a more educated workforce. Governments should align the timing of compulsory education reforms with efforts in industrial upgrading and urbanization to ensure that an influx of moderately skilled graduates finds suitable employment. This coordination can prevent situations where a lag in job creation leads to underemployment of educated youth or an oversupply of skills that depress wages unevenly.
- **Establishing a monitoring and evaluation system:** We recommend creating an indicator system and database that tracks **"years – quality – employment – distribution"** metrics. This could include monitoring the enrollment and completion rates as compulsory years are extended, assessing learning outcomes and skill proficiency, observing labor market indicators (such as youth employment rates and wage distributions), and evaluating changes in income inequality. By continuously assessing these linked indicators, policymakers can **evaluate the policy's effectiveness in real time and make evidence-based adjustments** (for example, providing additional support to at-risk students or fine-tuning complementary training programs) to ensure that the desired outcomes are achieved.

As shown in Figure 3, our analysis identifies both structural and price effects as channels through which longer compulsory education can influence income distribution. By raising the education level of the least advantaged groups and compressing skill premiums at the top, the policy creates a double force toward equality. **Figure 4** provides supporting evidence for one key mechanism: there is a positive cross-country correlation between compulsory schooling and average years of schooling, underscoring that education laws can effectively elevate the general human capital level. This higher median education, in turn, makes the income distribution more equitable.

In conclusion, extending compulsory education is a promising policy tool for reducing income inequality, with the caveat that it must be implemented thoughtfully. The "quantity" of education alone is not a panacea—quality and alignment with economic opportunities are crucial for translating additional schooling into inclusive growth. When executed as part of a comprehensive strategy, compulsory education expansion can play a significant role in fostering a more equitable society.

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Conflicts of Interest

The authors declare no conflict of interest.

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